ENGINEERING RESEARCH INSTITUTE
UNIVERSITY OF MICHIGAN
ANN ARBOR

SPRINGS

A BIBLIOGRAPHY

Compiled by

THE RESEARCH COMMITTEE

OF THE

ASSOCIATED SPRING CORPORATION

Project M685

THE ASSOCIATED SPRING CORPORATION
BRISTOL, CONNECTICUT

September, 1952

FOREWORD

The preparation of this bibliography of mechanical springs was authorized in early 1952 by the Research Committee of the Associated Spring Corporation, and supervised by the Engineering department of the Barnes, Gibson, Raymond Division. It covers the period from 1678 to July 1, 1952, and includes published articles, reference books, and patents, the latter being listed only after 1934.

The references are grouped chronologically as they appeared in the reference sources. This does not necessarily mean that the year in which the subjects originally appeared is the same as the one in which they are listed in the bibliography, since abstracting and publication of references involves a necessary time lag. This is particularly true in the case of foreign articles. In any event, this chronological arrangement provides a rough indexing by years. Complete author and subject indexes are provided at the end of the bibliography. Patents are indicated in the author index by the letter P following the page reference.

The sources of the references and annotations are as follows:

(a) ASM Review of Metal Literature, 1944 to date.

(b) ASME Research Publication.

(c) Chemical Abstracts.

(d) Current Metallurgical Abstracts, as they appeared in "Metals and Alloys" in the years 1930-1940.

(e) Engineering Index.

(f) Industrial Arts Index.

(g) Metallurgical Abstracts, British Institute of Metals.

Also consulted were Science Abstracts and Reader's Guide, but there were either no items included, or if so, they were already listed in one or more of the sources named above.

The items from Industrial Arts Index include no annotations, but usually the title indicates quite well the subject of the article.

The abbreviations "il.", "diag.", or "diags." appear in many of the references from Industrial Arts Index, and indicate that the article as illustrated, and/or, includes one or more diagrams or graphs.

The sub-headings used after 1927 are essentially those used by Engineering Index, some new ones being used where a subject seemed to warrant it.

Convention papers are frequently abstracted from preprints or advance papers. The Engineering Index Service lists the papers again when they appear in the official proceedings or transactions, giving page references to discussions of the papers if any. These second listings are included in this bibliography, the abstract or annotation being found in the previous year. Also included are the original references in Engineering Index.

In work involving the listing of such a large number of proper names, errors in initials and spelling creep in. These were more than once checked against the abstract sources, but disagreement existed there on occasion. It was of course impossible to check all original sources. This is the reason for most of such errors as may appear.

W. P. Wood

University of Michigan
September 17, 1952

SPRINGS

A BIBLIOGRAPHY

1678

Hooke, R.

De potentia restitutiva. 1678. (London)
States that 18 years before the date of this paper he had first found out the theory of springs, namely, "Ut Tensio sic vis," that is, the power of any spring is in the same proportion with the tension thereof.

1770

Lagrange.

The force of laminated springs, (Sur la force des ressorts plies.) 1770. Memoires de l'Académie de Berlin, xxv, 1771
Discussion and mathematical analysis in reference to the proportionality of loads to deflections in springs.

1825

Gilbert, D.

General nature and advantages of wheels and springs for carriages, the draft of cattle and the form of roads. 1825. Jl. of Sci., v. 18, p. 95-8
Discusses the effect of springs and their mechanical effect on the riding qualities of carriages.

1847

Frodsham, C.

On the laws of isochronism of the balance spring, as connected with the higher order of adjustments of watches and chronometers. 1847. Instn. Civil Engrs.—Prov., v. 6, p. 224-54
Pages 233-39 give complete data on the design and materials for balance springs in watches.

St. Venant.
Note on the torsion of prisms and on the shape as affected by their orginally plane transverse sections (Memoire sur la torsion des prismes et sur la forme affectee par leurs sections transversales primitivement planes). 1847. Académie des Sciences — Comptes rendus, v 24, p 485-88
Solution of the problem of torsion in rectangular prisms.

1850

Adams, W. A.
Railway carriage and wagon springs. 1850. Instn. Mech. Engrs. — Proc., Jan., pp 19-31 and Apr., pp 14-26
Discusses and analyses the various forms of springs in use in railway carriages and wagons, pointing out their advantages and defects, and the relative qualities of spring steels, from English and Swedish iron.

Blacher.
Application of spring calculation (Application du calcul aux ressorts). 1850. Société des Ingénieurs Civils de France, p 143-52
Formulas given for the effect of the number of plates on the curvature of the spring and the dynamic work of the spring.

Le Chatelier.
Notes on suspension springs applied to vehicles in general and especially to railway cars (Note sur les ressorts de suspension appliques aux vehicles en général et specialement aux waggons de chemins de fer). 1850. Société d'Encouragement pour l'Industrie Nationelle — Bulletin, v 49, p 592-9
Gives formula for computation of equilibrium factors in half-elliptic railway car springs.

Phillips, E.
Multiple-leaf, steel springs used in the construction of vehicles and cars (Sur les ressorts formés de plusieurs feuilles d'acier employés la construction des voitures et wagons). 1850. Académie des Sciences — Comptes rendus, v 31, p 712-15
Discusses the flexibility of car springs and derives a formula for spring deflection.

1852

Phillips.
Memoir on steel springs used in railway material (Mémoire sur les ressorts en acier employés dans le matérial des chemins de fer). 1852. Annales

des Mines, ser 5, v 1, p 195-336
Mathematical theory of leaf springs, formulas, calculations, tables.
Studies best forms for springs and rules for calculating them.

Young, A.
Theory of the main springs of a watch, showing how to select and adjust one that will fit in every respect, without having to try it in the barrel. 1852. Jl. Franklin Inst., v 54, p 344-7
Gives calculations showing the number of coils for certain diameters of barrel, revolutions by theory, revolutions by experiment in designing a watch spring.

1854

Bournique,
General considerations on springs used in railroad equipment (Considerations générales sur les ressorts employés dans les vehicules des chemins de fer). 1854. Société des Ingénieurs Civils de France, p 63-79
Calculates the flexibility, dynamic work, and loads which may be applied to railway car springs.

1855

Adams, W. B.
Improved spring and axle box for railway carriages. 1855. Instn. Mech. Engrs. — Proc., v 6, p 163-68; discussion, p 168-71
Discusses action of springs, ordinary laminated springs, improved springs, reversed spring, and the results of trials.

Baillie, J.
Applicaiton of volute springs to the safety-valves of locomotive boilers. 1855. Instn. Civil Engrs. — Proc., v 15, p 28-33
Describes experiments made on a locomotive boiler to determine the value of volute springs in valves which are to discharge very large quantities of steam.

1857

Anonymous 1.
Description of a new convex-plate laminated spring. 1857. Instn. Mech. Engrs.— Proc., p 219-26
Discusses the construction of these springs and gives detailed tabulated data on specifications.

1858

Anonymous 2.

New construction of railway springs. 1858. Instn. Mech. Engrs. —Proc., p 160-5

Gives weight of steel, length of bearing, number of plates, breadth of plates, thickness, camber, load and deflection for straight and curved springs.

Phillips, E.

Work of elastic forces in the interior of a solid body and particularly in springs (Travail des forces élastiques dans l'interieur d'un corps solide, et particulierement des ressorts). 1858. Académie des Sciences — Comptes rendus, v 46, p 333-6

Gives Clapeyron's theory and formula and derives a formula for coefficient of elasticity of springs, taking into account the fibre stress of the material, the load to be applied and the dimensions.

1861

Phillips, M.

Adjustable spiral for chronometers and watches (Mémoire sur les spiral réglant des chronomètres et des montres). 1861. Annales des Mines; memoires, v 20, ser 5, p 1-107

Using the series of formulas derived, a series of tables gives the dimensions and physical characteristics of spiral springs of varying dimensions.

1866

Morandiere, J.

Belleville disc steel springing system (Note sur les ressorts en rondelles d'acier du systéme Belleville). 1866. Société des Ingenieures Civils de France, p 629-42

Describes the Belleville spring, gives its advantages and gives formula for proportioning the discs.

Rankine, W. J. M.

Elasticity of spiral springs. 1866. Engineer, v 22, p 374

Formulas for steady and sudden loads on helical springs.

1867

Résal, H.

Experimental research on the expansion of main springs in watches (Recherches expérimentales sur la détente des ressorts moteurs des chronomètres). 1867. Annales des Mines, ser 6, v 12, p 93-125
Fromulas for computing the dimensions of watch springs.

Integration of differential equations by trigonometric series relative to the flexure in elastic plates (Note sur l'intégration par séries trigonométriques des équations différentielles relatives à la flexion des lames elastiques). 1867. Annales des Mines, ser 6, v 12, p 127-40
Formulas for the calculation of elasticity in leaf springs.

1871

Résal, H.

Equilibrium, elasticity and strength of a helical spring (De l'équilibre d'élasticité et de la résistance du ressort à boudin). 1871. Annales des Mines, ser 6, v 19, p 265-77
Fundamental formulas are given with dimensions for springs made from iron, copper, bronze and other materials.

1875

Caspari, E.

Isochronism of spiral watch springs (Sur l'isochronisme des spiraux des chronométres). 1875. Académie des Sciences — Comptes rendus, v 81, p 1122-3
Derives a formula for computing the interior stresses in a spiral spring depending on the duration of oscillation.

1876

Anonymous 6.

Spring motors. 1876. Sci. Am. Supp., v 2, p 725
Illustrates Steel and Austin's spring-propelled car, using coiled, flat spring-steel springs.

Bacon, A. M.

Torsion spring motive power. 1876. Sci. Am. Supp., v 2, p 791-2
Illustrates a series of torsion wires on bars forming the spring, the power produced corresponding to the degree of twist.

Caspari, E.
Isochronism of cylindrical, helical springs (Sur l'isochronisme du sprial regulant cylindrique). 1876. Académie des Sciences — Comptes rendus, v 83, p 47-9
Derives formulas for helical springs.

Doubler, J. W. H.
Improved spring motor. 1876. Sci. Am. Supp., v. 2, p 791
Spiral springs are used to create motion, the duration depending on the extent of spring expansion.

Frahm, C. M., and Scharnweber, W.
Spring motor. 1876. Sci. Am. Supp., v 2, p 791
Illustrates a stop mechanism composed of a series of coiled springs ang gears; each spring may be wound separately.

Howell, J. B.
Spring motive power. 1876. Sci. Am. Supp., v 2, p 792
Illustrates a series of coiled springs and drums combined so as to form a transmitting mechansim having the effect of one great spring.

Lathrop, L. W.
Spring motive power. 1876. Sci. Am. Supp., v 2, p 792
Illustrates the use of a coil spring as motive power for two spirally-wound rubber belts moving on the shaft of a motive device.

Leveaux, E. H.
Spring motors. 1876. Sci. Am. Supp., v 2, p 741
Describes a spring-propelled railway car. The springs used are 50 to 60 ft. long, which when coiled exert a pressure of 800 to 900 lbs. without permanent set.

Spring propulsion for street carriages. 1876. Jl. Franklin Inst., v 102, p 9-14
Gives dimensions of the springs and describes the operation of a large spring motor tried out on a trolley car.

Moeslein, V.
Moeslein's plan for spring motor. 1876. Sci. Am. Supp., v 2, p 792
Illustrates a continuous power device having double, but independent springs which serve as motive power for a train.

Rey, L.
Spring suspensions of railroad equipment (Note sur les ressorts de suspension des véhicles de chemin de fer). 1876. Société des Ingénieurs Civils de France, p 845-55
Calculates formulas for the design of locomotive and car springs.

Schumacher, C. J.
Combined spring motors. 1876. Sci. Am. Supp., v 2, p 757
Diagrams are given to show the use of four or more coil springs.

Shoemaker, W. S.
Volute spring motor. 1876. Sci. Am. Supp., v 2, p 791
Illustrates the application of volute spring winding to communicate motion in a vehicle.

Terfloth and Jones.
Spring motors. 1876. Sci. Am. Supp., v 2, p 757
Illustrates the use of elastic rubber springs for street car propulsion.

1878

Anonymous 7.
Sewing machine spring motors. 1878. Sci. Am. Supp., v 6, p 2256
Illustrates the arrangement of spiral springs on a spindle to form a winding device for a sewing machine.

De Bonneville, A.
Springs. 1878. Van Nostrands Eclectic Eng. Mag., v 18, p 391-9, 519-28
Discusses the forms of springs in common use, materials, sizes, uses and manufacture, with special reference to the design of helical and rubber springs.

Givré, D.
Oscillatory movements of a locomotive, where the body is suspended by springs (Mouvements oscillatoires d'une locomotive; ou voiture suspendu sur ressorts). 1878. Société des Ingénieurs Civils de France, p 389-404
Tabulated data on the period, in seconds, of oscillations in the springs of locomotive bodies.

1879

Kelvin, W. T.
Elements of natural philosophy. 1879. Published by University Press, Cambridge, Eng., 285 p
Page 133 gives data force measurement in spiral springs; p 228-31 discuss kinetic energy and lengthening due to torsion.

1880

Levy-Lambert, M.
Graphical tables for the calculation of springs (Tableau graphiques pour le calcul des ressorts). 1880. Annales des Ponts et Chaussées, v 20, pt 2, ser 5, p 59-65
Gives formulas and tables for calculating flexibility.

1881

Baker, B.
Railway springs. 1881. Instn. Civil Engrs. —Proc., v 66, p 238-45
Calculated data on the variation in railway springs due to hardness, flexibility, chemical composition of the steel used.

Rey, L., and Vallot, H.
Establishment of the use of plate springs in railway equipment (Note sur l'établissement des ressorts à lames employés dans le material des chemins de fer). 1881. Société des Ingénieurs Civils de France, p 399-495
General formulas for calculating plate springs, application of the formulas to design of traction equipment.

1883

Smith, O.
Spiral springs, compressible and tensile. 1883. Am. Soc. Mech. Engrs.—Trans., v 4, p 335-50
Defines the important types of springs, briefly describes methods for coiling spiral springs, discusses the theory of their action, followed by a lengthy discussion.

Spalding, B. F.
Dropping cast steel — making gun spring — forging swords. 1883. Am. Mach., v 6, n 29, p 4-5
Discusses spring steels and their heat treatment.

1884

Kohlrausch, F.
Absolute measurement of strong electric currents with tangent compass and spring galvanometer for technical purposes (Ueber die absolute Messung starker elektrischer Sträme mit der Tangenten bussole und über ein Federgalvanometer fur technische Zwecke). 1884. Electrotechnische

Zeitschrift, v 5, p 13-20
Gives formulas for the testing of springs for very accurate galvanometers.

Lewis, W.
Resilience of steel. 1884. Engrs. Club Phila. — Proc., v 4, p 226-32
Briefly discusses the relation of resilience of steel to the torsional action of springs.

1885

Anonymous 8.
Spring motors for vehicles. 1885. Sci. Am. Supp., v 19, p 7548-50
Describes a number of patents of spring motors.

Anonymous 127.
Topical discussions and interchange of data. 1885. Am. Soc. Mech. Engrs. — Trans., v 6, p 843-71
Pages 866-71 discuss the speed with which steel springs will open and close.

Hobart, J. F.
Spiral springs. 1885. Am. Mach., v 8, n 46, p 7
Notes on forming methods for helical springs (not spiral springs).

1886

Anonymous 5.
Making long spiral springs. 1886. Am. Mach., v 9, n 26, p 5
Brief notes on machining method.

Kohlrausch, W.
Use of spiral springs in measuring instruments and accuracy with the spiral spring galvanometer (Verwendung von spiralfedern in Messinstrumenten und die Genauigkeit der mit Spiralfedern arbeitenden Galvanometer). 1886. Elektrotechische Zeitschrift, v 7, p 323-7
Discusses design of parts of instruments for precision work and gives formulas for calculating dimensions and performance of springs.

1888

Résal, H.
The theory of the Belleville spring (Essai sur la théorie du ressort Belleville). 1888. Académie des Sciences — Comptes rendus, v 107, p 713-18
Formulas for the design of the Belleville, truncated cone spring.

1889

Anonymous 3.
Fromulas for springs. 1889. Railroad Gazette, v 21, p 746-7
Gives Reuleaux calculations for cubic parabolic, common and compound triangular, spiral, helical flat and round, common torsion, helical torsion, flat and round, conical spiral flat and round springs.

Anonymous 4.
Force required to compress a helical spring one inch. 1889. Am. Mach., v 12, n 40, p 9

Meyer, J. G. A.
Modern locomotive construction. 1889. Am. Mach., v 12, n 40, p 5-6
Gives formula for calculating strength of helical springs.

Weisbach, J.
Theoretical mechanics, with an introduction to the calculus. 1889. Van Nostrand, London
Formulas for simple flat and flat laminated springs.

1890

Rateau, M.
Note concerning the Belleville disk (Note sur les rondelles Belleville). 1890. Annales des Mines, ser 8, v 17, p 5-46
Gives a series of mathematical calculations showing the derivation of the formula.

1891

Pennsylvania Railroad Co.
Specifications. 1891-1903
No. 13 gives specifications for elliptical springs, 34-A gives specifications for bar spring steel, 12F gives specifications for helical springs.

1892

Begtrup, J.
Spiral springs. 1892. Am. Mach., v 15, n 33, p 2-3
Contains table giving carrying capacity and deflection of spiral springs of round steel, and describes method of using the table

Dudley, C. B., and Pease, F. N.
Chemistry applied to railroads—steel for springs. 1892. Railroad and Eng. Jl. v 66, p 13-16
Gives Pennsylvania Railroad's specifications for locomotive spring steel.

Résal, H.
Properties of the loxodromics of a revolving cone and its application to conical springs (Sur les propriétés de la loxodromie d'un cone de révolution et leur application au ressort conique). 1892. Académie des Sciences — Comptes rendus, v 114, p 147-52
Gives formulas for the calculation of conical springs used in cars and trains.

Résal, H.
Strength and slight deformation in helical springs (Sur la résistance et les faibles déformations des ressorts en helice). 1892. Académie des Sciences — Comptes rendus, v 114, p 37-41, 99-102
A series of mathematical calculations of the deflections in helical springs.

1893

Unwin, S. C.
Tests of springs made from Z-section rods. 1893. Railroad Gaz., v 25, p 816-17
Gives dimensions of double-coil, flange-girder-volute, concave-volute and plain volute springs.

1894

Carpenter, R. C., and others.
Constants for correcting indicator springs that have been calibrated cold. 1894. Am. Soc. Mech. Engrs. — Trans., v 15, p 454-502
Discusses the theory of temperature effects, with ten pages of tabulated data on springs tested.

Reuleaux, F.
The constructor — a hand book of machine design. 1894. Published by Suplee, Phila., 301 p
P 18-21 — Formulas for rectangular, simple triangular and compound triangular springs; supporting power, deflection and elasticity.

Wilberforce, L. R.
Vibrations of a loaded spiral spring. 1894. Edinburgh and Dublin Philosophical Mag., v 204, p 386-92

Mathematical and experimental determination of the ratios of torsional modulus to Young's modulus by means of a vibrating helical spring loaded with a definite mass.

1896

Anonymous 9.
Results of tests made in the engineering laboratories. 1896. Tech. Quarterly, v 9, p 171-235
Pages 217-32 discuss torsion tests on copper, brass and steel wire, giving tabulated results.

Nadal, M. J.
Theory of the stability of locomotives (Théorie de la stabilité des locomotives). 1896. Annales des Mines, ser 9, v 9, p 413-67; ser 9 v 10, p 232-388
Gives equations for the oscillations in locomotives and other vehicles due to action of springs.

1897

Gagariny, A., and Begtrup, J.
Modulus of elasticity for steel helical springs. 1897. Am. Mach., v 20, p 328-9
A discussion on design with proper allowance for loads.

Grafstrom, E.
Helical versus elliptical driving spring. 1897. Railroad Gaz., v 29, p 685-6
Gives diagrams of spring rigging for consolidation engine, using the two types of springs.

1898

Anonymous 11.
Steel springs for motor cars. 1898. Prac. Eng., v 17, p 417-19
Discusses steels for springs and describes important types, such as helical, conical, leaf, spiral buffer and gives dimensions and loading for each type.

Begtrup, J.
What a machine designer should know about springs. 1898. Machy. (N. Y.), v 4, p 267-70, 347, 381-3

Series of articles giving formulas applicable to various types of springs with special reference to spiral and torsion springs.

Kirsch.
Theory of springs (Theorie der Federn). 1898. Zeitschrift des Vereines deutscher Ingenieure, v 42, p 429-36
On the action and calculation of the different kinds of springs.

McCarty, H. C.
Coil springs for freight cars. 1898. Railroad Gaz., v 30, p 119-20
For the majority of cars a single-coil spring of the four-group type is used; for cars over 60,000 lbs. capacity a greater number of coils are used. Gives specifications for steel for railroad springs.

Sinclair, A.
Development of the car spring. 1898. Locomotive Eng., v 11, p 296
Brief historical sketch of the evolution of springs for locomotives.

Trinks, W.
Calculation of springs for valves of steam engines and compressors (Berechnung der Federn fur die Ventile von Dampfmaschien und Kompressoren). 1898. Zeitschrift des Vereines deutscher Ingenieure, v 42, p 1162-8
Calculates a series of formulas used in designing valve springs.

1899

Anonymous 10.
Locomotive driving springs. 1899. Ry. and Eng. Rev., v 39, p 520
Discusses proper quenching temperatures for spring steels.

Bruce, R. A.
Deflection of cylindrical helical springs. 1899. Am. Mach., v 22, p 377-9, 406-11
Gives formulas and diagram for calculation of deflection, including a table of constants for the material used in spring construction.

Safe loads for helical springs. 1899. Am. Mach., v 22, p 328-30, 354-9
Discusses formulas and chart for calculating the strength of cylindrical helical springs, including a table giving the strength of various sizes of springs.

Gaines, F. F.
Some constants for use in designing elliptic springs. 1899. Am. Mach., v 22, p 667-9
Constants are given for use in the modified Realeaux formula for

semi-elliptic and full elliptic springs; the ratio between length of spring and width of plates and bands. Shows how to plot curves for values of deflection from stress and length.

Pomeroy, L. R.
Locomotive spring rigging. 1899. N. E. Railroad Club — Proc., 1899, p 34, 36, 38, 40, 42, 44, 46, 48, 50, 51-3, Feb. 21
Discusses the design of the underhung forms of spring suspensions.

Travell, W. B.
Carrying capacity and deflection of helical springs of round steel 1899. Am. Mach., v 22, p 892-3
A graphical determination using the formula given.

1900

Bovey, H. T.
Theory of structures and strength of materials. 1900. Published by John Wiley and Sons, N. Y., 830 p.
See p 355-8 for formulas for helical springs.

Bruce, R. A.
Flat springs. 1900. Am. Mach., v 23, p 688-90
Discusses the design of various types of flat springs and gives formulas.

Meyer, V.
Calculation of volute springs (Die Berechnung der Evolutfeder). 1900. Zeitschrift des Vereines deutscher Ingenieure, v 44, p 1791-3
Gives a table with principal dimensions calculated from the formulas given for this type of spring.

1901

Anonymous 40.
Pennsylvania Railroad's spring plant at Altoona. 1901. Railroad Gaz., v 33, p 58-60
Describes equipment for making elliptic springs.

Krarup, M. C.
Springs for automobiles. 1901. Horseless Age, v 7, p 14-16, Jan. 30; 15-17, Feb. 20
Considers rules for the design of springs for railway coaches and horse drawn carriages and the factors to be considered in springs for automobiles.

Lindstrom, C., and others.
Report of committee on revision of recommended practice for springs, including design for springs for 100,000-lb. capacity cars. 1901. Master Car Builders Assn. —Proc., v 35, p 173-79
Discusses the necessity of further study on the allowable stresses, total capacity and deflection in helical springs for car equipment.

1902

American Society of Mechanical Engineers.
Topical discussions and notes of experience. 1902. Am. Soc. Mech. Engrs. — Trans., v 23, p 269-97
Pages 277-90 discuss some of the peculiarities of springs and describe a testing machine.

Anonymous 12.
Topical discussions and notes of experience. 1902. Am. Soc. Mech. Engrs. — Trans., v 23, p 269-97
Pages 277-90 discuss some of the peculiarities of springs and describe a testing machine.

Anonymous 53.
Testing indicator springs. 1902. Machy. (N. Y.), v 9, p 192-5
Describes apparatus used at the New York Navy Yard for testing indicator springs under static steam pressure.

French, R. A.
Experiments on spiral springs. 1902. Am. Soc. Mech. Engrs. — Trans., v 23, p 298-312
Formulas given for the determination of coefficient of torsional elasticity and safe stress for different sizes of bar and different ratios of mean diameter of spring to diameter of bar.

Fry, L. H.
Diagrams for semi-elliptical plate springs. 1902. Am. Mach., v 25, p 1680-3
Gives charts to use in determining spring dimensions for specific loads.

Gaillardet, F.
Axles and springs. 1902. Horseless Age, v 10, p 172-4
Discusses the question of spring deflection and suspension and the effect of spring placing on riding qualities.

Kelley, J. P.
Underhung springs. 1902. Ry. and Locomotive Eng., v 15, p 109-10
On the method of hanging the driving springs and the equalizers of locomotives.

Koob, A.
Correcting for variations in indicator springs. 1902. Power, v 22, p 12-13 Mar.
Computes the proper scale of spring for pressure in kg. per sq. cm. and stroke of indicator in mm.

Lindstrom, C. A.
Construction of elliptical springs. 1902. Western Ry. Club—Proc., v 14, p 307-17
General requirements of railroad leaf spring with illustrations and examples of practice.

Markham, E. R.
Hardening and tempering coil springs. 1902. Machy. (N. Y.), v 8, p 270-1
Gives details and recommends a bath of sperm oil for all around spring hardening where the stock is larger than 1/4 of an inch.

Miller, C. A.
Springs and spring making. 1902. Ry. Master Mechanic, v 26, p 419-20
Briefly discusses the heat-treatment and hardening of spring steel.

Roser, E.
Testing of indicator springs (Die Prüfung der Indikatorfedern). 1902. Zeitschrift des Vereines deutscher Ingenieure, v 46, p 1575-84
Describes and illustrates the apparatus used in the testing of indicator equipment.

Summers, G. F.
Diagram for helical springs. 1902. Am. Mach., v 25, p 1822-4
Chart determining the strength of helical springs.

1903

Forster, E.
Notes on the determination of scale of indicator springs (Beitrag zur Bestimmung der Masstabe von Indikatorfedern). 1903. Zeitschrift des Vereines deutscher Ingenieure, v 47, p 319-21
Describes test apparatus used for indicator springs, to determine dimensions.

Grimshaw, R.
Development of the outside spring indicator. 1903. Power, v 23, p 679-80
Gives twelve diagrams showing the stages in development of the indicator.

Kirkegaard, I.

Springs and their use. 1903. Iron Age, v 71, p 10-14, June 4
Tests for spring wire and methods of tempering, brief data on material for springs and bluing and japanning springs. Describes and illustrates the various types of furniture springs, spiral, compression, helical, hot-wound, jig and flat wire springs; bluing and japanning of springs.

Markham, E. R.

Mistaken blaming of the steel. 1903. Am. Mach., v 26, pt 2, p 1685-6
Gives an example of the ill effects of over-heating springs during hardening.

Metcalf, W.

Springs. 1903. Iron Age, v 72, p 16-19, July 9
Gives short history of conditions and changes of the past 30 years in design and manufacture of steel for elliptic and coil springs for locomotives and railroad cars.

Springs and spring steel. 1903. Am. Soc. Testing Matls. — Proc., v 3, p 108-20
Reviews the history of metallurgy in reference to coil and elliptic springs; briefly discusses the chemistry of materials and testing of finished springs.

Mollsworth, W. H.

Pocket book on mechanics. 1903. E. and F. N. Spon, Ltd., New York
On page 256 formula for safe working load of cantilever leaf springs. Tables of working camber of springs for various thickness ofplates.

Spencer, H. K.

Safety valve springs. 1903. Mar. Eng., v 8, p 69-70
Gives formula for dimensions and capacity of helical springs used in valves of marine boilers.

Staus.

Testing of indicator springs and modern indicators (Prüfung von Indikatorfedern und neuere Indikatoren). 1903. Zeitschrift des Vereines deutscher Ingenieure, v 47, p 1821
Describes the mechanical apparatus used for tests on steam equipment at the Technical High School at Karlsruhe.

Wiebe, H. F., and Schwirkus, R.

Notes on testing of indicator springs (Beitrage zur Prüfung von Indikatorfedern). 1903. Zeitschrift des Vereines deutscher Ingenieure, v 47, p 54-9
Gives tabulated results of tests to determine change in dimensions and deflection of these springs when hot and when cold.

Woodworth, J. V.
Hardening, tempering, annealing and forging steel. 1903. Published by Henley, N. Y., 307 p
P 120, hardening and tempering small, spiral steel springs; p 184 for welding of buggy springs; p 96 for quenching spring dies; p 161 for bluing of small springs.

1904

Anonymous 14.
Topical discussion on forms and relative advantages of teeth in gears. 1904. Eng. Soc. Western Penn. —Proc., v 20, p 238-54
See p 246-54 for notes and constants on helical and elliptical springs.

Anonymous 126.
Pfeiffer spring motor. A mechanism for the storage of potential energy. 1904. Iron Age, v 73, p 1-2, Apr 7
Manufactured by the New Britain Hardware Manufacturing Company, New Britain, Conn. Designed primarily for use in connection with automatic piano players, but is adapted for any use where a supply of power at a uniform rate is required, but where the source is incapable of the necessary close regulation and constant speed.

Beverts, W. J.
Experience in making small coil springs. 1904. Machy. (N. Y.), v 10, p 556-8
Describes the equipment used in making small, helical springs for numbering stamps.

Bronson, H. L.
Transverse vibrations of helical springs. 1904. Am. Jl. Sci., v 168, ser 4, v 18, p 59-72
Gives calculations resulting from tests on helical springs to determine the correct diameter of wire, relation between length and tension, and constancy of pitch.

Nachman, H. S.
Design of helical springs for safety valves. 1904. Am. Mach., v 27, pt 1, p 96
Calculates formula.

1905

Anonymous 15.
Indicator springs-testing, correction and innovations in indicator (Indikatorfeder, Prüfungs, Einrichtung und Neuerungen an Idikatoren).

1905. Glückauf, v 41, p 635-41
Data on the design and testing of helical springs in indicator equipment.

Dubois, E.
Study of expansion springs (Etude sur les ressorts à expansion). 1905. Revue de Mecanique, v 17, p 352-9
Designs are worked using formulas given.

Greene, C.E.
Structural mechanics, comprising the strength and resistance of materials, and elements of structural design. 1905. Published by John Wiley and Sons, N.Y., 240 p
Formula for deflection of beams of uniform strength, p 97-102. P 229-34 give formulas for loading of straight, coiled, helical, circular, and rectangular plate springs.

Guarini, E.
Tolli spring governor. 1905. Sci. Am. Supp., v 60, p 25007
Illustrates the device which employs both vertical and horizontal spiral, traction springs.

Hundhausen, R.
Recent belt drives (Ueber neuere Riemengetriebe). 1905. Dinglers Polytechnisches Journal, v 320, p 436-40
Discusses the use of helical springs in dynamos.

Olsen, T. Y.
Teetering effect of springs. 1905. Am. Mach., v 28, p 628
Describes tests on helical springs under loads.

Schwirkus, R.
Indicator springs loaded in tension (Auf Zug beanspruchte Indikatorfedern). 1905. Zeitschrift des Vereines deutscher Ingenieure, v 49, p 487-9
Gives tabulated data on the dimensions for the indicator springs for different steam pressures and different size machines.

1906

Elder, R.
Calculation of tensile springs for electrical and mechanical equipment (Berechnung von Zugfedern fur elektrische und mechanische Apparate). 1906. Elektrotechnik und Maschinenbau, v 24, p 375-80, 397-401, 417-21
Gives formulas and detailed data on the design of springs for governors, signal apparatus, and all types of control equipment.

Emery, A. H., Jr.
Precision dynamometer springs. 1906. Am. Mach., v 29, pt 2, p 702-4
Describes the machining and finishing of a compression coil spring.

Ewing, J. A.
Strength of materials. 1906. Published by Cambridge University Press, Cambridge, Eng., 244 p
Gives formulas on p 198-9 for the shearing stress and twist of helical springs.

Howe, F. D.
Notes on wire springs, with table of loads and deflections. 1906. Am. Mach., v 29, pt 2, p 808-9
Table for helical springs of round steel.

Krull, F.
Table for the calculation of helical springs (Abraque pour le calcul des dimensions des ressorts hélicoidaux cylindriques). 1906. Revue de Mecanique, v 19, p 354-8
Gives Proell's formula for the design.

Proell, R.
Table for spring calculation (Rechentafel für Federberechnung). 1906. Zeitschrift des Vereines deutscher Ingenieure, v 50, p 1076-7
Illustrates a measuring device for calculating dimensions of coil springs.

Thelin, O. A.
Review of formulas for helical springs. 1906. Am. Mach., v 29, pt 2, p 847-8
A new solution for certain problems.

1907

Anonymous 17.
Few notes about helical springs. 1907. Am. Mach. v 30, pt 1, p 711
Shows how the spring formula is developed.

Lake, E. F.
Steels used in automobile construction. 1907. Am. Mach., v 30, pt 1, p 376-82
Page 382 gives composition of a good spring steel, also briefly discusses physical characteristics of springs.

Lüttmann, J.
Deflection in rotating helical springs (Durchbiegnung rotierender

Schraubenfedern). 1907. Zeitschrift des Vereines deutscher Ingenieure, v 51, p 1788-91.
Mathematical calculation of changes in helical springs due to deflection.

Perry, J.
Applied mechanics. 1907. Published by Van Nostrand, N. Y., 676 p
See p 613-51 for formulas, design and materials for helical, spiral and leaf springs.

Rumney, J. G.
Construction of motor vehicle springs. 1907. Automobile, v 17, p 297-8
The limit of deflection in automobile springs is said to depend on the nature of the material, length and proportionate arch and width and thickness of plates.

1908

Albree, C. B.
Spring formulas simplified. 1908. Eng. Soc. Western Penn. — Proc., v 24, p 433-47.
An attempt to simplify existing formulas and to render the solution of helical spring problems easy for anyone having standard tables of areas and decimal equivalents at hand.

Anonymous 41.
Tempering steel. 1908. Am. Mach., v 31, pt 1, p 496-97
Gives graphical results of tests on leaf springs reheated to 800 deg. fahr.

Fay, T. J.
About automobile spring suspensions. 1908. Automobile, v 19, p 637-8, 671-2.
A general review of the various types of springs used in automobiles and their riding qualities.

Hall, M. A.
Discussion of commercial vehicle springs. 1908. Commercial Vehicle, v 3, p 201-203.
Discusses types and methods of suspension.

Hallard, M.
Experimental determination of coefficient of friction in the plates of springs (Note sur le détermination expérimentale du coefficient de frottement des lames de ressorts). 1908. Revue générale des Chemins des Fer, v 31, pt 1, p 400-7.
Gives formula for determining the coefficient of friction in locomotive and carriage leaf springs.

Jackson, A.
Using helical springs. 1908. Am. Mach., v 31, pt 1, p 368-9
Rules for design.

James, O.
Tests of square springs. 1908. Am. Mach., v 31, pt 1, p 578
Gives log of tests on helical springs made of square wire.

Morley, A.
Strength of materials. 1908. Published by Longmans, Green, Lond., 481 p
See p 182-6 and 223 for formulas on carriage springs; p 278-88 for helical springs; p 314-6 for flat, spiral springs.

Morrison, E. R.
Morrison's spring tables. 1908. Published by Morrison and Martin, Sharon, Pa.
Gives formulas for the design of light and heavy springs, and tables giving the properties, strength and dimensions of helical and elliptical springs.

Nickerson, A. T.
Sizes of helical springs without mathematics. 1908. Am. Mach., v 31 pt 2, p 228.
Charts for finding safe loads, deflections, sizes of wire, diameter of coils and the number of coils.

Peddle, J. B.
Construction of graphical charts. 1908. Am. Mach., v 31, pt 2, p 335-42
Page 337 gives an alignment chart for determining load supported by a helical spring.

Tolle, M.
Sag of rotary, helical springs (Durchbiegung rotierender Schraubenfedern). 1908. Zeitschrift des Vereines deutscher Ingenieure, v 52, p 1994-7
Mathematical discussion on bending of rotating spiral springs.

Whittlesey, F. E.
Design of springs for gas engine valve. 1908. Machy. (N. Y.), v 14, p 585-6.
Gives formulas and information as to the proper design for compression springs and factors to be considered, with an example.

Wolfenden, R.
Design of semi-elliptic springs. 1908. Eng. Rev., v 19, p 248-252
Gives formulas and discusses various features of design.

Zvonicek, J.
Deflection in rotating helical springs (Durchbiegung rotierender Schraubenfedern). 1908. Zeitschrift des Vereines deutscher Ingenieure, v 52, p 303-4.
Gives formulas for measuring deflections in helical springs.

1909

Anonymous 42.
Making the Colt automatic pistol 1909. Am. Mach., v 32, pt 2, p 95-101
Briefly describes the heat treatment and machining of magazine springs for Colt pistols.

Anonymous 43.
Sub-press die for special springs. 1909. Machy. (N. Y.), v 15, p 791-2
Illustrated description of a punch and die used to make this special spring of 0.055 in. wire.

Anonymous 130.
How springs neutralize shock. 1909. Motor Car Jl., Dec. 18
Explains the reactions and actions and how they are absorbed.

Armstrong, John F.
Spring motor. 1909. Official Gaz., v 140, p 1049, March 1909

Astier, M.
Study of the helical spring (Etude sur le ressort à boudin). 1909. Revue de Mecanique, v 24, p 261-7
Mathematical study of helical springs, and the theory of their action.

Fischer, V.
Logarithmic, graphical table for spring calculation (Logarithimisch-zeichnerische Tafel zur Federberechnung). 1909. Zeitschift des Vereines Deutscher Ingenieure, v 53, p 1075-7
Explains the construction and use of the chart; logarithmic table for calculation of helical springs.

Fry, L. H.
Heat treatment of spring steel. 1909. Supplementary reference. Iron Age, v 84, p 1070-72, Int. Assn. Test. Matls., 5th Congress, paper I_3
Article gives various methods of heating and cooling steel bars, a method of testing and results of tests obtained at Baldwin Locomotive Works.

Hanson, H. L.
Helical springs. 1909. Machy. (N. Y.), v 15, p 342

Gives tables showing the greatest allowable pressure of load in pounds and the corresponding compression or deflection, in inches per coil of helical springs, of various sizes, with examples and explanations.

Heldt, P. M.
Spring suspension of tractors. 1909. Automotive Industries, v 40, p 793-4
Sketches and brief description of several front end suspensions for tractors. Rear end suspensions are rare because of the difficulty of transmitting power through the suspension.

Johnson, Chas. A.
Spring power motor. 1909. Official Gaz., v 143, p 584, June 1909.

Landau, D., and Golden, A.
Calculations of chassis springs. 1909. Horseless Age, v 24, p 481-2; 529-30; 555-8; 569; 604; 651
Comparison of formulas from various authorities for deflection and flexibility, and the development of true formula; formulas for determination of number of leaves and their thickness; tables of maximum safe deflections for various thickness of leaves for varying elastic limits of materials.

Lecornu, L.
Use of very flexible springs for regulating the movement of motors (Sur l'emploi de ressorts à grande flexion pour la regularisation du mouvement des moteurs). 1909. Revue de Mecanique, v 25, p 321-4
Formulas are given to be used in determining the moment of resistance in a dynamo, as influenced by the flexure of springs.

Mathews, J. A.
Alloy steel for motor car construction. 1909. Jl. Franklin Inst., v 167, p 379-97
Discusses the heat treatment and merits of chromenickel and silico-manganese and silico-chrome steels for springs.

O'Bannon, Wm. H., and Field, Jas. M.
Spring motor. 1909. Official Gaz., v 146, p 908, Sept. 1909

Rowell, H. S.
Notes on the effect of eccentricity of loading in spiral springs. 1909. Practical Engr., v 40, p 618-19
Gives formulas for load and elongation of helical springs.

Schröder, Hermann.
Spring motor. 1909. Official Gaz., v 139, p 594, Feb. 1909

Sharp, A.
Pneumatic springs for road vehicles. 1909-10. Instn. Automobile Engrs. —Proc., v 4, p 87-121
Discusses the theory of vertical acceleration, resiliency and weight of springs; load-compression curves; air springs — their advantages and disadvantages for motor vehicles.

Sirius.
Winding springs. 1909. Machy. (N. Y.), v 15, p 625-6
Discusses several factors in connection with the winding of coil springs.

Unwin, W. C.
Elements of machine design. 1909. Published by Longmans, Green, Lond., 2 vol.
Volume 1, p 103-10 gives formulas for the design and loading of helical and laminated springs.

Viall, E.
Winding springs with initial tension. 1909. Machy. (N. Y.), v 15, p 462
Illustrates a device invented by W. A. Bright of the Decatur Novelty Works.

1910

American Railway Engineering and Maintenance of Way Association.
Calibration of helical car springs. 1910. Am. Ry. Eng. and Maintenance of Way Assn. — Proc., 11th annual convention, pt 1, p 153-7
Gives tables for determining the deflection of single and nested, helical springs.

Recalibration of helical car springs. 1910. Am. Ry. Eng. and Maintenance of Way Assn. — Proc., 11th annual convention, pt 1, p 157-9
Includes numerous tables for determining deflections under varying loads.

Report of the sub-committee on allowable length of flat spots on car wheels. 1910. Am. Ry. Eng. and Maintenance of Way Assn. — Proc., 11th annual convention, v 11, pt 1, p 147-52
Discusses the causes of deflection in car springs.

Anonymous 19.
Calibration of helical car springs. 1910. Am. Ry. Eng. and Maintenance of Way Assn. — Proc., 11th annual convention, pt 1, p 153-7
Gives tables for determining the deflection of single and nested, helical springs.

Anonymous 20.
Recalibration of helical car springs. 1910. Am. Ry. Eng. and Maintenance of Way Assn. —Proc., 11th annual convention, pt 1, p 157-9.
Includes numerous tables for determining deflections under varying loads.

Anonymous 44.
Making springs and rock shafts. 1910. Am. Mach., v 33, pt 1, p 1212-13
Describes the machining and testing of various types of adding machine springs.

Butzow, L. J.
Design of flat spiral springs. 1910. Machy. (N. Y.), v 16, p 881-3
Deals with the principles entering into the calculation of flat springs, and gives the most important equations used in the design.

Davis, M. E.
Slide rule for helical spring calculation. 1910. Machy. (N. Y.), v 16, p 528-9.
Gives a reproduction of the graduations on a slide rule used for such calculations with directions for its use. Rules were used for more than two years in the Ordnance Department drawing rooms of the Washington Navy Yard.

Hurlbrink, E.
Calculation of cylindrical compression springs for safety against lateral cracks (Berechnung zylindrischer Druckfedern auf Sicherheit gegen seitliches Ausknicken). 1910. Zeitschrift des Vereines Deutscher Ingenieure, v 54, p 133-7, 181-4.
Mathematical discussion on the calculation of cylindrical bearing springs and their security against lateral displacement.

Lake, E. F.
Over-fired and under-fired heat treating furnaces. 1910. Am. Mach., v 33, pt 1, p 206-10
Discusses the processes connected with the hardening of steel, coil springs.

Landau, D., and Golden, A.
Some notes on good spring suspension. 1910. Horseless Age, v 26, p 67-9
Shows the application of semi-elliptic, three-quarter elliptic, platform, full elliptic and full elliptic springs with two shackles.

Lanza, G.
Applied mechanics. 1910. Published by John Wiley and Sons, N. Y., 922 p.
Pages 338-49 give formulas for the design and loading of helical springs made of round and rectangular wire, flat springs, coiled springs.

Morrison, E. R.
Design of automobile springs. 1910. Machy. (N. Y.), v 16, p 343-7
Deduction of general formulas for load, deflection, number of leaves and proper initial distance between portions before banding and the load on the band of semi-elliptic springs. Table of safe load and deflection of varying thickness of leaves.

Pomeroy, L. H.
Laminated springs for motor cars. 1910. Autocar, v 24, p 208-10
Formulas for the thickness and deflection of laminated springs. Shape and camber of leaves shown.

Seeders, Zephaniah C.
Spring motor. 1910. Official Gaz., U. S. Patent Office, v 158, Sept. 1910

Von Hohenstein, C. H.
Spring motor. U. S. Pat. 954, 602. Official Gaz., v 153, p 343, Apr. 12, 1910.

Whittlesey, F. E.
Choice of a factor of safety for high class motor springs. 1910. Machy. (N. Y.), v 16, p 609
Discusses the determination of fibre stress from the rate of compression of an automobile spring.

1911

American Society for Testing Materials.
Report of Committee A-7 on tempering and testing of steel springs and standard specifications for spring steel. 1911. Am. Soc. Test. Matls. — Proc., v 11, p 115-16
Gives chemical composition for open-hearth, crucible, or electric steel.

Angelino, J. C.
Diagrams for helical springs. 1911. Horseless Age, v 28, p 8-9
Gives diagrams with notes showing the load which a helical spring will support.

Batcheller, B. C.
Graphical design of helical springs. 1911. Am. Mach., v 35, p 198-9
Discusses the preliminary laying out to determine maximum extension before applying formulas for coil details.

Bayard, R. S.
Choosing a value of "E" in the spring formula. 1911. Am. Mach., v 34,

pt 1, p 268-269
Brief discussion of George F. Summers' article. See also G. F. Summers, and V. H. Snook.

Dalbey, W. E.
Laminated bearing springs. 1911. Instn. Civil Engrs. —Proc., v 185, pt 3, 346-62
Mathematical study of the design, giving results of experiments on bearing springs.

Guetet, A.
How to improve harsh suspension. 1911. Automobile, v 25, p 103-5
Abstract of a paper in "La Vie Automobile," on the action of springs in aiding riding comfort.

Hofmann, A.
Effect of spring weight. 1911. Am. Mach., v 34, p 891-2
Gives formula for computing deflection of coil spring under load.

Jones, B. E.
Hardening and tempering steel. 1911. Published by Cassell, London, 126 p
Pages 58-60 discuss the hardening of large springs for carriages and small springs for guns and revolvers.

Landau, D.
Deflection of chassis springs. 1911. Horseless Age, v 27, p 396-9; 405
Derivation of formula for deflection with load, with illustration of its applications to practical examples. Formula for weight and length of springs.

Morrison, E. R.
Design of grouped helical springs. 1911. Machy. (N. Y.), v 17, p 530-3
Study of the design of round, bar coils, developing the subject on the basis of the relation which exists between the diameter of the bar and the mean diameter of the spring.

Nikcul, L.
Helical springs. 1911. Practical Engr., v 44, p 421-3
Gives formula for load which round and square wire helical springs will carry.

Rowland, E. K.
Leaf springs. 1911. Soc. Automobile Engrs. —Trans., v 6, p 156-8, discussion, p 159-85
Discusses laws of strength, deflection and resilience in leaf springs, the heat treatment, design and materials for springs.

Shanton, I. A.
Spring motor. U. S. Pat. 996, 147. Official Gaz., v 167, p 806, June 1911

Siebeck, H. A.
Notes on the calculation of helical springs (Beitrag zur Berechnung der Schraubenfedern). 1911. Zeitschrift des Vereines deutscher Ingenieure, v 55, p 2177-81
Diagrams, formulas and table for determining stresses in helical springs.

Slocum, S. E. and Hancock, E. L.
Text book on the strength of materials. 1911. Published by Ginn, Boston, 366 p
Formulas for the design of helical springs, theory of spiral springs, and questions and answers concerning springs, p 145-53.

Snook, V. H.
Value of "E" for springs. 1911. Am. Mach., v 34, pt 2, p 797-8
Gives formula for calculating deflection in coil due to weight.

Summers, G. F.
Finding the value of "E" for springs. 1911. Am. Mach., v 34, pt 1, p 147
Gives a simple test by which the quality of the material may be determined, so that accurate results may be obtained in designing new springs.

Thomas, J. M.
Effect of inertia of helical spring. 1911. Am. Mach., v 34, pt 1, p 749
Gives formula for computing inertia.

Thomas, R. G. T.
Safe load and deflection of helical springs. 1911. Engineer, v 112, p 171-2
Discusses the calculation of helical springs both in respect to safe loads and safe deflections. Gives charts to be used in such calculations.

Zacharias, L.
Research on cylindrical springs of circular cross-section (Untersuchungen au zylindrischen Schraubenfedern mit kreisförmigen Zuerschnitt). 1911. Zeitschrift des Vereines deutscher Ingenieure, v 55, p 1801-7
Derives formulas for dimensions of coil springs to be made from circular material.

<u>1912</u>

Anonymous 35.
Comparative endurance tests of chrome-vanadium and chrome-nickel-tungsten steel automobile springs. 1912. <u>Am. Mach.</u>, v 37, p 986
Brief notes on tests used by the Liggett spring and Axle Co., Pittsburgh, Pa.

Anonymous 59.
Auxiliary suspension. 1912. <u>Autocar</u>, v 28, p 181-5
Shows the function of leaf springs, discusses periodicity and illustrates various type of springing devices.

Anonymous 60.
Springs and shock absorbers at the shows. 1912. <u>Horseless Age</u>, v 29, p 147-8
Shows the percentage of half and full elliptic springs used on American and foreign cars displayed, with description of special spring features shown, such as lubrication space between leaves.

Anonymous 108.
Pneumatic springs for automobiles. 1912. <u>Eng. News</u>, v 67, p 302-3
Description of Westinghouse air spring as applied to an automobile, with graphical representation of load-travel characteristics.

Anonymous 121.
Wheelbarrow and truck springs. 1912. <u>Machy</u>. (N.Y.), v 18, p 370
Brief notes on the increased efficiency of the workman using a vehicle provided with springs.

Brenier, P.
Study on springs (Etude sur les ressorts). 1912. <u>Société de l'Industrie Minérale—Bul</u>., v 1, p 363-41, 525-48
Considers the elastic energy which a system of solid elastic body can absorb.
Makes application to leaf springs for the rational determination of the leaves.
Studies leaf springs which can be attained.
Studies conditions of proper joining of the leaves.
Gives formulas of flexibility. Studies the fatigue of the metal and the fatigue at the shear. Shows the application of the formulas in an appendix.
Gives a table to facilitate calculations.

Coapman, J.
Design of automobile springs. 1912. <u>Am. Mach</u>., v 37, p 804-6
Treats of the design of automobile springs to agree with the best practice

known. Includes tables, charts and formulas. See also discussion by David Landau and Asher Golden in Am. Machinist. 1913. v 38, p 148-50.

Coker, E. G.
Determination of the stresses in springs and other bodies by optical and electrical methods. 1912. Engineering, v 94, p 404-5
Describes and illustrates a method of testing plate springs to determine internal stresses.

Halsey, F. A.
Charts for helical springs. 1912. Am. Mach., v 37, p 271-4
Gives charts applicable to any material with explanatory notes; data on the fiber stress of spring wire, the torsional modulus of elasticity and deflection of springs.

Hamilton, D. T.
Watch movement manufacture. 1912. Machy. (N.Y.), v 18, p 663-7
Gives formula for computing the number of turns in the main spring of a watch which is to run a definite number of hours.

Landau, D.
The commercial testing of leaf springs. 1912. Horseless Age, v 30, p 679-82; 719-20; 754-6
Apparatus used in testing springs and methods of testing, with some side-lights on faulty design and specifications. Photographs of testing machines and description of methods and application. Deflection and its phases; the values of friction and formula. Stress tables for deflection for various lengths and thicknesses of steel. Sixteen items of information to be observed in making a test are listed.

Lane, L. J.
Leaf springs. 1912. Automobile Topics, v 26, p 413-14
Give statistics on the percentage of semi, full and three-quarter elliptic springs in use on modern pleasure cars.

Morrison, E. R.
Design of conical helical springs. 1912, Machy. (N.Y.), v 18, p 681-4; with data sheet supp., p 694
Develops formulas applicable to the various types, taking into account deflection and compression capacity for given loads.

Peebles, R. A..
Compression springs and materials 1912. Am. Mach., v 36, p 710-12
Considers the principal sources of error in commercial helical and compressing springs. Gives spring specifications of Westinghouse and results of tension and torsion tests on black spring wire; tension tests on music wire, on the phosphor-bronze spring wire and on brass wire.

Shearer, G. W. and Watson, C.
Some notes on springs, principally with reference to those for railway rolling stock. 1912. Engineering, v 93, p 206-10
Gives diagram for regulating the deflection of successive coils of conical springs and elaborate calculations to be used in determining stresses allowable in flat, elliptical and round wire to be used in helical springs under load.

Snow, W. M. G.
Testing motorcycle springs. 1912. Am. Mach., v 37, p 1007-8
Describes the heat treatment, quenching and breakage tests.

Society of Automotive Engineers
Third report of the Springs Division of the Standards Committee.—Leaf springs. 1912. Soc. Automobile Engrs.—Bul., v 3, p 130-40. Also Soc. Automobile Engrs.— Trans., 1913, v 8, pt 1, p 70-96
Gives detailed specifications for leaf springs.

Strombeck, G. M.
Formulas for conical springs. 1912. Am. Mach., v 36, p 174

Summers, G. F.
Useful spring table. 1912. Am. Mach., v 37, p 775-7
Table for calculating proportions for helical springs of circular cross-section and with a fibre stress of 100,000 lb.

Viall, E.
Making Victor talking machines. 1912. Am. Mach., v 37, p 347-52
Describes the annealing of wire, coiling and testing of springs.

Webster, W. H.
Length and diameter of spring 1912. Am. Mach., v 37, p 323-4
Calculates formula for coil springs.

White, E. L.
Method of winding springs in vise. 1912. Machy. (N.Y.), v 18, p 965
Illustrates the equipment and wire in process of being coiled.

1913

Anonymous 36.
Vanadium springs in locomotive service. 1913. Ry. and Eng. Rev., v 53, p 324
Gives results of a test conducted by the Illinois Central R. R. on a set of chrome-vanadium and a set of carbon-steel springs attached to a 10-wheel locomotive, to determine their relative wearing qualities.

Anonymous 45.
Winding piano wire tension springs. 1913. Machy. (N.Y.), v 19, p 591 also data sheet following p 594
Four tables are given for use in determining the pitch and diameter of springs and the presssure required for punching.

Anonymous 54.
Reducing spring manufacture to a science. 1913. Iron Trade Rev., v 52, p 567-70
Describes the equipment in a modern testing laboratory in the Perfection Spring Co's plant at Cleveland.

Anonymous 61.
Adapting spring suspension to varying loads. 1913. Automobile, v 28, p 1023
Abstract of article (in La Vie Automobile, April 26, 1913) on spring suspension which will serve equally well for underloads, normal loads, and overloads.

Anonymous 62.
Reasons for the wobbling of front wheel. 1913. Automobile, v 29, p 380
Discusses the relation existing between flat springs placed at the sides or front and back of vehicles and the action of the steering gear.

Anonymous 109.
Pneumatic suspension of varying load. 1913. Automobile, v 28, p 694
Illustrates the Cowey pneumatic suspension for automobiles in which the load is supported on four air cushions attached to the rear ends of the leaf springs.

Anonymous 110.
Shock absorbers show improved details. 1913. Automobile, v 28, p 371-3
Illustrates five types of shock absorbers designed for riding comfort. Plate and helical springs are important parts of these devices.

Anonymous 129.
Tests of spring steel. 1913. Am. Engr., v 87, p 70
Describes a series of tests on spring steel.

Aston, W. G.
Springing systems. 1913. Autocar, v 30, p 1025-9
Sketches and comments on the advantages and disadvantages of 18 types of motor car leaf suspensions.

Baillie, G. H.
Springs. 1913. Instn. Automobile Engrs.—Proc., v 7, p 451-90; abstract in Automobile, v 28, p 1124-6

Results of investigations and remarks on their importance.

Bobeth, E.
Tests on spring suspensions of automobiles (Versuche über die Abfederung von Kraftfahrzeugen). 1913. Motorwagen, v 16, p 467-71; 493-7
Description of machine designed to similate road conditions in the laboratory and test runs made, with charts showing oscillations and vibrations.

Cathcart, W. L.
Spring supported cantilever. 1913. Machy. (N.Y.), v 20, p 314; 499
Solution of a problem presented by a reader regarding the deflection at the free end of a cantilever beam for a certain load, and the stress at any point in the beam. The beam touches a coil spring at half the distance from the point of support.

Devries, R. P.
Mechanical tests of heat treated spring steel. 1913. Am. Soc. Test. Matls.—Proc., v 13, p 550-60
Gives results of tests to determine the cold-bend, hardness, effect of quenching in water at various temperatures and some other physical properties of 1 per cent carbon, spring steel.

Fry, L. H.
Helical spring calculations. 1913. Engineering, v 96, p 143-4, 196-7
Diagram with explanation of method of using; intended to show the allowable load and the elasticity of any helical spring, whether made of round or rectangular wire.

Golden, A.
Springs and suspensions at the shows. 1913. Horseless Age, v 31, p 143-5
Discusses European versus American practice; describes several automobiles having variations of the leaf type of springs.

Haas, A. L.
Data for balance springs. 1913. Am. Mach., v 38, p 283
Facts are mentioned which have bearing on the design of cylindrical, helical spring used torsionally.

Inokuty, A.
Formulae for helical springs. 1913. Technical Papers of A. Inokuty. 437 p
Pages 297-304 give formulas for helical springs to be designed from round and rectangular wire.

Lake, E. F.
Methods employed in leaf spring manufacture. 1913. Iron Age, v 91, p 701-5

Describes improvements in processes and accuracy in mechanical working and heat treatment.

Tests for leaf springs and their treatment. 1913. Machy. (N.Y.), v 20, p 217-21; Soc. Automobile Engrs.—Bul., v 4, p 471-5
Describes machines for testing springs for deflection and fatigue. Fig. 8 shows the relation of hardening temperatures to the life of the spring; Fig. 11 shows the variation in physical properties of carbon spring steel due to drawing temperatures. Fig. 12 shows the camber given to springs and the taper of plates.

Landau, D., and Golden, A.
Design of automobile springs. 1913. Am. Mach., v 38, p 148-50
It is shown that the solution of design given by J. Coapman (Am. Mach., v 37, p 804-6) is wrong in method and in practice.

Markham, E. R.
Steel, its selection, annealing, hardening and tempering. 1913.
Published by Henley, N. Y., 367 p
Contains data on spring tempering, p 259-70.

Merrill, R. K.
Testing motorcycle fork springs. 1913. Am. Mach., v 38, p 116
Author takes exception to remarks in W. G. Snow's article, v 37, p 1007.

Norris, G. L.
Vanadium steel and its application in locomotive construction. 1913. Western Ry. Club— Proc., v 26, p 3-26
Pages 15-16 give data on elastic limit, tensile strength, elongation and reduction of area in semielliptic, chrome-vanadium springs.

Peddle, J. B.
Charts for full and semi-elliptic leaf springs. 1913. Am. Mach., v 38, p 645-8
Two charts are given which are based on his spring formulas and by means of which design of springs can be made graphically.

Pletts, J. St. V
Spring design. 1913. Engineer, v 116, p 61-2
Develops formula for the design of large spring on the order of a clock spring.

Riedler.
Action of springs. 1913. Automobile, v 28, p 846-7
Abstract of an article in Automobile Rundschau, Mar. 15, 1913, showing the effect on springs of obstacles in the road and the necessity of having springs extend downward after a jolt.

Spooner, H. J.
Machine design, construction and drawing. 1913. Published by Longmans, Green, Lond., 720 p
Page 584 gives specifications for Krupp's motor car springs; pages 615-20 give data on twisting moment, design and strength of helical and plate springs.

1914

Anonymous 21.
Cantilever springs much heavier. 1914. Automobile, v 31, p 935
Several engineers express their opinions as to the correctness of the theory that cantilever springs must be heavier than semi-elliptics.

Anonymous 22.
Charge against cantilever springs that they must be heavier than semi-elliptics proved false. 1914. Automobile, v 30, p 1144-5
Builders do not agree with the theory that cantilever springs must be heavier; graphic comparison shows the theory to be false. Actually it is found that fewer and thicker leaves are necessary. Unsuspended mass should be reduced to a minimum.

Anonymous 34.
Pneumatic springs give varying resiliency. 1914. Automobile, v 31, p 454-5
Description of the Cox air cushion which automatically increases the pressure with the load, keeping the frame level constant.

Anonymous 55.
Watch spring testing apparatus. 1914. Sci. Am., v 111, p 494-497
Discusses the principle of the testing apparatus and describes the method.

Anonymous 63.
Cantilever spring. 1914. Horseless Age, v 34, p 355-6
A short discussion on the ability of the cantilever spring to produce a longer wheel base.

Anonymous 64.
Rear springs. 1914. Horselesss Age, v 34, p 952-3
A brief review of spring types, including quarter, semi, three-quarter, seven-eighths and full elliptic springs; floating cantilever and platform types.

Anonymous 65.
Relations of cross springs to weight of axles and steady steering. 1914.

Automobile, v 30, p 410
The front cross spring is said to be more flexible than the other types of springs, because it allows a pivoting action on the rear and firm action on the front, thus assisting in keeping the steering arm rigid.

Anonymous 66.
Universal search for better springs; a new design of progressive type favorably received abroad. 1914. Automobile, v 30, p 1336-8
The new mission for automobile racing is to develop and demonstrate the best spring for all motor vehicles.

Anonymous 67.
Vehicle spring of variable flexibility. 1914. Horseless Age, v 34, p 67
Descriptions of the Serrell variable length leaf spring. Under heavy load the effective length of the spring is shorter.

Anonymous 111.
Cox automatic load regulated air springs. 1914. Horseless Age, v 34, p 213
Illustrates a flexible bulb with integral shanks used by the Cox Pneumatic Cushion Co., on pleasure and commercial vehicles.

Anonymous 112.
Development of spring moderators and rebound checks. 1914. Automobile, v 30, p 1177-8
Illustrates the transverse and longitudinal sections of the Houdaille hydraulic rebound check and shock absorber.

Arndts, E. C.
Scientific manufacture of automobile springs. 1914. Horseless Age, v 34, p 921-3
Description of the process of manufacturing leaf springs at the plant of the Cleveland Canton Spring Co.

Beck, H.
Properties of floating cantilever springs. 1914. Horseless Age, v 33, p 846-7
Abstract of article published in "Autotechnik" dealing with the design of leaf springs and comparing the compression in floating cantilever with semi-elliptic spring.

Bull, A. A.
Thinks driving through springs impairs their efficiency. 1914. Automobile, v 31, p 842-3
Deals with the endurance of springs and the effect on the rear axle design.

Golden, A.
Springs and suspensions for 1914. 1914. Horseless Age, v 33, p 88-9
Discusses the semi-elliptic springs in use and the growing popularity of the floating cantilever type. The tendency is toward longer and wider springs.

Goodman, J.
Mechanics applied to engineering. 1914. Published by Longmans, Green, Lond., 841 p
Formula for laminated springs, effects of friction not taken into consideration, p 519-22. See p 585-92 for design and safe loads on helical springs.

Graburn, A. L.
Springs for railway equipment. 1914. Ry. Master Mechanic, v 38, p 245-7
Gives specifications for leaf, helical, bar coil, tension coil springs.

Hamilton, D. T.
Spring winding and coiling. 1914. Machy. (N. Y.), v 21, p 114-18
Describes various methods of winding and coiling conical, barrel and irregular shaped springs, with illustrations of machines used.

Hartford, E. V.
Why spring suspensions are a compromise: Why shock absorbers are a necessity. 1914. Horseless Age, v 34, p 489-90
Shows the disadvantage of too stiff springs and too flexible springs, the effect of inter-leaf friction; legitimate field for leaf springs and the advantages of helical spring devices.

Heldt, P. M.
Some points on modern practice in chassis springs. 1914. Horseless Age, v 34, p 294-6
Formulas for periodicity, deflection and load of three quarter elliptic springs, and the effect of clips.

Krarup, M. C.
The improvement of spring suspension. 1914-15. Automobile, v 31, p 987-8, 993, 1068-71, 1274-6, v 32, p 26-7, 196-9, 280-83, 321-3, 361, 389, 462-4, 590-3, 764-7, 783, 854-6, 901-3
An examination of forces and movements to which motor vehicles are subject on the road and the cushioning devices in use or required, in order to express the requirements in definite mechanical terms.

Kreissig, E.
Unstable and stable suspension of axle springs on street cars (Die labile und stabile Aufhängung der Achsbuchsfedern bei Strassenbahnwagern). 1914. Elektrische Kraftbetriebe und Bahnen, v 12, p 193-7

Gives calculations for design of street car springs.

Landau, D.
Influences affecting the fundamental deflection of leaf springs. 1914. Am. Soc. Mech. Engrs. — Jl., v 36, p 0114-15; Soc. Automobile Engrs. — Bul., 1914, p 428-64; Soc. Automobile Engrs. — Trans., 1914, pt 1, p 295-331
A treatise on the effects of heat treatment on the value of the elastic modulus; the efficiency of inclined shackles, banding, double sweep, full elliptic springs and secondary springs.

Lund, J.
Design of flat volute springs. 1914. Am. Mach., v 41, p 365-6
Gives formulas for determining, by test, the actual capacity of such springs.

Mainwaring, W. D.
Failures in coil spring manufacture. 1914. Iron Trade Rev., v 55, p 820
Gives chemical analyses and micrographs showing structure of steel springs that failed.

Mestre, H. C.
Note on a suspension system with varying flexibility (Note sur un système de suspension à flexibilité variable). 1914. Revue générale des Chemins de Fer et des Tramways, v 37, pt 1, p 79-81
Describes combination method using helical and leaf springs on locomotives.

North, O. D.
The springing question. 1914. Autocar, v 32, p 735-8
Deals with the various forms of springs, showing how supplemental springing may be useful. An adjustable suspension is required to compensate for the variations of loading.

Peddle, J. B.
Charts for the strength and deflection of flat spiral springs. 1914. Am. Mach., v 41, p 641-3
Examples given of method employed in putting formulas into practice.

Summers, G. F.
Proportions of music-wire springs. 1914. Am. Mach., v 40, p 546-8
Tabulated data on requirements followed by Brown and Sharp and Washburn and Moen, for music-wire springs.

Taylor, C. S.
Cantilever really an inverted elliptic. 1914. Automobile, v 30, p 914
Discusses the advantages of the cantilever spring and shows that this type is really the quarter-elliptic type.

Thomas, J. M.
Spring formulae. 1914. Horseless Age, v 34, p 684
The deduction of the general formulas for floating cantilever springs.

Utz, J. G.
Care of truck springs. 1914. Automobile, v 31, p 1122-3
Discusses loading problems, the effect of over-speeding; worn springs are said to be unfit for resetting.

1915

Anonymous 13.
Distribution of forces between cushioned and uncushioned components of sharp shocks. 1915. Automobile, v 32, p 722, 729
A mathematical study of improvements to be made in spring systems.

Anonymous 16.
Variable resistance helical spring gear. 1915. Engineering, v 99, p 456-8
Describes method of obtaining increased resistance with increased load on a helical spring. The device consists of a pair of cylindrically coiled steel springs separated by a pair of flanged ferrules.

Anonymous 23.
Adjustable fulcrum for cantilever springs. 1915. Autobobile, v 34, p 978-80
Discusses the North system, its theory and practical solution for springs of variable flexibility.

Anonymous 46.
Spring forming and hardening machine. 1915. Iron Age, v 95, p 1164-5
Description and photos of machines used at the Harvey Spring Co. for forming spring leaves and for quenching them in oil.

Anonymous 58.
Testing spring suspension and dampers. 1915. Automobile, v 33, p 1152-3
By use of the apparatus illustrated, it is shown that friction between leaves represents only one-fourth to one-third of the total damping effect produced by various resistance during spring oscillation.

Anonymous 68.
Adjustable cantilever suspension. 1915. Autocar, v 35, p 571-2
Describes the details of the device for adjusting leaf springs for light and heavy loads.

Anonymous 69.
Average spring types show changes. 1915. Automobile, v 33, p 1181.

The cantilever spring is now an established type. Of the American cars 28 per cent have cantilever, 42 per cent three quarter elliptic, 15 per cent semi-elliptic and 6 per cent platform.

Anonymous 70.
Compensated cantilever eliminates roll. 1915. Automobile, v 32, p 186-8
Discusses new springing system for automobiles adopted by larger European manufacturers. Considers the periodicity of springs.

Anonymous 71.
Compensated cantilever spring. 1915. Autocar, v 34, p 59-64
Gives details of Wolseley system in which two cantilever springs are fixed at their centers to a common cross bar, free to rock in the car frame.

Anonymous 72.
Compensated cantilever springs. 1915. Horseless Age, v 35, p 218-19
Illustrates the Wolseley compensated cantilever system, and curve obtained during its use.

Anonymous 73.
Finding spring pressures for tangential cams. 1915. Horseless Age, v 36, p 539
A chart giving minimum pressure which the spring must exert when the valve is lifted, with directions for use.

Anonymous 74.
New system of spring suspension for motor cars. 1915. Engineer (Lond.), v 119, p 142
Describes a new type of compensated cantilever suspension for the rear axle, placed on the market by Wolseley Motors Ltd.

Anonymous 75.
Novel and contrasting rear spring suspensions. 1915. Automobile, v 33, p 1203
Illustrates the Moline-Knight, Marmon, National cantilever, King cantilever, and Cadillac platform spring suspensions.

Anonymous 113.
Absorber permits limited free motion. 1915. Automobile, v 33, p 802
A device utilizing a ratchet and pawl to introduce resistance to violent action of the springs.

Anonymous 128.
Compensated spring suspension, action of the system and advantages. March 1915. Soc. Automobile Engrs. -Bul., p 385-97
Description of an improved system of spring suspension.

Chiles, G. S.
Characteristics of plate springs. 1915. Ry. Age Gaz. (Mech. ed.), v 89, p 161-3, 219-22, 340-3, 392-5
Design of locomotive springs; the effect of friction; relation of service to test deflections; detecting permanent set; influence of variables in material and construction, upon the action of springs; formulas composed; load-deflection curves.

Clayden, A. L.
Science in spring manufacture. 1915. Automobile, v 32, p 835-40
Describes the new methods of manufacture at the Perfect Spring Co. plant. Eliminating old inaccurate methods by scientific control of all operations. Laboratory testing assures uniformity.

Gleason, C. H.
Spring design. 1915. Soc. Automotive Engrs. — Trans., v 10, pt 2, p 233-44. Abstract, Horseless Age, v 35, p 798
Discusses the efficiency of half-elliptic springs, and the best placing for springs on front and rear of automobiles.

Golden, A.
Relative deflections of semi-elliptic and floating cantilever springs. 1915. Horseless Age, v 35, p 266-7
Formula given for the calculation of deflection in semi-elliptic and floating cantilever springs.

Heldt, P. M.
Horseless Age engineering charts. 1915. Horseless Age, v 36, p 496-7
A chart is given for determining the spring pressure required for a motor of any speed, having reciprocating parts of any size.

Hermann, H.
Spring oscillations with special consideration of railway car construction (Federschwingungen mit besonderer Berücksichtigung des Eisenbahnwagenbaues). 1915-1916. Glasers Annalen, v 77, p 121-8, 142-9, 161-7, 210-16, 226-32, v 78, p 19-22
Mathematical examination of springs oscillation especially as applied to railroad cars.

Landau, D., and Golden, A.
The partial and total deflections of leaf springs en masse. 1915. Horseless Age, v 35, p 104-7, 153-4, 213-15, 250-2, 278-81, 316-18, 383-6, 416-18, 447-9
Quarter and semi-elliptic springs and formulas derived for their practical calculations.
Floating cantilever spring and misconceptions concerning it.

Analysis of floating cantilever type of spring, with formulas for reactions, and comparison with an equally dimensioned half elliptic spring.

Morrison, E. R.
Wire springs. 1915. Machy. (N. Y.), v 21, p 558-60
Data for determining the properties of wire springs, using the "spring index" formula. A table is given for determining the proper weight per inch of wire and capacity of coil, using two simple formulas.

Pastoriza, H.
Simple machine for comparing spring action. 1915. Automobile, v 33, p 707-8
Shows curves of pitch and bounce obtained from three cars, using the simple recording device described.

Utz, J. G.
Cantilever springs. 1915. Soc. Automobile Engrs. —Trans., v 10, pt 1, p 172-95
A comparison of cantilever springs with semi-and three-quarter springs. Mathematical proof of advantages of cantilever spring, such as; decreased weight, increased pendulum length, decreased inertia effect, increased dumping, decreased fibre stress, increased dynamic life.

Wemp, E. W.
A compensating spring suspension. 1915. Soc. Automobile Engrs. — Trans., v 10, pt 1, p 269-83
A mathematical treatment of the distribution of stresses in the Wemp compensating spring suspension, which consists of tie rod connections between the front and rear springs.

Zilen, V. W.
Design of steel passenger equipment. 1915. Ry. Age Gaz. (Mech. ed.), v 89, p 459-61, 515-16
The design of elliptical springs using Realeaux's formula.

1916

Akimoff, N. W.
Free oscillations of springs. 1916. Am. Mach., v 45, p 318
Deals briefly with a short-cut method of calculation of flat or coil springs.

Anonymous 24.
Variable springing. 1916. Sci. Am., v 114, p 106
Illustrates the method whereby leaves of springs are automatically lubricated.

Anonymous 31.
North adjustable cantilever springing. 1916. Automobile Engr., v 6, p 130-3
Formulas of the north suspension and diagram of the relationship of the fulcrum position to deflection. Photographs and sketches showing the adjustable features of the suspension.

Anonymous 47.
Coiler machines for springs. 1916. Engineering, v 101, p 586
Illustrates and describes a large cold coiler, weighing 7 tons and able to handle 5/8 in.; oil-tempered wire, coiling and automatically cutting at a speed of 50 ft. per min.

Anonymous 76.
Improving the suspension. 1916. Automobile, v 34, p 144-5
Illustrates a number of supplementary springs used to improve riding comfort.

Anonymous 77.
Springs without shackles possible. 1916. Automobile, v 34, p 766
Experiments made by the Sheldon Axle and Spring Co. to eliminate shackle have been started.

Anonymous 114.
Jones pneumatic spring. 1916. Automobile, v 34, p 197
The description of a pneumatic spring for use with solid tire vehicles. An air cushion is placed between the axle and frame.

Church, H. D.
Refinements in truck design. 1916. Soc. Automotive Engrs. — Trans., v 11, pt 2, p 324-35
Pages 330-2 discuss spring shackles and pins for trucks.

Clayden, A. L.
No magic in spring design. 1916. Automobile, v 35, p 393-6
Discusses the effect of spring type, advantages of long springs, effect of flatness and camber, and effect of number of leaves.

Dyke, H. H.
Faults in front spring suspension. 1916. Automobile, v 34, p 550-1
An analysis of front end of chassis, fundamental faults in conventional design and causes of wobble. Necessity of new type of construction is apparent.

Getting correct front spring action. 1916. Automobile, v 35, p 236-8
Illustrations showing the changes necessary in the mounting of front springs so as to have the shackle and the steering link move in the same

arc, thus eliminating front wheel wobble and interference of steering, due to road shocks.

Halsey, F. A.
Handbook for machine designers, shop men and draftsmen. 1916. Published by McGraw-Hill, N. Y., 550 p
P 201: formulas for the strength and deflection of elliptic and semi-elliptic springs; p 203: table of formulas for all types of flat springs; p 204-5: charts for rapid determination of carrying capacity and deflection of springs; p 208: materials for springs.

Helweg, S.
High power spring motor. 1916. Machy. (N. Y.), v 22, p 687-8
Discusses the application of a spring motor for driving a sewing machine or a phonograph.

Hoare, A.
Graphical particulars for spiral springs. 1916. Inst. Mar. Engrs., v 21, p 163-4
Formulas and charts for determining the size of steel wire, number of coils, safety loading on springs for marine work.

Kent, W.
Mechanical engineers pocket book. 1916. Published by John Wiley and Sons, N. Y., 1477 p
Pages 417-24 give formulas for determining the elasticity, carrying capacity and deflection in helical springs.

Krarup, M. C.
Results from a special suspension developed for brewery trucks and applicable to automobiles. 1916. Automobile, 34, p 493-7
Increases load capacity gained by larger flexibility and range of action. Stability secured by coupling auxiliary coil spring for one wheel with that for its mate. Data from an exceptional installation that has been tried for several years.
Self-tensing springs for varying loads compared with adjustable. 1916. Automobile, v 34, p 1075-8
Comparison of the "North" adjustable fulcrum system with automatic adjusting systems. The advantage is with a minimum load spring of high flexibility combined with a damper or rebound check, which is self-adjusting to the load variations.

Lake, E. F.
Manufacture of automobile cushion springs. 1916. Machy. (N. Y.), v 23, p 225-8
Describes means and methods of forming, conveying, and treating of wire springs in the Detroit Wire Spring Co's plant.

Automobile cushion springs. 1916. Machy. (N. Y.), v 22, p 1071-6
Describes the equipment and methods in use at the Jackson Cushion Spring Co's plant, for manufacture and japanning of all types of coil, seat springs.

How upholstery springs are made. 1916. Horseless Age, v 37, p 421-3
Describes the manufacture of a number of different coil springs for automobile seats.

Liebowitz, B.
Dynamics of vehicle suspension. 1916. Soc. Automobile Engrs. -- Trans., v 11, pt 2, p 186-222
Mathematical treatment of the effect of road obstacles on spring suspensions, the effect of the ratio between sprung and unsprung weights, of speed, flexibility of the spring, friction, and synchronism. Tables and diagrams show values computed.

Moore, C. R.
Design and characteristics of four torsional springs. 1916. Am. Mach., v 44, p 327-30
Four torsion, single flat-blade, double flat-blade, helical and "squirrel cage" springs were made and tested.

Myers, J. S.
Helical springs under centrifugal action. 1916. Machy. (N. Y.), v 22 —400-3
The device illustrated is used to analyze the effect of centrifugal force on the action of the mechanism. Using the formula calculated for measuring this force, an example is given of a typical design taking this factor into account.

North, O. D.
North adjustable cantilever spring. 1916. Automobile, v 35, p 157
Answers criticisms of his mathematical deductions by Krarup. Every spring made with these calculations does not vary 5 per cent.

Society of Automotive Engineers
Spring formulas. 1916. Soc. Automobile Engrs. — Data Sheets, v 2, p 12-12a
Formulas for semi and full elliptic springs.

Squire, C. E.
Springs. 1916. Mech. Engr. (Lond.), v 38, p 415-17, 448-50
Principal kinds, history, manufacture, testing, etc., characteristics of spring steel.

Wendle, G. E.
Spring attachment as shackle bolt rattle eliminator. 1916. Automobile,

v 35, p 719
Illustrates forms of this spring attachment.

1917

Akimoff, N. W.

Remarks on dynamics of the automobile. 1917. Soc. Automotive Engrs. — Trans., v 12, pt 1, p 141-52; abstract in Am. Soc. Mech. Engrs. — Jl., v 39, p 178-9.
Discusses the fundamental principles of a theory of spring suspension, with brief consideration of the dynamics of spring damping, kinematic features of harmonic motion, energy consumption, and shock absorbers.

Spring suspension problems. 1917. Automobile, v 36, p 776-7
Formula for the period of oscillatory pitching motion. Recommendations for construction for road holding qualities.

Anonymous 56.

Manufacture of springs for automobiles. 1917. Iron Age, v 99, p 1202-3
Describes the testing of semi-finished and finished leaf springs in the Detroit Steel Products Co's plant.

Anonymous 78.

Coil springs to neutralize hollows. 1917. Automobile, v 36, p 1145
Illustrates the Crockett suspension which prevents movement of leaf springs in passing over holes in the road.

Anonymous 79.

Spring deflections recorded by photography. 1917. Automobile, v 36, p 959
Gives a photographic diagram of the action of springs and their effects on all parts of the car when striking an obstacle.

Anonymous 122.

New truck has air suspension. 1917. Automotive Industries v 37, p 827-8
Adjustable, pneumatic springs care for vibrations in load; pressure in four cylinders is equalized from central air tank.

Bacon, S. N.

Testing springs for military rifles. 1917. Machy. (N. Y.), v 23, p 969-71
Describes testing of springs to determine firing, vibrating and weight characteristics.

Brown, W. F.
Design of coil springs. 1917. Automotive Industries, v 37, p 918-19; abstract Am. Soc. Mech. Engrs. — Jl., v 39, p 1043-4; Automobile Engr., v 7, p 286
Describes method which simplifies and accelerates the calculation of coiled springs with special reference to valve springs for automobile engines.

Coulson, J.
Electrolytic pickling process and its effect on the physical properties of iron and steel. 1917. Am. Electrochem Soc. — Trans., v 32, p 237-43
Discusses the electrolytic pickling of steel springs.

Dixon, A. J.
Pipe hangers to eliminate vibrations. 1917. Power, v 46, p 837
Illustrates the use of helical springs for suspension of overhead steam pipes.

Fuller, T. S.
Prevention of brittleness in electroplated steel springs. 1917. Am. Electrochem. Soc. — Trans., v 32, p 247-55
A résumé of opinions of various experimenters as to the effect of nascent or atomic hydrogen liberated during the eletroplating of steel springs.

Heldt, P. M.
The gasoline automobile. 1917. Published by Heldt (Nyack, N. Y.), 3 vol.
Vol. 2, chapter 18, discusses springs, classification; spring material; theory and formulas for leaf springs; table of dimension for motor truck springs; width and thickness of leaves, flexibility; mathematical load comparisons of various types; mountings, center bolts, chips, perches, eyes, shackles, etc.

Heller, A.
Tire substitutes for motor cars (Ersatzbereifungen für personen-kraftwagen). 1917. Zeitschrift des Vereines deutscher Ingenieure, v 61, p 879-881
Describes and illustrates the application of a series of coil springs placed around the entire circumference of an automobile wheel, between the rubber tire and the spokes.

Hiscox, H. D.
Mechanical movements, powers and devices. 1917. Published by Henley (N. Y.), 402 p
See p 279 for illustrations of spring types and p 381 for spring motor on sewing machine.

Hunter, J. V.
Reworking electric railway truck springs. 1917. Am. Mach., v 47, p 885-91

Describes making of new bands for leaf springs, illustrates the leaf-forming machine, describes heat treatment and quenching, and upsetting.

Keys, W. C.
Spring design for easy riding. 1917. Soc. Automotive Engrs. — Jl., v 1, p 366-72; Soc. Automotive Engrs.—Trans., v 12, pt 2, p 454-74
A discussion of the proper qualities desired in a spring to give best riding qualities. A photographic arrangement is shown for recording jolts and body movement.

Kropidlowski, V. T.
Arbor for winding springs by hand. 1917. Ry. Rev., v 61, p 270
Illustrates the device for winding helical springs.

Lake, E. F.
Japanning cushion springs by the air drying process. 1917. Machy. (N. Y.), v 23, p 410-12
Discusses the heat-treating and coating of coil springs to prevent their rusting.

Landau, D., and Golden, A.
Determination of spring length. 1917. Horseless Age, v 39, p 1-2, Mar 15, Eng. Sect.; v 40, p 4-8, Apr. 1, Eng. Sect.: v 40, p 3-6, Apr. 15, Eng. Sect.; v 40, p 7-9, May 1, Eng. Sect.; v 40, p 6-9, May 15, Eng. Sect.; v 40, p 32-A—32-C and 32-G. June 1, Eng. Sect.

A series of articles dealing with empirical methods based on the substitution of one spring for another of the same or different type. A number of formulas are given for determining the length of all types of leaf springs.

Leutwiler, O. A.
Elements of machine design. 1917. Published by McGraw-Hill, N. Y., 589 p
Pages 136-46 discuss formulas for helical springs, concentric and special torsion helical springs, conical, semi-elliptic, and leaf springs; materials for springs.

Lucas, C. L.
Automobile springs. 1917. Machy. (N. Y.), v 24, p 38-40
Fig. 1 shows the full elliptic, semi-elliptic, three-quarter elliptic, cantilever and platform type of springs. Fig. 2 general arrangement of spring plates, clips, etc., in true and double sweep springs. Details of spring manufacture and method of testing are described.

Prestiss, F. L.
Unit method in operating plant. 1917. Iron Age, v 99, p 84-90
Description of the methods used in manufacture of automobile springs

at the Standard Parts Co. and committee plan of operation.

Price, H. W.
Helical springs in torsion. 1917. Am. Mach., v 47, p 668
Gives a formula for computing helical springs to meet torsional requirements.

Thompson, M. DeK., and Richardson, C. N.
Investigation of the brittleness produced in steel springs by electroplating. 1917. Met. and Chem. Eng., v 16, p 83-4
The steel wires used in these experiments were several sizes of Edgar T. Ward and Sons' black tempered spring wire and piano wire. Results of tests given.

1918

Anonymous 80.
New system of truck springing. 1918. Automotive Industries, v 38, p 731
The torque arm has been retained and is connected by a ball joint to the rear axle housing and does not restrain the axle except the angular motion. The two radius rods are retained against volute springs.

Anonymous 81.
Trott spring suspension absorbs horizontal shocks. 1918. Automotive Industries, v 38, p 496-7
Description of the Trott suspension system, consisting of an additional quarter elliptic spring acting as a shock absorber. The additional spring is connected to the main spring through a lever supported on the frame.

Anonymous 115.
Shock absorbers for automobiles and ambulances. 1918. Automotive Industries, v 38, p 684, 693
Describes a device for checking recoil and modifying the action of chassis springs.

Bradley, F. W.
Haudaille brings out adjustable car suspension. 1918. Automotive Industries, v 39, p 1004-5
By having slotted eyes at the end of the springs the tension can be changed to suit any loading condition. This is accomplished by a hand lever. It is not practicable when the drive is through the rear suspension.

Brayton, M. M.
Charts for the design of helical springs. 1918. Am. Mach., v 48, p 1007-11; abstract Am. Soc. Mech. Engrs. — Jl., v 40, p 724
Gives practical charts used in designing springs, which eliminate lengthy mathematical calculations.

Edgerton, C. T.
Helical and elliptical springs. 1918. Chem. and Met. Eng., v 19, p 762-7
Discussion of the manufacture of elliptical and coil springs, types of steel alloys used, method of testing, formulas of calculating loads, deflections and torsion.

Fleckenstein, C. T., and Watts, O. P.
Brittleness produced in steel springs by electroplating. 1918. Am. Electrochem. Soc. — Trans., v 33, p 169-72
Tests were made on watch springs to determine whether the brittleness induced in steel by use as cathode in strong cyanide electrolyte is due to the presence of free cyanide or to electrolytically generated hydrogen. The conclusion of the tests is that the latter is the cause of brittleness.

Goldberger, E.
Mechanics of tractor spring mounting. 1918. Automotive Industries, v 38, p 542-5
An analysis of the effect produced in springs when tractors of different types pass over rigid obstacles.

Hendrickson, N. E.
Manufacture, heat treatment and physical tests of automobile springs. 1918. Steel Treating Res. Soc. — Proc., v 1, p 39-44.
Description of the methods used at the Mather Spring Co's plant.

Horak, G. J.
Device for winding springs. 1918. Machy. (N. Y.), v 24, p 606
Illustrates a simple device used in winding brass or phosphor-bronze, helical springs.

Kennedy, H. H.
Laminated steel spring proportions. 1918. Am. Mach., v 48, p 182-3
The easy riding qualities of laminated springs are due in a great measure to the relatively great length that can be used, A long spring rides easier than a short one and the work performed is proportional to the volume of steel. The article explains why the discomforts of rebound are due to other proportions than length.

Lake, A. H.
Helical spring calculation. 1918. Ry. Mech. Engr., v 92, p 101-2
Shows correct and incorrect taper for coils, with formula for calculating taper.

Landau, D., and Parr, P. H.
A new theory of plate springs. 1918. Jl. Franklin Inst., v 185,

p 481-507; v 186, p 699-721; v 187, p 65-97, 199-213
The fundamental assumption is that any leaf of a spring except the short leaf may be considered as a beam, encastre at one end, loaded at the other, and having a floxible support somewhere between the point of encastrement and that of application of the load. From this assumption formulas are deduced for stresses and deflections in the leaves of a spring.

Landis, M. H.
Shock absorbers for easy riding. 1918. Soc. Automotive Engrs. — Jl., v 2, p 424-38. Also Soc. Automotive Engrs. — Trans., v 13, pt 1, p 474-510
Illustrates some helical springs and air-spring shock absorbers.

Long, J. K.
Spring heating furnace. 1918. Am. Mach., v 48, p 244-5
Furnace illustrated for heating and tempering leaf springs.

Page, V. W.
Modern gasoline automobile. 1918. Published by Henley, N. Y., 1011 p
Pages 718-9 discuss the design of leaf springs without shackles; loads for elliptic and semi-elliptic springs.

Paul, F. M.
The springs of the car. 1918. Am. Blacksmith, v 17, p 168; 255-6; 280; 298-9
A general discussion of alloy steels for springs. Action of springs in absorption of energy, effect of thickness and length, types of springs.

Reeves, D. H.
Helical springs computations. 1918. Machy. (N. Y.), v 24, p 430-5
Gives charts for determining dimensions and properties of helical springs in tension and compression.

Schell, C. A.
Universal joints as shock reducers. 1918. Automotive Industries, v 39, p 1015
Illustrates a flexible universal joint consisting of the Hardy laminated disks made from 60 per cent fabric and 40 per cent rubber.

Schwarz, C. P.
Leaf springs, their capacity for dissipation of energy. 1918. Automobile Engr., v 8, p 141-2; abstract Am. Soc. Mech. Engrs. — Jl., v 40, p 591-2
The mathematical examination of the capacity for dissipation of energy when subject to shocks. The formulas derived show that the dissipation decreases with length of master loaf; if, however, all the leaves

are of the same length, the dissipation is doubled. Developments should progress to thin leaf springs and springs with inserts.

Seemann, R.
Calculation of cylindrical, helical springs (Berechnun zylindricher Schraubenfedern unter Verwendung von Schaulinien). 1918. Dinglers Polytechnisches Jl., v 333, p 91-6, 99-101
Gives charts and formulas for designing helical springs.

Smith, A. W., and Marx, C. H.
Machine design. 1915. Published by John Wiley and Sons, N. Y., 483 p
Definitions and illustrations of spring types, p 429-35.

Society of Automotive Engineers
U. S. A. ambulance body and trailers. 1918. Soc. Automotive Engrs. — Trans., v 13, pt 2, p 97-9
Page 98 gives the dimensions and types of springs. Rear springs: 54 x 2-1/2 in. with 16 leaves. Flexibility 275 lb. per inch at 1350 lb. load. Front springs: 38 x 2-1/4 in. with 9 leaves. Axle center to rear eye 20 in. to front eye 18 in. Flexibility 515 lb. per inch at load of 900 lb. Half elliptic, silicomanganese, graphite filled with heavy recoil check, is the standard type specified.

Spreen, C. C.
Drafting room specifications for compression springs. 1918. Machy. (N. Y.), v 24, p 1034
Eleven factors are covered in these specifications.

1919

Andrade, J.
New method for the experimental study of flat spirals (Nouvelle méthode pour l'étude expérimentale des spiraux plats). 1919. Académie des Sciences — Comptes rendus, v 168, p 1268-70; Sci. Abstracts, v 32, pt A, p 500
Experimental study of flat springs, considering in detail the various forces operating; the necessary arrangements are described for ensuring accurate regulation.

Minimum number of associated spirals (Sur le nombre minimum de spiraux associés). 1919. Académie des Sciences — Comptes rendus, v 168, p 139-41; in Science Abstracts, v 32, pt A, p 139
The object of this paper is to complete, from a practical standpoint, the work of the author on associated spirals, begun in 1911. Shows how with minimum number of spirals suitable adjustment may be made, whereby mechanical effects can be produced, either separately, or in combination.

Anonymous 18
Spring calculations; practical formulas. (Calcul des ressorts; formulas pratique.). 1919. Métallurgie, v 51, p 581-2
For helical springs.

Anonymous 37.
Testing automobile springs. 1919. Machy. (N. Y.), v 25, p 506
Gives a formula for computing the elastic limit of springs.

Anonymous 82.
New springing device. 1919. Autocar, v 43, p 244-5
In the suspension described the road shocks are met through the agency of variable leverage toggles which compress the springs.

Anonymous 83.
Ralls spring suspension for vehicles. 1919. Soc. Automotive Engrs. — Jl., v 5-429
Brief description of supplemental horizontal spiral springs to take up the horizontal components of road shocks.

Bock, H.
Thermodynamics of springs. 1919. Am. Soc. Mech. Engrs. — Jl., v 41, p 55
Method evolved after p.r. diagram of Gast theory for presenting thermal processes. Application of method to theory of springs makes it possible to calculate "elastic after effect" by means of entropy theorem.

Burkhardt, O. M.
Progressive and retrogressive designing. 1919. Soc. Automotive Engrs. — Jl., v 4, p 216-26
Computes the load on springs, front and rear, and the effect of torque rods and brakes.

Hemstreet, H. E.
Heat treating automobile springs and methods of manufacture. 1919. Am. Soc. Steel. Treating — Jl., v 2, p 160-7
Description of the methods used at the Sheldon Spring Co's plant.

Hendrickson, N. E.
Testing automobile springs. 1919. Machy. (N. Y.), v 25, p 506
Describes the means of approximately determining the elastic limit of spring steel by the deflection method.

Jacobs, F. B.
Spring making on a quantity basis. 1919. Iron Trade Rev., v 64, p 1343-8
Describes the manufacture of large and small steel, brass and bronze, coil springs.

Landau, D., and Parr, P. H.
Theory of plate springs. 1919. Soc. Automotive Engrs. — Jl., v 4, p 67-72: p 467-72
A paper in two parts giving a synopsis of the theory of plate springs with results obtained by the application of this theory to automobile springs. Mathematical analyses are made to show the effect of tapered leaf ends, nip stresses and leaf spring action in general.

Russell, J. W.
Spring making and repairing. 1919. Am. Drop Forger, v 5, p 440-1
Gives table showing temperatures used in heat treating plate, locomotive springs of different lengths.

Sanders, T. H.
Laminated springs. 1919. Automobile Engr., v 9, p 333-41, 385-90
The articles covers fully the principles underlying the design of laminated springs; mathematics of the spring, actual working formulas, chart of spring length and deflection for carbon and alloy steels, carbon and alloy spring steels, and their heat treatment.

Slade, A. J.
Supplemental springs for metal tired German trucks. 1919. Automotive Industries, v 41, p 409-12
Additional springs were added to the regular semi-elliptic springs. These are spiral springs at the shackle connection, or cantilever connection to the frame. Table gives spring dimensions and number of leaves of all the German trucks. While the supplemental springs were added where rubber tires were not available, it is believed that they will be used to increase the resiliency of rubber-tired trucks.

Soper, C. C.
Results of tests on torsion springs. 1919. Am. Mach., v 50, p 655-6
Gives load deflection diagram for free and fixed ends.

Springer, J. F.
Springs and spring making metals. 1919. Raw Matls., v 1, p 433-42
Describes all the important forms of commercial springs, with a list of articles in which springs are used to-day, followed by data on the resilience, tensile strength of springs made from steel of varying composition.

Sullivan, J. H.
Tables for calculating helical springs. 1919. Machy. (N. Y.), v 25, p 961-4
Tables show maximum loads in pounds and corresponding compressions per coil in inches of helical, round, bar springs.

1920

Anonymous 25.
Unusual spring features mark truck line. 1920. Automotive Industries, v 42, p 1014
A brief description of spring bolt lubrication and spring leaves alignment of the Service Motor Truck Co's. new design. The spring bolt shackle has an oil reservoir cast into it which holds the oil for a month's supply. The spring leaves are made cup-shaped at the center bolt so that it is impossible for the leaves to slide over each other. Sketches show the design.

Anonymous 48.
Heat treating springs electrically. 1920. Iron Trade Rev., v 67, p 714-15
Describes methods used by the Spring Perch Co., Bridgport, Conn.

Anonymous 49.
Spring scragging machines. 1920. Engineering, v 110, p 243-4
Illustrates the machine and its application to leaf, helical and volute springs.

Anonymous 84.
Road springs. 1920. Automobile Engr., v 10, p.1.
Cleat plates directly over the center bolt is recommended to prevent leaf breakage.

Anonymous 132.
Heat treatment of leaf springs in France. 1920. American Steel Treaters' Society. — Jl., v 2, p 214-15
Inspection of the spring shop of the Acieries d'Imphy à Imphy, Nievre, and also of the great Forges d'Allevard by the U. S. government official of the Motor Transport Reconstruction Park during the World War. Comparison between French and American practices.

Bourdon, M. W.
Correct anchorage of the cantilever spring. 1920. Automotive Industries, v 42, p 902-4
Sketches and description of European practice in cantilever spring suspension. Sliding supports and forked torque tubes shown. In England there is an increasing demand for supplemental springs to absorb the minor shocks.

Favary, E.
Springs and spring suspensions. 1920. Soc. Automotive Engrs. — Jl., v 6, p 49-55, discussion p 316-21. Soc. Automotive Engrs. — Trans., v 15, pt 1, p 143-76

A paper on the factors of riding qualities. Discusses vibrations, relation of sprung to unsprung weight, spring inertia, fundamentals of periodicity, advantages of auxiliary springs, effect of center gravity and length of wheelbase. Suggests method for future construction of suspension to satisfy theoretical requirements of proper spring action.

Galbrun.
Deformation of a helical spring when its ends are fixed (Déformation d'un ressort en helice dont les extremités sont encastrees). 1920. Académie des Sciences - Comptes rendus, v 171, p 386-9, 464-6
Formulas for computing deflections in helical springs whose ends are fixed to the body of the vehicle.

Hanneman, G. C.
Pointers on spring winding. 1920. Machy. (N. Y.), v 26, p 725
Shows that allowances must be made for shortening of a spring and increase in its diameter after it is taken from the machine.

Hatfield, W. H.
Most suitable steels for automobile parts. 1920. Instn. Automobile Engrs. - Proc., v 14, p 503-600
Composition of spring steels given on p 521-3.

Jenkinson, S. H.
Design of laminated springs. 1920. New Zealand Jl. Sci., v 3, p 16-25
The author states that the conclusion of Landau and Parr (Franklin Inst. Jl., v 105-7) was based on incomplete observations. Formulas are deduced which cover and correct those of Landau and Parr.

Judge, A. W.
Aircraft and automobile materials of construction. 1920-21. Published by Pitman, London. 2 vol
Volume 1, p 82, 124, 351-4, 380-4 gives results of tests on the properties of spring steels. Pages 229-31 describe spring testing machines.

Masury, A. F.
A study of road impact and spring and tire deflection. 1920. Soc. Automotive Engrs. - Jl., v 7, p. 96-102, Soc. Automotive Engrs. - Trans., v 15, pt 2, p 554-72.
A study of variation of tire and spring equipment on trucks, to show the effects of various factors in an actual road test. The data is given and the formula used. The impact of striking the road after bounding over an obstacle is proportional to the square of the speed and weight and inversely proportional to the resiliency of the spring and tires and the ratio between the sprung and unsprung weights.

Pennington, G. R. and Wellman, S. K.
The new army light artillery tractor. 1920. Soc. Automotive Engrs — Jl., v 7, p 321-5
Description of spring suspension, consisting of two crossed leaf springs on each side of the tractor

Puica, G.
Study of suspension of vehicles and buffers (Etude sur la suspension des véhicules et les amortisseurs). 1920. Vie Technique et Industrielle, v 2, pt 1, p 117-20
States that the Rolin buffer increases the relative friction of the suspension. Studies the influence of leaf spring friction. Gives formulas.

Richardson, L. W.
Flat spring bender. 1920. Machy. (N. Y.), v 26, p 659
Illustrates a device which forms a flat spring composed of eight bends.

Schneider, G.
Calculations of plate springs (Berechnung der Blattfedern). 1920. Organ für die Fortschritte des Eisenbahnwesens, v 57, p 247-9
Calculations and tables of railway springs, one table for bent springs which elongate under load, and another for straight springs which bend under load.

Stacy, T. F.
Steel compression springs of circular cross station. 1920. Am. Mach., v 53, p 581-2
Chart is developed for use in design of such springs; formulas for cylindrical compression springs.

Stenger, E. P.
Selective heat treatment of spring steel. 1920. Iron Age, v 106, p 1-3
Describes a method of furnace control which gave a uniform result for every melt, even though the raw materials varied in composition.

Strickland, F.
Defects in motor vehicles and their remedy. 1920. Engineering, v 109, p 782-5; v 10, pt. 33, p 202-4, 271-2, 463-4; 796, 855-6
A comparison of springs used on lorries with formula for approximate computations. The proper design should be a static stress under load not exceeding 45,000 lb., a deflection under static load of at least 2 in. preferably 3 in., buffer stops to limit the deflection from fully loaded static position to such an extent that the total stress under full deflection does not exceed 90,000 lb.

Thomas, W. N.
Helical springs. 1920. Instn. Mech. Engrs. — Proc., 1920, pt 2, p 869-89
Discusses factors of importance in the design of these springs and gives formulas for their calculation.

1921

Allen, A. W.
Manufacture of coil springs. 1921. Machy. (London), v 19, p 85-9
Describes coiling machines for open-coil, barrel springs; press operations, eye forming, cutting, eyeing and bowing.

Anonymous 26.
Spring testing. 1921. Automobile Engr., v 11, p 142-4
Recent developments of the Amsler Testing Machine for the testing, bending, compression, and tension of leaf springs. Fatigue testing machines described.

Anonymous 32.
Formulas for spring design. 1921. Machy. (London), v 18, p 209-11
Formulas for the design of flat springs; and the determination of overload.

Anonymous 33.
Quarter elliptic springs. 1921. Automobile Engr., v 11, p 162
The castoring effects of quarter elliptic springs on front end and the effect on steering. Formulas for the deflection, castoring, and centrifugal wheel pressure are given.

Anonymous 38.
Manufacture of heavy-duty helical springs. 1921. Machy. (N. Y.), v 27, p 870
Manufacture of the steel, coiling and heat treating, determining physical properties and testing, are the points discussed.

Anonymous 50.
Furnaces for heat treatment of springs. 1921. Forging and Heat Treating, v 7, p 568-72
Discusses the various furnaces, heat treatments and annealing methods used for vehicular springs.

Anonymous 85.
Acme spring suspension. 1921. Autocar, v 47, p 427-8
Illustrates the mounting of three sets of cantilever springs parallel with the length of the car on each side.

Anonymous 86.
Axle anchorage of cantilever and quarter elliptic springs. 1921. Automotive Industries, v 45, p 103
A description of the Bugatti anchorage. The thick end of the quarter elliptic spring is fixed on the rear end and the thin ends project forward. It is claimed that in this way the weight of the rear of the chassis acts on the driving axle so as to counter balance the driving torque.

Anonymous 87.
Helical spring suspension for motor vehicles. 1921. Automotive Industries, v 44, p 817
Illustrates the Baker R. and L. duplex, compensating suspension.

Anonymous 88.
Rear suspension. 1921. Automobile Engr., v 11, p 415-21
Illustrates a series of leaf, cantilever, quarter-elliptic, twin cantilever springs on automobiles.

Anonymous 89.
Suspension. 1921. Automobile Engr., v 11, p 41
For rear suspension, the quarter-elliptic spring is recommended, but not for front suspension due to its ability to interfere with the steering apparatus.

Anonymous 90.
Brouilhet system of automobile suspension (suspension des voitures automobiles, système Brouilhet). 1921. Génie Civil, v 79, p 495-6
Describes and illustrates a device for attaching rear springs, in order to give transverse equilibrium and improved riding qualities.

Anonymous 91.
Suspension shock absorber for automobiles. 1921. Sci. Am. Monthly, v 4, p 69-70
Describes the combination of helical spring and differential lever, which adjusts itself to light or heavy load.

Bourdon, M. W.
Novel type of suspension interests British car manufacturers. 1921. Automotive Industries, v 45, p 858-9
A new type of suspension (the Cowey) is being tried out by various makers. It consists of a long two leaf spring connecting the rear and front axles and held between rubber lined brackets at two points on the frame. It is claimed that the sympathetic deflection of the ends makes unusually easy riding.

Bowman, H. R.
Helical spring design. 1921. Machy. (N. Y.), v 27, p 789-90
Gives formulas used in the design of a helical, recoil spring for an American-made gun.

Broulhiet, M.
The problem of automobile suspensions (Le problème de la suspension des voitures automobiles). 1921. Revue de l'Industrie Minérale, v 1, pt 2, p 87-100
States that the problem of the good suspension of a vehcile is first of all a problem of anatomic equilibrium. Solves the problem by means of an apparatus called "contraccelerator" which operates parallel with the springs. Explains the composition of the apparatus and how it operates.

Chaullet, H.
Determination of practical formulas for the calculation of leaf springs (Détermination de formules pratiques pour le calcul des ressorts à lames). 1921. Arts et Métiers, v 1-2, p 145-9
Gives formulas for leaves of the same thickness and leaves of different thicknesses. Also gives formula for the arrangement of the leaves.

Franz, F.
Remedy for spring breakage. 1921. Automotive Industries, v 45, p 924-5
Majority of spring failures are clean breaks of the top leaf. This is probably because this part takes the driving and breaking forces in addition to the load. A thin top leaf has proven more efficient than those made the same thickness as the other leaves. A method is given to calculate the thickness of the upper leaf.

Guernsey, C. O.
Cushioning in motor truck design. 1921. Soc. Automotive Engrs. — Jl., v 9, p 143-50
Shows spring suspensions for motor trucks used to eliminate twisting of the chassis and to take up torque of the Hotchkiss drive.

Hemstreet, H. E.
Design and heat treatment of leaf springs. 1921. Forging and Heat Treating, v 7, p 240-2
Describes present day methods of cambering, heat treating, tempering, hardening and testing.

Hendrickson, N. E.
Automobile road springs. 1921. Automobile Engr., v 11, p 330-1
An analysis of the forces exerted on the spring clips and axle attachment. Precautions to be observed in the design of these parts.

Horine, M. C.
Spring shackle action. 1921. Automotive Industries, v 44, p 1331-2
The spring suspension is the weakest part of the motor truck. The design must provide for greater variances of loading. Spring shackles do not provide for lateral thrust. Developments are in progress for correction of these details of design.

Jacobi, E.
Formulas for spring design. 1921. Machy. (N. Y.), v 27, p 882-4
Shows the application of formulas for extension and compression spring designs.

Kennedy, D. F.
Modern automobile spring manufacturing. 1921. Iron Age, v 107, p 19-22
Process of manufacturing leaf springs at the Detroit Steel Products Co., showing chart of assembly procedure.

Landau, D.
Thin top leaves for springs. 1921. Automotive Industries, v 45, p 1231
Discusses the wearing qualities of the "Sheldon-Landau" springs.

Maydell, A.
Tables for the calculation of cylindrical helical springs (Tafeln zur Berechnung von zylindrischen Schraubenfedern). 1921. Dinglers Polytechnisches Journal, v 336, p 41-3
Gives charts and formulas for calculating the dimensions of helical springs.

McAllister, J.
Equalization of spring rigging. 1921. Ry. Mech. Engr., v 95, p 38-9
Illustrates the leaf spring arrangement used on the Pacific type of locomotive.

Napier, J. L.
Holding the road. 1921. Automobile Engr., v 11, p 266-72
A discussion of the fundamental principles affecting the interaction of wheels, springs and roads. A mathematical analysis of vibration due to road shock at various positions of the obstacle. The addition of supplemental springs is precisely the same as substituting the more flexible springs originally. Shock absorbers may have a tendency to produce skidding.

Parr, P. H.
Road spring manufacture. 1921. Automobile Engr., v 11, p 438-45
Describes the manufacture of plate and spiral springs.

Pearson, H. A.
Hydraulic spring testing machine. 1921. Machy. (N. Y.), v 27, p 448
Illustrates a device wherein the pressure applied to the spring is shown on a gage, while the deflection is indicated on a graduated scale.

Reissner, H.
Automobile shock absorbers (Bemerkungen zur Abfederung der Motorwagen). 1921. Motorwagen, v 17, p 339-43
A mathematical study of the design of shock absorbers.

Schipper, J. E.
Adjustable spring shackles take up wear and prevent rattle. 1921. Automotive Industries, v 45, p 361-2
Describes a coil spring so arranged that it takes up side play and thus prevents noise in worn spring shackles.

Automatic control employed in spring production. 1921. Automotive Industries, v 44, p 506-9
A description of the method of manufacture at the Detroit Steel Products Co. Accurate control of the steel and temperatures assures uniformity and high quality of springs. Photograph shows various operations.

Seelar, L. F.
Springs for easy riding cars. 1921. Elec. Ry. Jl., v 58, p 275-7
Ratio of dead to live load and maximum to average load are factors considered in the design of leaf springs.

Slocum, S. E.
A new principle of engine suspension. 1921. Soc. Automotive Engrs. — Jl., v 8 p 54-6
A special form of double telescoping spring is used in combination with coiled springs placed between the cradle and the chassis, to absorb vibration and still not respond to road shocks.

Spooner, T., and Kinnard, I. F.
Magnetic testing of springs. 1921. Am. Soc. Testing Matls. — Proc., v 21, p 883-90
Describes tests for flaws, for hysteresis data and magnetic properties of helical springs.

Stacy, T. F.
Nested steel compression springs. 1921. Am Mach., v 55, p 795-6
Chart for design of a 2-spring nest of springs.

Stenger, E. P., and B. H.
Effect of heat treatment of the fatigue strength of steel. 1921. Am. Soc. Steel. Treating — Trans., v 1, p 617-38

Gives tabulated results of physical tests on carbon spring steels quenched at temperatures of from 1300 to 1700 deg. fahr.

Wood, J. K.

A general method for spring design. 1921. Am. Mach., v 55, p 757-62
A new method of generalizing formulas for all types of springs; need for research on springs shown to be urgent; universal spring chart for calculating all types of flexural springs given; summary of factors effecting the values of the safe fiber stress and the modulus of elasticity.

Design of springs. 1921. Am. Mach., v 55, p 674-7
Derivation of formulas for built-up leaf springs, both free and constrained cantilevers, spiral springs, coil springs and flat buffer springs; the control of the "spring criterion" in designing springs.

Design of flat springs. 1921. Am. Mach., v 55, p 46-9
Derivation of formulas for flat multiple-leaf springs; calculation for work and resilience of free and constrained cantilever springs; the importance of the "spring criterion" in designing springs.

Design of helical springs. 1921. Am. Mach., v 54, p 628-32, 780-4, 854-7
A new point in the design of helical springs is disclosed; method is developed especially for small springs and gives chart for rapid calculation; "material index"; determination of torsional modulus; controlling spring criterion methods of making helical springs and investigation of spring material; fatigue, corrosion and electroplating.

1922

Anonymous 27.

Radical departure in suspension springs. 1922. Automotive Industries, v 47, p 921
Description and sketches of the new Kelly suspension. The springs are made up of flat plates, all of full length and without nip. The shape of the plate is a frustrated rhomboid. Under static load the spring is horizontal. There are spacers between each leaf.

Anonymous 51.

Grinding in the manufacture of leaf springs. 1922. Machy. (N. Y.), v 29, p 272-3
Removal of scale from individual leaves, chamfering edges of leaves and squaring of sides of the eyes are the operations now done on the grinding wheels.

Anonymous 92.

Gattie's spring system. 1922. Motor Transport (Lond.), v 35, p 336-7
Illustrates a suspension device for light and heavy motor vehicles.

Anonymous 93.

New chassis spring. 1922. Automotive Industries, v 46, p 886
Laher Auto Spring Co. produces a spring without center bolt hole. The side clips holding the leaves together are welded electrically to the leaves.

Anonymous 94.

New departure in vehicle spring design. 1922. Automotive Industries, v 46, p 173-4
Describes new spring suspension which eliminates shackles, reduces weight and gives better riding qualities. It consists of compound or double sweep leaves which take care of the increase of length under load. The effective length decreases under load. They are made in quarter, half or full elliptic; designed and made by Sheldon Axle and Spring Co.

Anonymous 95.

New suspension system. 1922. Automobile Engr., v 12, p 343-5
Describes and illustrates a system using horizontal coil springs.

Anonymous 96.

Road springs. 1922. Automobile Engr., v 12, p 385
Brief discussion on the effects of spring plate length, number of leaves, friction between leaves and attachment on life of springs.

Anonymous 97.

Spring suspension which secures greater flexibility. 1922. Automotive Industries, v 46, p 969
Brief description of the new Coleman suspension, which has an equalizing bar connection between the opposite wheels so as to balance the road shocks.

Anonymous 98.

Springing and comfort. 1922. Soc. Automotive Engrs. —Jl., Dec., v 11, p 553-4
An analysis of the mechanical action of an automobile on the passenger, taking into account motions of translation in the direction of the axis, vertical, transverse and rotary motions.

Anonymous 99.

Springs and suspensions. 1922. Automobile Engr., v 12, p 381-4
Illustrates several methods of attaching leaf springs to the chassis of cars.

Anonymous 100.
Stresses and wear in automobile tires. 1922. Soc. Automotive Engrs. — Jl., v 11, p 438-43
Translation and comments on an article by Otto Enoch, in Motorwagen, Sept. 10, 20 and 30, p 442, on interaction of tires and springs. Table of work done by spring and tire deflection. Formulas for work done by the spring and its deflection.

Anonymous 123.
Unusual spring design in New Indiana truck. 1922. Automotive Industries, v 47, p 368
Brief description of the spring suspension of the Indiana truck; a three quarter elliptic spring with a number of main leaves and without shackle is used.

Anonymous 124.
Reclaiming coil springs at McKees Rocks. 1922. Ry. Mech. Engr., v 96, p 656-7
Describes salvaging and repairing methods in the McKees Rocks blacksmith shop of the Pittsburgh and Lake Erie R. R.

Anonymous 125.
Volute journal box springs. 1922. Ry. Mech. Engr., v 96, p 561
Volute springs, on the six-wheel locomotive described, are arranged in groups of four for each box, the upper springs being very light and flexible.

Anonymous 131.
Making small springs. 1922. English Mechanic and Wld. of Sci., v 116, p 129
Practical notes on the making and heat treating of small helical and flat springs from steel, brass, bronze and German silver.

Armstrong, W. H.
Calculation of elliptic springs. 1922. Ry. Mech. Engr., v 96, p 438-40
Gives formulas and tables for the rapid determination of capacity and deflection of elliptic springs.

Bourdon, M. W.
European makers adopt quarter-elliptic springs for light cars. 1922. Automotive Industries, v 46, p 1153-7
Sketches are shown of the types of springs and suspensions of various car makers.

Chiles, G. S.
Spring assemblages for freight car trucks. 1922. Ry. Rev., v 70, p 844-50

Considers the increase of coil spring capacity, the arrangement of the springs, the influence on the design of the truck and bolster, and the resultant reduction in weight.

Coatalen, L.
Problem of spring suspension. 1922. Autocar, v 49, p 537-40
Notes on a simple method of improving springing action in light cars, to increase their road-holding qualities.

Crane, H. M.
New system of spring suspension for automobile vehicles. 1922. Soc. Automotive Engrs. — Jl., v 10, p 463-5; Automotive Industries, v 46, p 1421-2; Soc. Automotive Engrs. — Jl., p 237-40
A description and illustration of the new Crane suspension, semi-elliptic springs with a distance rod connected to the frame and to a point below the center of the wheel. It is claimed to give good spring action and aid the Hotchkiss drive.

Dorer, C. J.
Spring winding by hand. 1922. Am. Mach., v 57, p 810
Illustrates a device for producing a spring of even diameter and pitch.

Endsley, L. E.
Springs, draft gears and other problems in car design. 1922. Ry. Rev., v 70, p 591-4
Shorter spring travel is suggested as one of the solutions of a serious problem.

Favary, E.
Motor vehicle engineering, the chassis. 1922. Published by McGraw-Hill, N. Y., 456 p
Types of springs used; S. A. E. Standard; frame brackets, shackle bolts, spring clips; page 420, table of motor truck spring dimensions; spring deflection; cantilever spring; periodicity relation of sprung and unsprung weights. The book does not cover formulas for the design of springs; only covers the general relationship of requirements.

Forster, A. A.
Winding small helical springs. 1922. Machy. (N. Y.), v 28, p 954
Illustrates the vise in process of winding a small spring.

Lake, E. F.
Modern methods of making leaf springs. 1922. Iron Age, v 109, p 1269-74; 1343-6
Description of method of manufacture at the American Auroparts Co. New type of forming and hardening machine, continuous furnaces, assembly conveyors, testing jigs, etc.

Lanchester, G. H.
The defects commonly found in automobile suspension systems. 1922. Instn. Automobile Engrs. — Proc., v 16, pt 2, p 273-9
A discussion of the practical aspects of the suspension problem. The oscillation period should be about 90 per minute. Rolling is due to the center of gravity being too high. Harshness of springing due to inadequate deflection of springs, too short wheel base. Further discussion on the Hotchkiss drive and shock absorbers.

Mann, L. H.
Graphic representation of absorption of impact by springs. 1922. Machy. (N. Y.), v 28, p 554-5
Works out a formula for determining the energy absorbed by a spring under load, assuming that the body producing the deflection is moving with the center of gravity in line with the axis of the spring.

Merten, W. J.
Coiling and heat treating plant for helical springs. 1922. Am. Soc. Steel Treating — Trans., v 2, p 977-83
Discusses the design, selection and fabrication of material, coiling and heat treating.

Helical springs for flexible drives. 1922. Forging and Heat Treating, v 8, p 492-6, 567-73
Describes the design and development of open-wound springs for locomotive drives; new quenching devices.

Owen, G. A.
Treatise on weighing machines. 1922. Published by Griffin, London, 197 p
Forms for springs, theory of helical spring discussed, p 120-25.

Pilgram, D. M.
Note on the calculation of cylindrical, helical springs (Beitrag zur Berechnung zylindrischer Schraubenfedern). 1922. Dinglers Polytechnisches Journal, v 337, p 21-4
Gives formula for the calculation of helical springs.

Remington, A. A.
Design and functioning of laminated automobile suspension springs. 1922. Instn. Automobile Engrs. — Proc., v 16, pt 2, p 187-259; Automotive Industries, v 46, p 757-63, 807-12; Automobile Engr., May 1922, p 139-41
Takes up character of laminated springs as well as their theoretical and actual functioning. Gives mathematical treatment for deflections under varying conditions for various grades of steel, permissible stress, periodicity, torsion, friction and mounting. Effect of clips, blade ends and cross section of leaves are shown.

Motor car springs. 1922. Engineering, v 113, p 369-70
Abstract of a paper before Institution of Automobile Engineers, giving formulas for periodicity of springs.

Reynal, C.
Helical springs (Ressorts en helice cylindrique). 1922. Arts et Métiers, v 3, p 272-9
Gives formulas for the design of helical springs to be made of round, square, rectangular and elliptical wire.

Superposed leaf springs (Ressorts à lames superposées). 1922. Arts et Métiers, v 3, p 164-73; 210-12
Uses schemes to illustrate practical formulas. Studies the different influences which often cause the condemnation of calculations. Specifies the conditions for the construction and functioning. Studies special leaf springs, such as three quarter elliptical springs and springs with accentuated curvature.

Rockwell, W. S.
Methods of handling and heat treating springs. 1922. Can. Machy., v 27, p 21-5, Feb. 23
Description of methods of forming and heat treating springs. Types of furnaces used and arrangement.

St. Clair, B. W.
Springs for electrical instruments. 1922. Gen. Elec. Rev., v 25, p 562-4
Discusses fatigue in and physical structure of silver, bronze and steel for special springs.

Sanders, T. H.
Laminated springs for automobiles. 1922. Machy. (Lond.), v 20, p 125-8; 185-8; 249-53; 317-21; 345-8
Gives design details, British, Continental and American practice with comparative efficiency and cost table; comparative steel quality and tempers. British system of forging with diagram of routing of operations. Manufacturing rolled eye backs, hand fitting, treating and assembling. Machine spring fitting, American practice, routing schedules, furnace types, testing of springs. Manufacture and assembly of spring clips, clamp plates, axle pass, etc.

Schipper, J. E.
Four new methods in spring production. 1922. Automotive Industries, v 47, p 821-3
Description of the production methods employed at the American Auto Parts Co. plant, for making leaf springs.

Schlachter, W.
Automobile springs (Automobilwagenfedern). 1922. Motorwagen, v 25, p 395-8, 481-4
The formulas for laminated springs with mathematical analysis of the stresses in each component.

Tanaka, Y.
General theory of leaf springs (Allgemeine theorie der Blattfeder). 1922. Zeitschrift fur angewandte Mathematik, v 2, p 26-34
The mathematical treatment of the effects of and formulas for friction and initial pressure between the leaves and various shapes and curvatures of the springs.

Taub, A.
Practical helical spring calculation. 1922. Am. Mach., v 56, p 179-83
Outlines design essentials, analyzes troubles and calculates formulas.

Templin, E. W.
Highway transportation as it affects the automotive engineer. 1922. Soc. Automotive Engrs. — Jl., v 10, p 212-17; 226
On page 215 is described and illustrated the spring suspension of a 6-wheel truck used by the Goodyear Tire and Rubber Co.

Watt, J.
Automobile calculations. 1922. Instn. Automobile Engrs. — Proc., v 16, pt 2, p 333-419
Pages 343-6 give formulas for design of any spring; special dimensions are given for helical springs, taking into account acceleration, maximum load, mean radius of coil, number of coils and sectional diameter of wires.

1923

Acres, F. A. S.
Relative movements between axle and frame. 1923. Automobile Engr., v 13, p 9-10
A mathematical treatment of the relative movements of axle and frame, and the proper location of the brake steering and similar connections. Gives table of extensions and other values for use of formula.

American Railway Association. Mechanical Division.
Manual of standard and recommended practice. 1923. Published by the Association, New York
Pages 27-35 give specifications for springs and caps for freight car trucks. Section A, pages 199-204, give specifications for standard, helical springs, p 287-90 give recommended practice for chrome-molybdenum alloy steel for helical springs, p 193-8 recommended practice for eliptical springs.

Anonymous 28.
New spring design makes master leaf thinner than shorter plates. 1923. Automotive Industries, v 49, p 117-20
Conventional practice has been revised by David Landau of the Shelton Axle and Spring Co., in order to minimize nip, distribute stress uniformly and to avoid breakage.

Anonymous 29.
Notes on spring action. 1923. Soc. Automotive Engrs. — Jl., v 12, p 312-14
A study of the resultant vibrations due to bouncing and pitching, and the effects of axis of oscillation and weight distribution on the amplitude of the oscillations. The paper is an outline of the investigation to be made.

Anonymous 52.
Grinding the eyes of leaf springs. 1923. Machy. (N. Y.), v 30, p 119-20
By use of a no. 220, double-disk grinding machine of the Badger Tool Co. type, it is possible to grind 330 springs, at both ends, per hour.

Anonymous 101.
Carrying the body on ball bearings. 1923. Bus Transportation, v 2, p 345
Describes the Badger suspension to protect an automobile body from vibration and road shocks.

Anonymous 102.
Eliminating spring shackles. 1923. Sci. Am., v 128, p 121
Illustrates details of a rear suspension in which the two upper leaves are riveted to two metal liners fitting into a rubber block.

Anonymous 103.
New company makes rubber spring supports. 1923. Automotive Industries, v 49, p 539
Illustrates rubber blocks used to house front and rear springs, in place of steel shackles.

Anonymous 104.
Novel spring assembly. 1923. Sci. Am., v 129, p 260
Illustrates the use of a leaf spring across the front of the automboile and resting on the two side springs.

Anonymous 105.
Spring shackle improvements and substitutes. 1923. Automotive Industries, v 48, p 1402-3
Sketches showing new designs of spring suspensions and shackles for pleasure and truck service.

Anonymous 106.
Springs and suspensions at the Olympia show. 1923. Automobile Engr., v 13, p 374-7
A series of illustrations of methods used by various manufacturers in attaching automobile springs.

Anonymous 107.
Taking the roughness out of ruts. 1923. Sci. Am., v 129, p 411
Illustrates the arrangement of a rear, auxiliary relief spring composed of straight, laminated plates, with frictionless connection, and a quarter-elliptic front spring.

Anonymous 116.
Absorbing shocks. 1923. Autocar, v 51, p 505-560
Illustrates a device in which air under pressure is equalized by compensating dust; also a combination of three-friction surfaces controlled by spring star washers.

Anonymous 117.
Auxiliary springs take up shocks. 1923. Bus Transportation, v 2, p 536
Illustrates the Lomar shock absorber composed of a series of helical springs.

Anonymous 118.
Barduff rebound dampers. 1923. Autocar, v 51, p 218
Illustrates a device which permits free spring compression and checks recoil.

Anonymous 119.
De-bouncer for the car. 1923. Sci. Am., v 129, p 45
Illustrates the "checker" type of shock absorber using an adjustable, helical spring to press down the floating wedge.

Anonymous 120.
Promising shock absorber. 1923. Autocar, v 51, p 1138
Illustrates the Crompton absorber which gives adjustment in two directions.

Chase, H.
A critical study of modern automotive vehicle steering systems. 1923. Soc. Automotive Engrs.—Jl., v 13, p 205-6
Discussion by A. W. Werner on the mathematical relationship of the front spring design and the location of the steering connections.

Delanghe, G.
Broulhiet system of automobile suspension (Les suspensions d'automobiles—Systeme Broulhiet). 1923. Génie Civil, v 83, p 517-519

Gives calculations for theoretical suspension upon which the Broulhiet system is based and illustrates the action of the device when attached to an automobile.

Friquet, M.
Contribution to the study of automobile suspension (Contribution à l'étude de la suspension automobile). 1923. *Industrie des Tramways*, v 17, p 269-75
Studies the case of the Parisian omnibus and develops a simple theory for the calculation of a suspension at a variable flexibility. Develops formulas and makes calculations.

Hammond, E. K.
Manufacture of leaf springs. 1923. *Machy.* (*N. Y.*), v 29, p 769-71
Methods used in making automobile springs at the plant of the Perfection Spring Co.

Kimball, D. S., and Barr, J. H.
Elements of machine design. 1923. Published by John Wiley and Sons, N. Y., 440 p
Chapter 8, p 188-97; springs; material for springs; formulas for the design of single leaf and multiple leaf springs.

König, A.
New springs for automobiles (Neue Federung für Kraftwagen). 1923. *Motorwagen*, v 26, p 436-7, 464-6
Calculations of the spring deflections, effect of road obstructions on spring loading and illustrates some new type of leaf and helical springs and shows their method of attachment.

Landau, D.
An analysis of the tensions and flexures in leaf springs (Une analyse des tensions et flexions dans les ressorts à lames). 1923. *Technique Automobile et Aérienne*, v 14, p 33-45
States that there is a series of varied tensions in a spring of many leaves. Shows how the tensions and flexures are determined under any conditions of load and design. Gives formulas and tables. Considers a spring of great endurance.

Lemaire, P.
Suspension of vehicles (Quelques remarques sur la suspension des véhicules). 1923. *Technique Moderne*, v 15, p 241-3, p 265-73, p 300-7, p 327-31
A serial article dealing with the technical side of the vibration question, with formulas for determining the proportions of cantilever and semi-cantilever springs.

Lewton, R. E.
Some fatigue tests on spring steels. 1923. Am. Soc. Steel Treating — Trans., v 3, p 944-53
Data on the testing of leaf springs for automobiles; springs made from five types of steel were tested.

Litle, T. J., Jr.
Spring movement and vibration study of cars in action. 1923. Soc. Automotive Engrs. — Jl., v 13, p 445-9
Describes a device which combines a recording seismograph and a spring-action recorded, which were used in a series of tests to determine the action of a composite spring, the effect of inter-leaf friction and means of insulating springs against shock.

Masury, A. F.
Flat springs and Hotchkiss drive favored in bus design. 1923. Automotive Industries, v 49, p 163-5
Wide, thin leaves are considered preferable; the importance of fastening springs securely to axle and of using rubber blocks instead of metal shackles are discussed.

Mease, J. A., and Nordenholt, G. F.
Design of machine elements. 1923. Published by McGraw-Hill, N. Y., 232 p
Pages 213-20 for data on the design of helical springs, action of loads, allowable stresses, computation of dimensions and deflections.

Moore, H.
Spring bending device. 1923. Machy. (N. Y.), v 30, p 56
Illustrates a device used in making a U-shaped bend at the end of heated springs stock.

McCain, G. L.
Can more flexible front springs be successfully used? 1923. Automotive Industries, v 48, p 516-7
Advantages of more flexible front springs discussed with respect to difficulty in steering. Suggested method shown for improving front design.

Northway, R. E.
Spring suspensions and spring material. 1923. Soc. Automotive Engrs. — Jl., v 12, p 620-1
A discussion of types of springs; the essential fundamentals are:
A long spring is more flexible and easier riding than a short one, a spring should carry its normal load without much camber, that is with the main leaf practically straight, a maximum safe deflection is dependent on the thickness of the main leaf and the elastic limit of the material used, a spring made of thick leaves will be stiffer than one made of thin

leaves, although both carry the same load.

Peebles, H. G.
Manufacture and inspection of leaf springs. 1923. Am. Soc. Steel Treating — Trans., v 3, p 907-17
Manufacturing methods, furnaces, electrical control, mechanical quenching, machines and capacity tests on springs are described.

Prescott, J.
Mechanics of particles and rigid bodies. 1923. Published by Longmans, Green, Lond., 530 p
Pages 179-81 give formulas for calculating the elasticity of spiral springs.

Rockefeller, J. W.
Common fallacy in the calculation of extension springs. 1923. Machy. (N. Y.), v 29, p 558
Gives formulas for computing fibre stress in helical springs.

Rowell, H. S.
Principles of vehicle suspension. 1923. Instn. Automobile Engrs. — Proc., v 17, pt 2, p 455-519
Pages 465-92 discuss the simple spring system of two masses and the spring cart, road stress on springs and a vehicle's ability to hold the road. Pages 492-510 give formulas for vehicle springs of equal and unequal length of leaf.

Sanders, T. H.
Laminated springs. 1923. Published by Locomotive Publishing Co., Ltd., Lond., 450 p
Takes up the spring as a beam, development of unit deflection formula for all classes of laminated springs, including full-elliptic, semi-elliptic, quarter-elliptic, etc.; stress effect of centre fastenings; skin stresses; periodicity; resiliency; design; adds to spring calculations. Second half of the book takes up the manufacture of springs.

Sommerfeld, A.
Coupled oscillations of a helical spring. 1923. Optical Soc. Am. — Jl., v 7, p 529-35
Gives calculations and formulas resulting from the use of a mechanical contrivance for testing helical springs.

Sullivan, J. H.
Designing and making of wire springs. 1923. Iron Age, v 112, p 413-14
Describes dimensioning of valve springs, coiling, grinding ends, special steels and wires used.

Wines, W. E.
Strength of materials. 1923. Published by McGraw-Hill, N. Y., 233 p
Design of leaf, helical, and spiral springs with calculations of their elasticity, allowable loads and deflections, p 165-72.

Wolf, A. M.
Flexibility of front springs. 1923. Automotive Industries, v 48, p 681
Illustrates the Wolf transverse spring mounting for leaf springs.

Wood. J. K.
Oscillations and fatigue of springs. 1923. Am. Mach., v 58, p 67-70, 113-17, 155-8, 185-7
Treats first of the general case of vibration; derives formula with constant load, damped vibrations; formula for springs without load and values of constants for helical and flexural springs; internal friction, fatigue; static and kinetic indexes, hysteresis and overstrain; finally develops new formula covering the oscillations of springs in general.

1924

American Society for Testing Materials.
Standard specifications for elliptical steel springs for automobiles. 1924. Am. Soc. Test. Matls — Standards, p 134-9
Includes physical tests, loads, permanent set, flexibility, marking and inspection.

Standard specifications for carbon steel bars for railway springs. 1924. Am. Soc. Test. Matls. — Standards, p 110-11
Gives requirements for Grade A elliptical and helical springs and Grade B helical spring steel.

Standard specifications for carbon steel bars for railway springs with special silicon requirements. 1924. Am. Soc. Test. Matls. — Standards, p 112-13
Gives chemical composition, analyses, dimensions, finish and inspection requirements for open-hearth, crucible or electric furnace steel for elliptical and helical springs.

Standard specifications for carbon steel bars for vehicle and automobile springs. 1924. Am. Soc. Test. Matls. — Standards, p 114-15
Gives required chemical composition, dimensions, finish, marking and inspection specifications.

Standard specifications for silico-manganese steel bars for automobile and railway springs. 1924. Am. Soc. Test. Matls. — Standards, p 116-7
Includes material, manufacture, chemical composition, finish, marking and inspection of such springs.

Standard specifications for chrome-vanadium steel bars for automobile and railway springs. 1924. Am. Soc. Test. Matls. — Standards, p 118-19
Gives required chemical composition of steel, ladle analyses, permissible variations in open-hearth, crucible or electric-furnace-made material.

Standard specifications for helical steel springs for railways. 1924. Am. Soc. Test. Matls. — Standards, p 120-3
Includes chemical composition, workmanship, tests and inspection of springs.

Standard specifications for elliptical steel springs for railways. 1924. Am. Soc. Test. Matls. — Standards, p 127-31
Gives required chemical composition; compression tests and physical tests.

Anonymous 30.
Leaf spring definitions. 1924. Machy. (N. Y.), v 30, p 873
Load, unsprung weight, spring height, clearance, opening, length, flexibility and deflection are the terms defined.

Appel, H. J.
Winding a 300 ft. coil spring. 1924. Machy. (N. Y.), v 31, p 210
Illustrates a tool for winding coil springs in the lathe.

Beebee, J. H.
Heat treating small steel springs. 1924. Machy. (N. Y.), v 30, p 715-16
Recommends that small springs be immersed in a cup of sperm oil and heated until the oil catches fire; the oil is to be kept burning for six minutes and the cup allowed to cool slowly. A uniformly tempered spring is said to result.

Colbeck, E. W., and Hanson, D.
Hardening of silico-manganese steels. 1924. Iron and Steel Inst.—Jl., v 109, p 377-407
Reviews the work of other experimenters and gives results of elaborate tests on the heat-treatment and tempering of these steels; brief information is given on the use of these steels for small spring clips.

Colvin, F. H.
Making springs for motor vehicles. 1924. Am. Mach., v 60, p 509-11
Gives test methods for steel and best heat treatment; methods of forming eyes and bending curves of leaf springs; assembling and testing for deflection.

Frith, J., and Buckingham, F.
Vibration in engineering. 1924. Published by Macdonald and Evans (London), 118 p
See p 8-9, 32 and 61 for data on loaded helical and motor-car springs.

Fry, L. H.
Steels used in locomotives. 1924. Iron Age, v 114, p 1686-7; 1713
Springs are made from one per cent carbon steel with low manganese and silicon.

Kreissig, E.
Railroad buffer springs. 1924. Mach. Eng., v 46, p 221-2
Abstract of an article in "Verkehrstechnische Woche," Sept. 21, 1922, illustrating the circular spring developed by the Uerdingen Car shops.

Marks, L. S.
Mechanical engineers' handbook. 1924. Published by McGraw-Hill, N. Y., 1911 p
See p 401, 438-46, 1274 for data on the design, loads, materials, deflection of coiled, conical, elliptic, semi-elliptic, helical, leaf, laminated plate springs.

McElroy, J. J.
Air riding comfort. 1924. Soc. Automotive Engrs.—Jl., v 14, p 93-5
Reviews the history of air-spring development and analyzes the air-and-steel spring combination which has the ability to dissipate large shock loads.

Rockefeller, J. W.
Causes of spring failures. 1924. Machy. (N. Y.), v 30, p 965-6
Fatigue is one of the causes of failure discussed; methods for designing and redesigning springs are described.

Coil calculations. 1924. Machy. (N. Y.), v 30, p 874-5
A chart is shown for use in designing coil springs made from circular or square-section wire.

Design of helical springs. 1924. Machy. (N. Y.), v 31, p 205-6
Gives formula for computing deflection, as well as a table of third and fifth powers of spring-wire diameters.

Heat treatment of steel springs. 1924. Machy. (N. Y.), v 31, p 4-5
Concludes that the best practice is to quench carbon steel springs at 1450 deg. fahr. and draw at from 400 to 800 deg. fahr.

Manufacture of wire springs. 1924. Machy. (N. Y.), v 31, p 115
Methods of coiling, hooking and grinding ends and factory inspections are the points described.

Rosenhain, W.
What are the best mechanical tests for spring materials? 1924. Automotive Industries, v 50, p 278-80

Difficulties in determining strength, hardness, resistance to shock and other physical properties, are discussed.

Wikander, O. R.
Characteristics of the ring spring. 1924. Am. Mach., v 60, p 253-4
Material in these springs is stressed in pure tension and compression under load. Gives formulae for calculating theoretical pressure and results in railway work.

Wood, J. K.
Railway and automotive leaf springs. 1924. Am. Mach., v 61, p 719-21
Discusses principles of design, giving ideal plan veiws; formulae for leaf springs used in the automotive and railway industries.

Heat treatment of steel springs. 1924. Am. Mach., v 61, p 443-6
Gives general spring requirements, compositions of spring steels; coiling, forming and heat treatment of helical and leaf springs.

How to select a spring material. 1924. Am. Mach., v 60, p 49-52
Selection of spring material by means of the "material index"; tabulated data on density, material index, modulus of elasticity, endurance limit, elongation, area reduction and tensile strength of 17 alloys.

1925

American Society for Steel Treating.
Recommended practice for the heat treatment of plain carbon and alloy spring steel. 1925. Am. Soc. for Steel Treating — Trans., vol 7, p 696
Complete specification for the heat treatment of carbon and alloy spring steels. Principally for heavy gages from which medium and large coil and flat leaf springs are made.

Anonymous 39.
Spring steel from cold-rolled strip mills. 1925. Iron Age, v 115, p 399-402
Describes the heat treatment of spring steel at the plant of Wallace Barnes Co., Bristol, Conn.

Anonymous 57.
Spring testing machine for weighing and repetition tests. 1925. Engineering, v 119, p 317
Illustrates a device for testing spiral or flat, laminated types of springs.

Anonymous 133.
Spring-testing machine for weighing and repetition tests. Mar. 13, 1925. Engineering, v 119, p 317
20-ton machine for static or dynamic tests on springs of either spiral or flat laminated types.

Anonymous 134.
Flexible fabric spring shackles. Jan. 1925. Automobile Engr., v 15, p 17
Describes innovation of American origin known as Belflex-Hobson spring shackle.

Anonymous 135.
Pneumatic springs suspension of vehicles (La suspension des véhicules au moyen de ressorts á air). April 1925. Société d'Encouragement pour l'Industrie Nationale — Bul., v 124, p 345-352
Discusses metal springs and their drawbacks; pneumatic spring as ideal suspension; its various applications.

Ash, P. T.
Cutting airplane starter spring from solid metal. 1925. Am. Mach., v 62, p 538
Describes boring, turning, cutting threads and assembling double-helical spring used in clutch.

Autocar.
Checking spring rebound. Dec. 11, 1925. Autocar, v 55, p 1125-1126
Discusses new methods of improving suspension system; clipping rebound leaves to main leaves and its effect.

Belle, F. H.
The reclamation of railway springs. April 1925. Pac. Ry. Club — Proc., v 9, p 5, 7, 9, 11, 13, 15, 17, 19, 21, and 23, and (discussion) 23-24
Deals with heat treatment of springs; tempering and drawing operation; factors entering into successful heat treatment of elliptic and coil-type springs.

Birnbaum, W.
Investigations of bending oscillations of helical springs (Untersuchung der Biegungsschwingungen von Schraubenfedernh. Feb. 14, 1925. Zeitschrift für Flugtechnik und Motorluftschiffahrt, v 16, p 74-78.
Theory of transversal oscillation of helical springs of round-drawn or flat steel; results of experimental investigation of theory.

British Engineering Standards Association.
British standard schedule of steels for laminated springs for automobiles. March 1925. Brit. Eng. Standards Assn., 6 p

Covers chemical composition, dimensions, concavity, margins of manufacture, heat treatment and mechanical tests; table giving standard sections for steels for laminated springs; appendix giving approximate metric equivalents.

Brown, F. H.
Manufacture of commercial steel helical springs. Mid-Nov. 1925. Mech. Eng., v 47, p 1053-1055
Present status of art of manufacturing small- and medium-diameter springs; trade requirements; methods of manufacture; materials and their selection.

Edgerton, C. T.
Formulas for the design of helical springs of square or rectangular steel. Am. Soc. Mech. Engrs. — advance paper for mtg. Nov. 30-Dec. 4, 1925, 15 p
Author points out lack of formulas for calculating any except springs of square-bar steel, and then develops formulas for rectangular-bar steel based on work of St. Venant; for solution of these formulas he gives tabulated values for two variables which depend on ratio of bar's cross-sectional dimensions; appendix contains 4 examples in which application of formula is illustrated.

Hermann, H.
The extensible ribbon spring balance (Die gestreckte Banfederwage). Dec. 1925. Zeitschrift für Instrumentenkunde, v 45, p 573-76
Discusses merits of spring balances constructed of long steel ribbons, giving experimental illustration of most convenient form to adopt as protection against moving air and vibration distrubance; includes experimental data to show how far present accuracy attained confirms Coulomb law.

Jasper, T. M.
An outline for the application of fatigue and elastic results to metal spring design. Am. Soc. Mech. Engrs. — advance paper, for mtg. Nov. 30-Dec. 4, 1925. 11 p
Deals particularly with steel springs used for shock-absorbing purposes and for recuperating machinery; problem of design of springs may be divided into parts; first, question of static elastic and fatigue properties of material to be used in their construction, and second, shape of springs desired, together with distribution of stresses developed in their use for given deformation; results of investigation of static properties of steel carried out at Eng. Exp. Sta. of Univ. of Ill.

Kummer, H.
Testing steel wire for helical springs (Prüfung von Stahldrähten für Schraubenfedern). Dec. 17, 1925. Maschinenbau, v 4, p 1238-42
Comparative tests of iron and steel wires for finding properties giving

most definite difference in test, which lies above limits of proportionality and elasticity of spring; testing under continuous load, and by means of rapidly repeated elongation.

Mock, F. C.
Elementary dynamics of vehicle spring-suspension. July 1925. Soc. Automotive Engrs. — Jl., v 17, p 37-51 and 73
Analysis of single-spring action and conclusions; experimental observation of pitching action shows that rapidity and amplitude can be reduced by concentrating weight as much as possible over or near axles and increasing flexibility of front springs, sometimes with reduction of flexibility of rear springs; with more flexible front springs careful attention must be paid to steering linkage; recoil checks or shock absorbers should not oppose yield of spring on bumps or apply appreciable constant counterforce tending to tie axle to frame.

Murphy, A.
Making springs for motor vehicles. Nov. 12, 1925. Can. Machy.; v 34, p 15-17. See also Can. Foundryman, v 16, Nov. 1925, p 21-23
Discusses improvements in processes of manufacture which result in springs doing four or five times more work.

Rapson, T.
Laminated springs for automobiles. July 9, 1925. Machy. (Lond.), v 26, p 454
Results of tests made on thousands of springs supplied by a large number of manufacturers which were made to comply with specifications sent to them.

Rockefeller, J. W.
Characteristics of weighing springs. Mid-Nov. 1925. Mech. Eng., v 47, p 1056
Duties performed by spring of weighing machine; presents table showing increase of deflection under continued stress.

St. Clair, B. W.
Springs for electrical measuring instruments. Mid-Nov. 1925. Mech. Eng., v 47, p 1057-1058
Brief statement of general spring problem in so far as it relates to electrical instruments.

Sanders, T. H.
Springing of business vehicles. May 25, 1925. Motor Transport (Lond.), v 40, p 603-606.
A study of what goes to make a sound spring, what causes failures, and how they may best be avoided.

Schlacter, W.
Automobile springs (Automobilwagenfedern). Sept. 30, 1926. Motorwagen, v 29, p 637-642
Calculation of stress of front springs on cars with 4-wheel brakes.

Simmons-Boardman.
Locomotive cyclopedia of American practice. 1925. Published by Simmons-Boardman, N. Y., 1115 p
Pages 684-95 give specifications for elliptical, helical and leaf springs, including the heat treatment of the materials used.

Stewart, E. W.
Calculation and design of coiled springs. Aug. 1925. Soc. Automotive Engrs. — Jl., v 17, p 195-201
Torsion formulas same for springs and rods; springs of square material; extension or closely coiled springs; conical springs a cure for valve-spring breakage; torsion springs; range of stress; use of alloy steels; condition of surface and fatigue resistance; tolerances.

Sullivan, J. H.
Helical round bar steel springs. 1925. Mach. (N. Y.), v 31, data sheet following p 524
Gives diameters of wire and pitch of springs in inches.

Urquhart, J. W.
Heat treatment of automobile springs. Feb 13 and 27, 1925. Mech. World, v 77, p 101-102 and 136
Reviews various designs used, as form of spring affects design of furnace used for hardening as well as kind of equipment required for quenching and tempering; carbon-steel spring treatment; failures in carbon-steel springs; heating for quenching; operative quenching and tempering; vertical and horizontal quenching; tempering in oil or in salts.

Wood, J. K.
A code of design for mechanical springs. 1925. Am. Soc. Mech. Engrs. — Jl., v 47, p 713-18
Gives new derivation of general spring formulas developed by the author from numerous existing orthodox spring formulas, although derived independently, are identical in form; in view of general manner in which new derivation establishes logical arrangement of formulas author has drawn up and included in paper brief code of design for mechanical springs, which, it is hoped will serve as nucleus for more complete code in future.

Development in the design of automotive and railway leaf springs. 1925. Am. Mach., v 66, p 923-28
Types of failures that occur in leaf-spring practice; design defects; calculation of bands stresses; various plan views and development of new "nozzle" plan.

Mechanical springs. 1925. Am. Soc. Mech. Engrs. —Jl., v 47, p 258-260
After defining mechanical spring and its material author considers general cases of unit cube stretched by tensile force, of replacing cube by bar, and of applying load transversely; from these are established load-deflection rate formulas for flexure and torsion; formulas for safe maximum load, deflection and work are derived in general terms containing constants which may be determined for stress method, material, form, etc., adaptability of spring to requirements of mechanical design; states that general or collective method of treating mechanical springs should eliminate much of complexity and diversity of subject.

Railway and automotive springs. 1925. Am. Mach., v 62, p 187-190
Effect of leaf shape on bending, nipping and pulling described; importance of leaf-end design; limitations of manufacturing methods; balancing theory and practice.

Recent progress in coating steel springs to resist corrosion. 1925. Am. Mach., v 63, p 981-4
Application of non-corrosive metallic coatings to steel spring surfaces; effect of processes on spring characteristics; Madsen process and its promise for successful solution of problem.

Ziegler, R.
Calculating forces in bent helical springs (Beitrag zur Bestimmung der elastischen Formanderung und der Momente von zylindrischen Schraubenfedern mit zebogener Achse). June 4, 1925. Elektrotechnische Zeitschrift, v 46, p 839-42
Design of various apparatus calls for helical springs which are subjected to side thrust, or, in general, to thrusts not in direction of straight axis of spring; instead of relying upon mere empirical determination, author attempts to develop accurate theoretical approach to problem, basing his calculations on known equations of elastic form changes of bent rods; this highly mathematical paper contains number of practical examples to show use in concrete cases of formulas arrived at.

1926

American Machinist.
Design of helical springs for compression or extension. July 29, 1926. Am. Mach., v 65, p 215
Formulas for computing helical springs. Reference-book sheet.

Brombacher, W. G.
Phosphor-bronze helical springs from the standpoint of precision instruments. May 1926. Mech. Eng., v 48, p 488-491 and (discussion), 493 and 494

Results of tests made at Bureau of Standards to obtain knowledge useful in design of springs for precision instruments; sets forth characteristics of spring material, method of construction, apparatus in which springs were tested and procedure followed: results relate to stiffness, maximum fiber stress, hysteresis, after-effect, drift and buckling.

Günther, O.
Leaf-spring friction and lubrication (Ueber Blattfedereibung und-Schmierung). Sept. 30, 1926. Motorwagen, v 29, p 642-644
Discusses means of reducing spring reduction; qualities which spring lubricant should possess.

Hankins, G. A., and Ford, G. W.
The mechanical properties of four heat-treated spring steels. Aug. 1926. Iron and Steel Inst. — Advance Paper, n 6 for mtg., 26 p
Investigation undertaken at National Physical Laboratory as part of systematic investigation of mechanical properties of steels commonly used in spring manufacture.

Heldt, P. M.
Action of springs should not affect uniformity of transmission. April 29, 1926. Automotive Industries, v 54, p 730-731
With most types of drive, when springs of chassis deflect under road shock, light angular motion is set up in transmission, either at engine end, road end, or both; reference to new German commercial vehicle, Mannesmann-Mulag chassis, in which low frame height is obtained without resorting to expensive kick-up in frame; construction also reduces unsprung weight at rear and makes it possible to use propeller-shaft type of universal with only the least "universalling" action.

Hudson, F. C.
Tools for making air springs. Aug. 12, 1926. Am. Mach., v 65, p 283-284
Fixtures and methods that utilize standard machines as well as special devices for closing tube ends at single heat.

Jasper, T. M.
Factors of design of shock-absorbing and recuperating steel springs. May 1926. Mech. Eng., v 48, p 487-488 and (discussion) 491-492
Factors of design of metal springs used for shock-absorbing purposes and for recuperating machinery; problem of design of springs is divided into (1) static elastic and fatigue properties of material to be used in their construction, (2) shape of springs, together with distribution of stresses developed in their use for given deformation.

Kilian, A. von
Springs in modern work-holding devices (Die Feder in der neuzeitlichen Hochleistungs-spannvorrichtung). Nov. 15, 1926. Werkstattstechnik, v 20, p 669-71

Discusses convenient use of springs in various types of semi-automatic holding devices for milling cutters, presses, etc., and gives examples.

Latshaw, E.
Elliptic spring chart. July 1926. Machy. (N. Y.), v 32, p 888-889
Presents chart for use in designing elliptic springs.

Mock, F. C.
Relation of spring-suspension to riding-qualities. Sept. 1926. Soc. Automotive Engrs.—Jl., v 19, p 288-294
Analysis of spring action such as occurs on automobile driven on highway having bumps and depressions; requirements of spring-recoil checking devices, and experiments made with car on which different combinations of springs of various lengths and flexibilities were used and distribution of weight on frame was varied; limitations of shock absorber or recoil check design; results of experiments with car on road.

Reichardt, W.
Report of German Industrial Standards Committee (NDI Mitteilungen). April 15, 1926. Maschinenbau, v 5, p 385-388
Proposed standards for grooved spring steel, rolled; and for elliptic springs for locomotives, automobiles, trucks, etc.

Richards, W.
A small spring-winding device. April 15, 1926. Machy. (Lond.), v 28, p 78-79
Details of simple device developed by author.

Sabine, H.
Helical springs. May 20, 1926, Machy. (Lond.), v 38, p 177-178
Tests carried out on certain highly-loaded springs used in various apparatus designed by author.

Society of Automotive Engineers
Springs from automotive viewpoint. Dec. 1926. Soc. Automotive Engrs.—Jl., v 19, p 543-546
Experimental determinations of strosses in leaf springs; fatigue-test results not adequately interpreted; standardization and research accomplished dynamical problems of spring suspensions; elastic problems. Report prepared for Special Research Committee on Mechanical Springs.

Wood, J. K.
Design of helical springs for compression and extension. 1926. Am. Mach., v 65, p 215
Reference-book sheet giving formulas for computing helical springs in compression or extension.

Design of helical and spiral springs for torsion or flexure. 1926. Am. Mach., v 65, p 789.
Reference-book sheet giving formulas for computing helical and spiral springs for torsion or flexure.

The specification and control of mechanical springs. 1926. Am. Soc. Mech. Engrs. — Jl., v 48, p 808-14
Gives list of available specifications for heavy springs and tabulates features of these specifications; introduces idea of load-deflection sector to be used in place of load-deflect-curve and employs idea in framing sample specifications.

1927

Automobile

T. Franzen, S. P. Hess and C. A. Tea.
Some Mechanical Features of Suspension Leaf-Springs. Soc. Automotive Engrs. — Jl., vol. 21, no. 3, Sept. 1927, pp. 231-238, 21 figs. Special emphasis is given to some of principles that underlie design and to dynamic behavior of springs with particular reference to interleaf friction.

F. Meineke.
Springs (Das Federproblem). Motorwagen, vol. 30, no. 14, May 20, 1927, pp. 313-319, 18 figs. Examination of action of ordinary leaf springs shows danger of too large rebounds; this can be overcome by counter leaves; while counter leaves give strong springs and reduce oscillation to minimum number, they also give hard riding unless balloon tires are used; better solution is so-called rolling springs, which bear on shaped pads or on rollers at middle or at ends; by properly arranging these carrying organs a spring of equal softness throughout its range can be produced; three arrangements of such springs are described; best shock absorber for use with coil springs is hydraulic kind. See brief translated abstract in Automotive Abstracts, vol. 5, no. 7, July 20, 1927, p. 218.

Corrosion, Protection Against

Anonymous 136.
Protection of Steel Springs Against Corrosion. Mech. Wld., vol. 82, no. 2127, Oct. 7, 1927, p 269. Discusses various methods for protecting springs, including: (1) painting; (2) oil finishing; (3) coating by molten metal, chiefly by tin; (4) electroplating; (5) non-metallic coating produced by boiling in special chemical solution often sold under trade name.

Design.

J. S. Barker.
The Design of Small Springs. Am. Mach., vol. 66, no. 24, June 16, 1927, pp. 1018-1019. Presents table giving values of load divided by deflection per coil for various sizes of wire and coils.

Fatigue Strength

A. L. Walker.
Steel Springs and Fatigue Strength, Mech. Wld., vol. 82, no. 2130, Oct. 28, 1927, pp. 322-323. Résumé of outstanding facts of repeated stress of steel springs.

Hairsprings for Instruments.

H. Moore and S. Beckinsale.
The Manufacture and Properties of Hairsprings. Inst. of Metals — advance paper, no. 424, for mtg., Mar. 9-10, 1927, 9 pp.; also abstract in Engineering, vol. 123, no. 3195, Apr. 8, 1927, pp. 439-440. Investigation at Research Department, Woolwich, into manufacture and properties of several types of hairsprings for instruments; related work, mainly of metallurgical nature, was also carried out on small springs used for other purposes; functions, and essential properties of hairsprings and control springs; respective merits and disadvantages of steels, ferrous alloys, and non-ferrous alloys; use of low-temperature heat treatments to restore elasticity, after cold working; steel hairsprings are subject to corrosion, but Elinvar is highly resistant; manufacture of phosphor-bronze and other hairsprings.

Heat Treatment

Anonymous. 137.
The C.N.R. Installs Spring Treating Plant. Ry. Mech. Engr., vol. 101, no. 6, June 1927, pp. 341-344, 6 figs. Electric Furnace and salt bath for heating and drawing at Stratford, Ont., shops are pyrometer controlled.

Helical

F. C. Lea and F. Heywood.
Failure of Helical Springs. Engineering, vol. 123, nos. 3199 and 3201, May 6 and May 20, 1927, pp. 562-564 and 621-623, 13 figs. Failure of some steel wires under repeated torsional stresses at various mean stresses determined

from experiments on helical springs. See complete paper in Instn. Mech. Engrs. — Proc., no. 2, 1927, pp. 403-443 and (discussion) 444-463, 19 figs.

Anonymous 138.
Helical Springs. Ry. Engr., vol. 48., no. 565, Feb. 1927, pp. 63-65. Describes alignment chart which has been prepared to facilitate calculations in connection with design of helical springs.

Hysteresis of

J. K. Wood.
Hysteresis Relative to the Operation of Mechanical Springs. Mech. Eng., vol. 49, no. 5a, Mid-May 1927, pp. 561-569, 20 figs. Springs and spring systems are shown to be associated with physical hysteresis of three characteristic types, mechanical, hypo-elastic, and hyper-elastic hysteresis; former is shown to be important from standpoint of automotive riding quality; mechanical hysteresis is caused by external agencies, while both hypo-elastic and hyper-elastic hysteresis are caused by internal behavior of crystalline structures; hypo-elastic hysteresis is due to internal friction of solid type, while hyper-elastic hysteresis is due to slip or plastic flow and hence has characteristic time factor. See also MACHINE SHOPS, Machine Parts; STEEL, HEAT TREATMENT, Automobile Springs.

Laminated.

Anonymous 139.
Laminated Springs. Ry. Engr., vol. 48, no. 564, Jan. 1927, p. 35. Alignment charts for calculations in design of laminated springs.

Railway

Anonymous. 140.
Railway Springs. Ry. Engr., vol. 48, nos. 570 and 571, July and August, 1927, pp. 249-250 and 293-295. Aspects of theory, design and construction with special references to laminated bearing springs for locomotives. Abstract of paper read before Instn. Locomotive Engrs.

Spiral.

A. Raasch.
Calculation of Round-Bar Spiral Springs (Berechnung der rundrähtigen Schraubenfedern). Maschinenbau, vol. 5, no. 23, Dec. 2, 1926, pp. 1084-1088, 5 figs. Calculation is made with aid of chart containing calculated units of large number of spiral springs; examples are given showing process of calculation.

Tempering and Resetting.

C. A. Kyle.
Tempering and Resetting Springs. Elec. Ry. Jl., vol. 69, no. 13, Mar. 26, 1927, pp. 576-577, 1 fig. Spring repairs are facilitated and cost of tempering and resetting springs reduced by spring-tempering furnace of gas-burning type installed in shops of New York State Railways, Syracuse, N. Y.

Testing

Anonymous.141.
Device for Testing Compression and Elongation of Springs. Iron Age, vol. 119, no. 23, June 9, 1927, pp. 1671-1672. Spring-testing machine, known as Elasticometer, placed on market by Coast Machine Tool Co., New York; device is essentially precision beam balance with ratio of 10 to 1.

G. Gerber.
Testing of Vehicle Springs (Prüfung von Fahrzeugfedern). V.D.I. Zeit., vol. 71, no. 43, Oct. 22, 1927, pp. 1521-1524, 16 figs. Classification of machines for testing with dynamic loading; fatigue tests; specifications for springs of railway cars; design, operation and use of spring-testing machine.

Testing and Scragging Machines.

Anonymous.142.
Spring Testing and Scragging Machines. Machy. (Lond.), vols. 28 and 29, nos. 727, 728, 729 and 737, Sept. 16, 23, 30 and Nov. 25, 1926, pp. 724-725, 754-756, 789-790 and 250-251, 18 figs. Describes various types of spring-testing machines.

1928

Automobile Engines

A. Moorhouse and W. R. Griswold.
Designing the Dual Valve-Spring. Soc. Automotive Engrs. — Jl., vol. 23, no. 6, Nov. 1928, pp. 461-469, 11 figs. Development of Packard dual valve springs by rational analysis combined with experimental verification is discussed; analysis of dynamics of valve mechanism; theory of vibration; previous theories inadequate; harmonic analysis; wave theory; conditions of resonance; concentric springs disappointing; mathematical design of spring; construction and assembly of dual valve springs.

W. T. Donkin.
Notes on Valve-Spring Design. Soc. Automotive Engrs. — Jl., vol. 23. no. 2, Aug. 1928, pp. 162-163 and discussion 163-166. With higher engine speeds, correct operation of engine depends upon correctly designed valve spring; formula for load in pounds per square inch of deflection; stress range more important than maximum stress, up to elastic limit; materials and heat treatments compared; electric-furnace chromium-vanadium steel heat treated after winding is recommended; failures traced to resonance between frequencies of spring and camshaft.

Automobile Springs and Suspension

Anonymous 143.
A Critical Survey of the Exhibits — Suspension. Automobile Engr., vol. 18, no. 247, Nov. 1, 1928, pp. 428-429, 5 figs. No charge in standard system of four semi-elliptic springs; out of 40 American models, 37 had arrangement of four elliptics; four semi-elliptics now regarded as most practical scheme for standard commercial production; form is not absolutely perfect, but no other tried system has yet proved practically superior; 14 types of suspension are exhibited, covering 206 models.

D. S. de Lavaud.
Automobile Suspension. Automobile Engr., vol. 18, no. 243, July 1928, pp. 261-263, 4 figs. Notes on certain factors affecting stability with reference to de Lavaud differential; usual design of front axle must soon disappear; radical betterment of car stability is only possible with independently sprung front wheels, duplicate steering mechanism and differential that permits one driving wheel to run free when taking turn.

L. Cazalis.
Bertrand Suspension. Automotive Abstracts, vol. 6, no. 9, Sept. 20, 1928, p. 270. Both front and rear wheels are suspended at ends of longitudinal levers hinged to chassis; these levers are connected to long elastic tube which runs from level in front to lever in rear and constitutes the spring;

tube also acts as shock absorber. Very brief abstract translated from Vie Automobile, July 27, 1928.

P. M. Heldt.
Engineers Seek to Improve Riding Qualities by Independent Springing. Automotive Industries, v. 58, n. 25, June 23, 1928, p. 942-948, 11 figs. Much development work accomplished in Europe in independent springing for each wheel of car with satisfactory results; chief advantages are reduction of unsprung weight and elimination of wheel wobble; tire wear also lessened; effect on wheel tread; spring type of rear axle; Tatra swinging rear-axle tubes; Steyr construction; Fiat vertical rear springs; Faudi pneumatic suspension.

D. S. de Lavaud.
Independent Front Springing Proposed. Soc. Automotive Engrs. — Jl., vol. 22, n. 2, Feb. 1928, p. 278-280. Review of Chassis Session; short abstracts of papers and discussion, as follows: Independently Sprung Front Wheels as a Remedy for Shimmy, conventional front suspension of automobiles deplorable survival of horse-drawn-vehicle days; damping and friction are not same; analysis confirmed by tests; Shock Absorbers from the Car Manufacturer's Viewpoint, N. F. Hadley; Self Energizing Brakes, J. Sneed.

Anonymous 144.
Problems of Suspension (Les problèmes de la suspension). Revue des Combustibles Liquides, v. 6, n. 54 and 55, Apr. and May 1938, p. 158-161 and 205-208, 12 figs. Apr.: Review of three principal types of shock absorbers; describes new device, known as Roumens absorber; auto-progressive absorber, Excelsior type; vibration damping by internal braking between springs. May: Treats of independent wheels of several systems and methods of attachment to chassis to prevent shocks from road.

Anonymous 145.
Researches on Springs. Dept. of Sci. and Indus. Research, Eng. Research—Special Report n. 8, 1928, 42 p., 32 figs. partly on supp. plates. Results of experiments with 30-cwt and 60-cwt army truck and with 2-seater high-speed automobile; National Physical Laboratory was asked to design mechanism which could be fitted to vehicle and which would give continuous record with time of displacements of springs relative to body of vehicle when run at different speeds and on different road surfaces; gives description of apparatus and results obtained.

J. A. Lucas.
The Lancia Floating Front-Wheel Suspension. Am. Mach., v. 68, n. 13, Mar. 29, 1938, p. 531-533, 7 figs. Construction of very unusual suspension and method of making springs and recoil mechanism; each front wheel has its own coil spring and shock absorber that resembles recoil mechanism, recuperator, for which French 75-mm guns were famous; tests of springs;

spring-winding machine.

E. Marquard.
Spring Problems in the Design of Fixed and Free Rear Axles (Federungsprobleme bei starren und schwingenden Hinterachsen). Motorwagen, vol. 30, nos. 35 and 36, Dec. 20 and 31, 1927, pp. 735-741, 6 figs. and pp. 755-761. 29 figs. Dec. 20: General theory and diagrams of parallel and unilateral axle shock for speeds of 10, 20 and 80 km. per hr. Dec. 31: Axles and axle shock; Benz experiments and development of Rumpler free axle, description of Rumpler, Tatra, Steyr, etc. front and rear axles, transmissions, differentials, axle suspensions, etc.; Daag motor bus and Faudi air springs; the Faudi combined pneumatic and mechanical brake.

B. C. Berry.
The Principle of Hydraulic Spring Control Can. Automotive Trade, vol. 10, no. 11, Nov. 1928, p. 20, 1 fig. Details of Houdaille hydraulic shock absorbers are given; forged-steel chamber divided into two equal sections by stationary partition in which wing-like piston is oscillated by arm of instrument chamber is filled with glycerine solution.

Coil

Anonymous 146.
Cause of Failure of Coiled Springs. Iron Age, vol. 122, no. 26, Dec. 27, 1928, p. 1635. Brief review of meeting of American Society of Mechanical Engineers in New York at which were reported definite results obtained in research into properties of springs; failure of springs discussed by A. M. Wahl; corrections determined for design tables; rough decarbonized surfaces detrimental; results of experiments made by D. J. McAdams, Sr., to determine fatigue limits of spring materials; mild corrosion to be avoided as it reduces endurance limit.

T. H. Sanders.
Coiled Springs—Design and Formulae. Locomotive, vol. 24, no. 436, Dec. 15, 1928, pp. 389-390, 1 fig. General summing up of situation relative to coiled springs; table presents whole of formulas needed for most used coiled springs, which are cylindrical.

E. Sodano.
Coil-Spring Making on the Lathe (La fabrication des ressorts à boudin sur le tour). Pratique des Industries Mécaniques, vol. 10, no. 11, Feb. 1928, pp. 451-452, 5 figs. Describes spring coiling on a lathe; piano wire used.

R. A. Johnson.
Coil Spring Specification. Machy. (N. Y.), vol. 34, no. 7, Mar. 1928, pp 528-530, 1 fig.; see also Machy. (Lond.), vol. 32, no. 820, June 28, 1928, pp 413-415. Factors to be considered in drawing up coil-spring specifications for quantity manufacture; helical open-wound compression

springs; explanation of table of formulas; helical close-wound extension springs; torsion springs; phenomenon of settage; ground-end springs subject to burrs on outside and inside edges of flat ends; systems of wire gaging; load-carrying capacity of springs; methods of submitting specifications.

Anonymous 147.
Production of Coil Springs. Machy. (Lond.), vol. 31, no. 795, Jan. 5, 1928, pp. 456-458, 8 figs. Description of machine to make coil springs with hook on extended straight portion; answer to question, how to do it.

G. Ashworth.
The Compression Spring of Rectangular Section. Inst. Civil Engrs.- Sessional Notices, no. 3, Mar. 1928, pp. 88-90. Deals with helical and volute spring, particularly of sizes in general use on railway rolling stock; account of investigation which determined internal distribution of shear stress and strain for overstrained circular section. Abstract.

Fatigue

D. J. McAdam, Jr.
Fatigue and Corrosion-Fatigue of Spring Material. Am. Soc. Mech. Engrs.- Advance Paper, no. 39a, for mtg. Dec. 3-7, 1928, 12 pp., 8 figs.; see also Am. Mach., vol. 69, no. 25, Dec. 20, 1928, pp. 966-967. For spring steels ratio of endurance limit in tension-compression or repeated bend to tensile strength is 0.4 to 0.5; ratio of torsional endurance limit to tensile strength is 0.2 to 0.3; nickel-copper alloys can be obtained, by cold working, with tension-compression endurance limit more than 50,000 lb. per sq. in.; for copper-tin alloys, 5 per cent alloy, known as phosphor bronze, can be obtained with tension-compression endurance limit of 27,000 lb. per sq. in. in form of 1-in. round bars. Bibliography.

Heat Treatment

Anonymous 148.
Hardening Springs for Elasticity. Wire, vol. 3, no. 10, Oct. 1928, pp. 338-339 and 355, 3 figs. Modulus of elasticity; science of spring making; heat treatment; tempering and inspection; correct hardness; uniform hardness imperative.

G. M. Eaton.
Spring Design and Heat-Treating. Mech. World, vol. 83, no. 2142, Jan 20, 1928, pp. 41-42, 7 figs. Quenching of springs discussed; quenching from inside by means of liquid-or air-spray head; rotation of head or spring; complicated distribution of axial plastic flow occurring on various elements of surface of wire; hot-water possibilities; air and liquid quench compared; complete protection of critical region from hoop stress. From paper delivered before Am. Soc. for Steel Treating.

Helical

C. H. Wingfield.
Avoiding Permanent Set in Helical Springs. Engineering, vol. 125, no. 3256 June 8, 1928, pp. 711-712, 6 figs. Helical springs which are not tempered after coiling, takes more or less marked set when first used, if made in usual way; this may be avoided by twisting wire until it takes set before coils are completed, provided they are sufficiently numerous.

R. C. Jordan.
Load Variations in Helical Springs. Wire, vol. 3, no. 4, Apr. 1928, pp. 122-124, 4 figs. Theory of load variation and graphs for redesigning helical springs; formula and graphs outlined for compression springs; over half of possible variation in spring due to allowance in mean diameter; explanation of graphs.

H. Barnes.
Springs From the Designer's Point of View. Wire, vol. 3, no. 7, July, 1928, pp. 227-228 and 244-246, 2 figs. Prejudice and lack of reliable data on performance records hinder wider application of coal springs; reliability of properly designed and heat-treated springs is established in variety of materials; new data for designers; springs properly classified as to duty with reference to "long-life factor."

A. M. Wahl.
Stresses in Heavy Closely Coiled Helical Springs. Am. Soc. Mech. Engrs. — Advance Paper, no. 39 for mtg. Dec. 3-7, 1928, 9 pp., 16 figs. More exact formulas are derived for computing stress in springs of type used frequently in railway work; formulas indicate that maximum stress in such springs may, in many cases, be from 40 to 60 per cent greater than stress computed by use of ordinary helical-spring formulas; formulas are verified by strain measurements, using special extensometers; frequent failures of this type of spring in service may, at least in part, be due to existence of higher stresses than thought possible on basis of ordinary spring formulas.

Laminated

Anonymous, 149.
Machine to Curve and Harden Spring Leaves (Machine à cintrer et tremper les lames de ressort). Industrie des Voies Ferrees et des Transport Automobiles, vol. 22, no. 253, Jan 1928, pp. 15-19, 10 figs. Machine developed by Tramway Co. of Amiens is Described, and its operation.

C. J. Graham.
Modern Methods in our Workshops. New Zealand Ry. Mag., vol. 2, no. 12, Apr. 1, 1928, pp. 28-40, 7 figs. New spring plant at Hillside; treatment of springs; cropping, nibbing and trimming; forming; quenching; drawing; assembling; testing; control of temperature.

R. G. Batson and J. Bradley.
Researches On Springs--the Effect of "Nip" on the Mechanical Properties of Laminated Springs. Dept. of Sci. and Indus. Research— Special Report, No. 11, 1928, 37 pp., 26 figs. It is sometimes practice to vary curvature of individual plates of spring in such a way that when leaves are placed on one another there are gaps between them; springs made in this way are said to have been given "nip"; advantage of "nip" is that, if it is adjusted correctly, master leaf when under repeated loadings has zero mean stress and is in its most favorable condition for resistance to repeated stresses.

G. Fraser.
Spring Making and Repairing. Ry. Mech. Engr., vol. 102, no. 10, Oct. 1928, pp. 572-574, 4 figs.; see also Ry. Jl., vol. 34, no. 11, Nov. 1928, pp. 27-28. Back-camber springs superior; how springs are repaired; making new springs; testing of springs. Abstract of paper presented before Master Blacksmiths' Assn.

Anonymous 150.
Spring Plant of the Baltimore and Ohio at Mt. Clare Shops. Ry. Mech. Engr., vol. 102, no. 7, July 1928, pp. 409-413, 12 figs. Design of plant and equipment with successful methods of manufacturing elliptic springs. Committee report to Am. Ry. Assn.

Anonymous 151.
Testing Machine for Laminated Springs. Eng. Progress, vol. 11, no. 4, Apr. 1928, p. 116, 1 fig. Describes testing machine in which laminated spring is clamped firmly on table of machine; rod of hydraulic pressure gage which serves for measuring force applied; spring to be tested can be exposed both to static and additional oscillating load used by German State Railway.

Manufacture

Anonymous 152.
Spring Making on a Quantity Basis. Abrasive Industry, vol. 9, no. 4, Apr. 1928, pp. 100-102, 1 fig.; see also Iron Trade Rev., vol. 82, no. 24, June 14, 1928, pp. 1544-1545, 1 fig. Elasticity of metal is made use of in torsion, extension and compression springs; brass and bronze springs more expensive than steel; music wire is tough and uniform; vanadium steel extensively used in spring making; automatic spring-coiling machine feeds wire and forces it through dies; various types of spring require further treatment; operation of double-disk automatic grinding machines.

Monel Metal.

G. V. Pickwell.
Monel Metal Springs for High Temperature. Inco, vol. 8, no. 3, 1928, pp. 10-11 and 20, 3 figs. Effect of high temperature on performance, hardness and strength of springs made of Monel metal; formulates from experimental data guide for use of springs made of Monel metal when operating at elevated temperatures; mechanically superior to all other metals under conditions of elevated temperature; does not corrode as readily under those conditions; Monel metal should be used advisedly and within range where loss of strength can be held down to minimum.

Motor Truck Springs and Suspension

Anonymous 153.
Farnsworth Suspension. Motor Transport, vol. 47, no. 1227, Sept. 17, 1928, pp. 335-336, 2 figs. Application of promising system of independent wheel springing to rigid six wheelers is discussed; principal defects of conventional springing arrangement which it is designed to supersede; application to front wheels.

Anonymous 154.
Researches on Springs. Dept. of Sci. and Indus. Research, Eng. Research — Special Report no. 8, 1928, 42 pp., 32 figs. partly on supp. plates. Results of Experiments with 30-cwt, and 60-cwt. army truck and with 2-seater high-speed automobile; National Physical Laboratory was asked to design mechanism which could be fitted to vehicle and which would give continuous record with time of displacements of springs relative to body of vehicle when run at different speeds and on different road surfaces; gives description of apparatus and results obtained.

J. H. Hyde.
Vehicle Springs. Times Trade and Eng. Supp., vol. 22, no. 527, Aug. 11, 1928, p. 546. Review of Engineering Research Special Report, No. 8, on measurement of displacement of vehicle springs under road-running conditions; three vehicles were used in test, 30-c.w.t. Army motor truck, three-ton Army motor truck before and after modification of rear-spring suspension had been made to imitate conditions of Hotchkiss drive, and two-seater high-speed automobile.

Research

M. F. Sayre and A. Hoadley.
Progress Report No. 4 of the A.S.M.E. Special Research Committee on Mechanical Springs. Am. Soc. Mech. Engrs. — Advance Paper for mtg. Dec. 3 to 7, 1928, 17 pp., 24 figs. Report covers first year of investigation carried on by Committee at Union College, Schenectady, purpose of which

is to examine fundamental characteristics of spring action; study of distribution of stresses in bending in spring steel at very high unit stresses; comparison of proportional limit and modulus of elasticity in bending and tension at high and at low stresses; comparative internal friction in spring material in bending and in tension for varying stress ranges up to very high loads.

Spiral

W. Weibull.

Dynamic Properties of Spiral Springs (De dynamiska engenskaprna hos spiralfjadrar). Ingeniors Vetenskaps Akademien — Handlingar, no. 70, 1927, 25 pp., 19 figs. Existing formulas for calculating strain in springs exposed to impact loading not satisfactory; proposes new formulas for helical springs; formulas verified by photographically registering various movements of turns of spring.

Anonymous 155.

Notes on Spiral Springs. Mech. World, vol. 83, no. 2148, Mar. 2, 1928, pp. 147-148, 2 figs.; see also Heat Treating and Forging, vol. 14, no. 4, Apr. 1928, pp. 388-391. Spring neither weakened nor stiffened by increasing or decreasing its hardness, if other conditions and dimensions are unchanged; spring with high temper is undesirable; dimensions and not temper determine stiffness; pressure that spring will produce bears definite relation to these dimensions; relation follows certain mathematical laws. From pamphlet issued by W. D. Gibson Co., Chicago.

F. W. Shaw.

Spiral Springs for Balancing. Machy. (Lond.), vol. 32, no. 815, May 24, 1928, pp. 225-231, 9 figs. Design, details and calculations of spiral springs used for balancing; securing utmost compactness consistent with efficiency and safety; what determines compactness; pull of spiral spring; thickness and length of spring; diameter of hub; coil diameters of free spring; number of coils and turns; fusee; calculations by formulas.

Testing

D. A. Gurney.

Tests on Belleville Springs by the Ordnance Department U. S. Army. Am. Soc. Mech. Engrs. — Advance Paper for meeting, Oct. 1-3, 1928, 5 pp., 11 figs. Belleville springs are dish-shaped and used where relatively large load capacity, small deflection, and limited closed height are necessitated by other controlling features of design; recent demands for larger Belleville springs disclose absence of reliable data; investigation at Rock Island Arsenal was undertaken to supply this lack of information; material used was chrome-vanadium sheet steel SAE 6145, containing carbon, 0.43; manganese, 0.62; chromium, 1.10; and vanadium, 0.18.

G. A. Hankins.
The Endurance of Spring Steel Plates Under Repetition of Reversed Bending Stress, Dept. Scientific and Indus. Research — Eng. Research — Special Report, no. 5, 1928, 26 pp., 5 figs.; see also Engineering, vol. 126, no. 3268, Aug. 31, 1928, p. 273, 5 figs. General arrangement of machine devised for tests; calculation of fatigue stresses; three different types of steel used in spring manufacture, namely carbon steel containing 0.75 per cent carbon, silico-manganese steel and chrome-vanadium steel; comparison of results given by spring-plate testing machine with rotating cantilever test pieces.

1929

Air

J. K. Wood.
A New Type of Air Spring. Am Soc. Mech. Eng.—Advance Paper for mtg. May 13 to 16, 1929, 11 pp., 15 figs. Development of new type of air spring especially applicable to automobiles; orifice in movable diaphragm separates two air chambers; spring has considerable hysteresis coupled with inherent fluid elasticity; load-deflection or F-H cycle depends entirely upon acceleration at which movable diaphragm and car body move in vertical position; range of F-H cycle adjusted by varying orifice diameter.

Automobile Springs and Suspension

Anonymous.156.
Balanced Axle Suspension. Autocar, vol. 63, no. 1762, Aug. 9, 1929, p. 277, 1 fig. Description of suspension system for automobiles designed by R. Greaves which used one spring for all four wheels.

Anonymous. 157.
Coil Spring Suspension. Autocar, vol. 62, no. 1735, Feb. 1, 1929, p. 235, 3 figs. Details of Horstman system; whereby each wheel can be independently sprung; coil springs under compression are used and load is taken through system of levers so arranged that springs progressively gain advantage over load.

Anonymous. 158.
Compound Springs Used in the Farman (Compound-Federung und Doppellenkung am Farman-Wagen), Oppenheim. Motorwagen, vol. 32, no. 15, May 31, 1929, pp. 323-324, 6 figs. Old problem of uniform spring action with varying loads has been solved in case of Farman by use of compound springs connected to chassis by means of roads, assuring safety in case front spring should break; spring consists of large cross spring augmented by

two cantilever springs; cross spring will take care of all normal loads while cantilevers are brought into play by unsymmetric forces or overloads.

H. Schieferstein.
Motor-Vehicle Springs (Die Abfederung von Fahrzeugen). Motorwagen, vol. 32, no. 3, Jan, 31, 1929, pp. 49-56, 17 figs. Possibility is discussed of finding better solution to spring problem based on oscillation principle; a periodically acting spring; overcoming oscillating vibrations; creation of artificial rest point in vehicle; practical results.

Anonymous. 159.
New Spring Design Eliminates Center-Bolt Hole. Automotive Industries, vol. 60, no. 12, Mar. 23, 1929, p. 478, 3 figs. Brief description of method of locating springs on axles or in trunnion blocks introduced by Jonas Woodhead and Sons, Leeds, England, which is finding favor among British truck and bus manufacturers; spring consists of dividing main leaf at center, forming eyes at adjacent ends, and utilizing transverse bolts, special top clamping plate, or slots in trunnion block to locate eyes.

Anonymous. 160.
Peculiar Phenomena in Automobile Transverse Springs (Eigenartige Erscheinungen an Automobil-Querfedern). Motorwagen, vol. 32, no. 4, Feb. 10, 1929, pp. 67-68, 5 figs. Results of investigations of fractures which occurred in front springs, taking into consideration design, manufacture, and properties of material employed; defects were found in method of construction and in chemical composition of metal employed.

A. G. von Loewe.
Problem of Spring Suspension (Das Problem der Federaufhaengung). Motor, vol. 17, no. 3, Mar. 1929, pp. 37-38, 3 figs. Brief review of developments, with special reference to Studebaker system and its advantages.

G. de Ram.
Problems Involved in Suspension (La suspension et les problèmes qu'elle soulève). Technique Automobile et Aérienne, vol. 20, no. 145, 1929, pp. 33-41, 6 figs. Discussion of problems arising in automobile suspension; design of de Ram suspension and special suspension; importance of front suspension; obtaining rigidity of frame; principles of good suspension; lateral stability and choice of flexible springs. Paper presented before Société des Ingénieurs de l'Automobile.

W. M. Evans.
The Case for the Independently Sprung Wheel. Automobile Engr., vol. 19, no. 257, Aug. 1929, pp. 308-312, 22 figs. Main factors affecting complex problem of automobile suspension; comparison of unsprung weight on regular type front axle and independently sprung wheel system; criticisms of latter system.

Anonymous. 161.

Automobile Engr., vol. 19, no. 260, Nov. 7, 1929 (Special Number), pp. 427-429, 11 figs. Trends in design of automobile suspension as shown in cars exhibited at Olympia are discussed; overshadowing of all other types of suspension by four semi-elliptics is most noticeable feature; comparison of ten types of springs exhibited on American, British and Continental cars; only type of springing which is competitive, although far behind is semi-elliptic front and cantilever rear combination; very few springs fitted with sliding ends; independent springing is represented by Steyr only.

Anonymous. 162.

High Production Equipment for Forming and Heat-Treating the Ford Spring. Am. Mach., vol. 70, no. 20, May 16, 1929, pp. 779-781, 8 figs. Various operations are described which are used to produce 5500 springs daily at Ford's Green Island plant; careful heat treatment under uniform conditions is predominating factor; description of forming machines employed and electric furnaces for preliminary heating before bending; assembling operations.

J. B. Bauen.

Manufacture and Heat-Treatment of Automobile Leaf Springs. Am. Mach., vol. 70, no. 6, Feb. 7, 1929, pp. 248-249; see also West. Machy. World, vol. 20, no. 5, May 1929, pp. 164-165. Springs fabricated in most uniform manner to give symmetrical action to finished product; automatic eye-forming machines; after steel is heated in automatically controlled oil-operated furnace, it is formed on machines that submerge leaves automatically into oil-cooling vat; continuous drawing furnace; finishing. Abstract of paper presented before Western Metals Congress.

Anonymous. 163.

Spring Production on a Large Scale. Am. Mach., vol. 71, no. 22, Nov. 28, 1929, pp. 884-886, 10 figs. Views of Studebaker plant are given showing how springs travel on straight line through various operations and on to storage; during its course of manufacture stock is heat-treated to Brinell hardness ranging between 387 and 444.

Coil

A. S. Langsdorf.

Oscillations of Compound Springs. Wash. Univ.—Sci. and Technology, no. 3, Oct. 1929, 17 pp., 4 figs. In order that springs of compound type may be designed to minimize oscillations under given operating conditions, it is necessary to analyze their performance by mathematical methods, so as to derive formulas in terms of spring constants; accordingly, analysis has been worked out to cover any general case.

E. W. Stewart.
Some Practical Suggestions in Reference to Coil Springs, Wire, vol. 4, nos. 8 and 9, Aug. and Sept. 1929, pp. 262-264 and 298-299, 2 figs.; see also Mech. Eng., vol. 51, no. 10, Oct. 1929, p. 773. Aug.: Four kinds of coil springs are discussed; compression, extension, torsion and flat; materials, sizes and specifications. Sept.: Knowledge of materials, sizes, and specifications will enable user to get best results from spring manufacturer; efficient spring should be obtained first and dimensions of other parts arranged to provide spring space necessary; high-speed problems; formula to determine wire size; spring with plain ends, ground ends, and tapered ends explained; extension spring; property of initial tension; torsion springs, direction of load.

Deflection

J. W. Rockefeller, Jr.
Deflection of Springs by Moving Weights. Machy. (N. Y.), vol. 35, no. 8, Apr. 1929, pp. 570-572, 1 fig. Chart for determining amount of deflection of helical compression spring in bringing moving load to rest is given with examples.

Design

J. K. Wood.
Conical Spring Design—Some New Facts and Formulas. Am. Mach., vol. 71, nos. 15 and 20, Oct. 10 and Nov. 14, 1929, pp. 620-624 and 827-830, 18 figs. Results of research that alter some of basic formulas heretofore used in this branch of design are discussed; new deflection formula for conical springs which takes into account vertical shear and deflection multiplication factor; new formulas are given for design of round-wire conical springs.

Anonymous.164.
Mechanical-Spring Characteristics. Iron Age, vol. 124, no. 25, Dec. 19, 1929, pp. 1664-1666, 6 figs. Review of papers dealing with spring design, which were presented before American Society Mechanical Engineers, New York meeting; radially tapered disk springs, W. A. Brecht and A. M. Wahl; present status of mechanical spring art, J. K. Wood; elastic and inelastic behavior in spring materials. M. F. Sayre.

D. Wolkowitsch.
New Type of Spring (Sur un type nouveau de ressort). Académie des Sciences—Comptes Rendus, vol. 188, no. 19, May 6, 1929, pp. 1228-1230; see also Génie Civil, vol. 94, no. 20, May 18, 1929, pp. 483-484. Principles of design of spring in which displacement of sections of one with reference to other is of sliding nature, according to use of word in theory of elasticity.

W. A. Brecht and A. M. Wahl.
The Radially Tapered Disk Spring. Am. Soc. Mech. Engrs.—Advance Paper, no. 5 for mtg. Dec. 2-6, 1929, 9 pp., 22 figs. Disk springs, both flat and dished, having radially tapered cross-sections are considered and their advantages outlined; equations are developed by approximate and more exact methods for calculating strength and flexibility of such springs; theoretical work is checked up by numerous tests, including both strain and deflection measurements; it is concluded that springs of this type may be of advantage in certain applications.

Fatigue.

D. J. McAdam, Jr.
Fatigue and Corrosion Fatigue of Spring Materials. Applied Mechanics (A.S.M.E. Trans.), vol. 51, no. 10, Jan-Apr. 1929, pp. 45-56 and (discussion) 56-58, 8 figs. Relation of endurance limit to other physical properties; endurance properties of steels; endurance properties and corrosion fatigue of nickel-copper and of copper-tin alloys; effect of varying position of endurance range within elastic range; effect of abrupt changes of section; corrosion-fatigue of spring steels; metallic protective coatings; effect of cycle frequency of fatigue and corrosion fatigue.

Heat Treatment

Anonymous,165.
Report of Committee on Electric Welding and Heat Treating. Ry. Elec. Engr., vol. 20, no. 10, Oct. 1929, pp. 331-335, 1 fig. Work confined to study of heat treatment of elliptical and coil springs; description of modern railway-spring heat-treatment plant; typical spring department layout plant. Report before Assn. Ry. Elec. Engrs.

Helical

J. W. Rockefeller, Jr.
Charts for Finding Weight of Helical Springs. Machy. (N. Y.), vol. 35, no. 9, May 1929, pp. 668-671, 3 figs. Series of charts designed for rapidly determining weight of helical springs, made from either round or square wire, is given.

A. B. Cox.
Common Sense in Helical Spring Design. Machy. (N. Y.), vol. 36, no. 1, Sept. 1929, pp. 22-23. Instances are given of spring designs that have failed because important factor has been overlooked; comparisons of two spring designs; best spring for special purpose is that which has greatest diameter and length for given capacity.

E. Latshaw.
Square Versus Round Wire of Helical Springs. Machy. (N. Y.), vol. 35, no. 8, Apr. 1929, p. 616; see also Machy. (Lond.), vol. 34, no. 878, Aug. 8, 1929, p. 585. Torsional stress, load, and energy-storing capacity of springs of round and square wire are compared, with formulas to be used in their design.

J. W. Rockefeller, Jr.
Static Deflection of Helical Springs. Machy. (N. Y.), vol. 35, no. 7, Mar. 1929, pp. 492-496, 4 figs. Series of charts for quickly determining static deflection and fiber stress in compression and extension springs subjected to given static load; they can be used also in determining such kinetic properties of springs as deflection under moving weight and period of vibration.

A. M. Wahl.
Stresses in Heavy Closely Coiled Helical Springs. Applied Mechanics (A.S.M.E. Trans.), vol. 51, no. 16, May-Aug. 1929, pp. 185-193 and (discussion) 193-200, 23 figs.; see also Mech. Engr., vol. 51, no. 6, June 1929, pp. 434-437, 9 figs., and Metal Stampings, vol. 2, no. 2, Feb. 1929, pp. 97-98, 1 fig. More exact formulas are derived for computing stress in heavy closely coiled helical springs of type used frequently in railway work; maximum stress in such springs may be from 40 to 60 per cent greater than stress computed with ordinary helical-spring formulas; new formulas verified by strain measurements; frequent failures may be due to existence of higher stresses than thought possible on basis of ordinary spring formulas. See Engineering Index 1928, p. 1725.

J. W. Rockefeller, Jr.
Time of Oscillation in Helical Springs. Machy. (N. Y.), vol. 35, no. 10, June 1929, pp. 748-751, 2 figs.; see also Machy. (Lond.), vol. 34, no. 876, July 25, 1929, pp. 528-531, 2 figs. Charts for determining period of vibration and damping factor in design of helical springs are given and discussed.

Laminated

R. J. Batson and J. Bradley.
Endurance of Laminated Springs. Iron Age, vol. 123, no. 26, June 27, 1929, p. 1758, 1 fig.; see also Times Trade and Eng. Supp., vol. 24, no. 566, May 11, 1929, p. 210. Brief discussion of results of tests made by Springs Research Committee of British Department of Scientific and Industrial Research to determine endurance of spring-steel plates under repetition of reversed bending stress, displacement of vehicle springs under road-running conditions, and effect of mechanical properties of laminated springs produced by "nip" to which they are subjected in process of assembly; special machine designed to alternate bending stresses in spring.

H. S. Rowell.
Kinematics of Laminated Springs. Engineering, vol. 127, no. 3302, Apr. 26, 1929, pp. 505-507, 9 figs. Advantages of laminated springs over other types and their application to automobiles; motions in quarter-elliptic and semi-elliptic springs calculated; shackle problems in latter discussed; relative rotation between spring eye and shackle; effects of shackle position and slope on spring stress and general behavior; cantilever springs.

Anonymous. 166.
Spring Making Machinery. Locomotive, vol. 35, no. 437, Jan. 15, 1929, pp. 19-22, 3 figs. Laminated springs for railway vehicles; various operations which can be performed by a group of machines are briefly described; comments on these operations; brief description of each machine; forging machines, seven-operation, triple-headed, double-headed; eye-rolling machine; single-stroke, and three-operation, taper-rolling machine; spring-plate forming machine.

Locomotive Springs

Anonymous. 167.
Locomotive Spring Construction. Am. Mach., vol. 70, no. 15, Apr. 11, 1929, pp. 598-599, 6 figs. Operations performed in Stratford, Ont., repair shops of Canadian National Railways, in building semi-elliptic springs for locomotives, are discussed.

Manufacture

R. W. Cook.
Fine Springs Need Close Tolerances. Iron Age, vol. 124, no. 2, July 11, 1929, pp. 83-85, 4 figs. Discussion of some things which spring maker can and cannot do and how variations in sizes have large influence on work which spring will be able to perform; good design, not heat treatment, is secret of successful spring manufacture; small errors in size and shape result in large variation in load-carrying ability; heat treatment affects elasticity and fatigue; method of testing in laboratory of Wallace Barnes Co.

S. Lewis.
Making and Repairing Railroad Springs. Ry. Jl., vol. 35, no. 12, Dec. 1929, pp. 19-21. Characteristics of good spring field; rolling new design of steel; essential features of proper fabrication; oil circulation in cooling is absolute necessity.

J. R. Fritze, R. J. Sutton and F. R. Porter.
Springs for Service at High Temperatures. Heat Treating and Forging, vol. 15, no. 3, Mar. 1929, pp. 301-302 and 310, 6 figs. Selection of steel of suitable composition and proper treatments to facilitate its fabrication

into springs is discussed; manufacturing operations described; elimination tests for steel; annealing and tempering; testing.

Monel Metal

G. V. Pickwell.
Monel Metal Springs for High Temperatures. Wire, vol. 4, no. 2, Feb. 1929, pp. 47-48 and 62-63, 3 figs. Effects of heat on performance, hardness, and strength of rust-proof and corrosion-resistant springs; article formulates from experimental data guide for use of springs made of monel metal when operating at elevated temperature; answers some questions often asked manufacturer of springs; controlling set; higher resistance alloys. Reprinted from Inco.

Motor Truck Springs and Suspension

Anonymous 168.
Air Springs. Power Wagon, vol. 43, no. 296, Aug. 1929, pp. 34-36. Effects of use of air springs on fleet of motor trucks are discussed; typical example of 35-truck fleet shows saving of $5,781.78 for 41 months' test; growing use of pneumatic tires on large-size trucks reveals value of air springs in reducing major operating costs; how maintenance is affected.

Anonymous 169.
Can Suspension Be Improved? Motor Transport, vol. 48, no. 1263, May 27, 1929, p. 619. Principal factors affecting realization of ideal suspension system for motor trucks, and shortcomings of those in use at present are discussed; advantages derivable from having each wheel independently sprung are outlined.

E. E. Pugsley.
Make Truck Springs in Vancouver Now. Can. Machy., vol. 40, no. 21, Oct. 17, 1929, pp. 48-49, 3 figs. Brief description of methods employed by Dendoff Springs, Ltd., for manufacturing springs for motor trucks; shearing; shaping process; drawing furnace.

Patents

Anonymous 170.
Springs and Vibration-Dampers. Abridgments of Specifications, class 108 (iii), period 1921-25, 1929, 226 pp. Patents for inventions; abridgments intended to serve as guides to specifications.

Research

M. F. Sayre.
Elastic and Inelastic Behavior in Spring Materials. Mech. Eng., vol. 51,

no. 12, Dec. 1929, pp. 915-916 and 970, 2 figs. Progress report, No. 5, of A.S.M.E. Special Research Committee on Mechanical Springs; results are given in millionths of inch per inch length of specimen; study of these elongation readings gave first definite indication that true modulus of elasticity of material changes as load increases.

M. F. Sayre and A. Hoadley.
Investigations on Mechanical Springs. Mech. World, vol. 86, no. 2227, Sept. 6, 1929, p. 216. Abstract of Progress Report No. 4 of Special Research Committee on Mechanical Springs of American Society of Mechanical Engineers, covering first year of investigations carried on by Committee at Union College, Schenectady; new type of bend test apparatus in which specimen is bent to uniform arc of circle. See Engineering Index 1928, p. 1726.

Testing

Anonymous. 171.
Spring Plant of the New Haven at Readville Shops. Ry. Mech. Engrs., vol. 103, no. 4, Apr. 1929, pp. 203-206, 6 figs. New York, New Haven and Hartford has put into service at Readville locomotive and passenger-car shops an up-to-date spring-testing plant for manufacture and repair of all locomotive and car elliptical springs and for repair of all coil springs for system.

D. A. Gurney.
Tests on Belleville Springs by the Ordnance Department, U. S. Army. Applied Mechanics (A.S.M.E. Trans.), vol. 51, no. 10, Jan.-Apr. 1929, pp. 13-17 and (discussion) 17-18, 12 figs. Description of tests of disk-shaped springs to secure information regarding design for larger springs of this type; formula developed; history of Belleville springs; chrome-vanadium sheet steel SAE 6145 tested; conclusions reached after correlation of results of tests, of mathematical analysis (not here given) and of photoelastic analysis made by P. Heymans of Massachusetts Inst. Tech.

Torsional

J. W. Rockefeller, Jr.
Static Deflection of Torsional Springs. Machy. (N. Y.), vol. 35, no. 11, July 1929, pp. 826-830, 3 figs. Charts for finding static deflection and fiber stress of torsional springs made from round or square wire of different gages.

1930

Applications

R. G. Standerwick.
Springs vs. Weights. Gen. Elec. Rev., vol. 33, no. 6, June, 1930, pp. 341-344, 5 figs. Author points out limiting features of dead weights and describes how these limits restrict their useful application in many cases; interesting features of springs and some of general laws.

W. A. Brecht.
The Radially Tapered Disk Spring. Applied Mechanics (A.S.M.E. Trans.), vol. 52, no. 15, May-Aug. 1930, pp. 45-53, and (discussion) 53-55, 22 figs. Before Am. Soc. Mech. Engrs., indexed in Engineering Index 1929, p. 1709, from Iron Age, Dec. 1929.

Automobile Springs and Suspension

Anonymous 172.
A New Road Spring. Automobile Engr., vol. 20, no. 274, Nov. 1930, p. 434, 3 figs. Experiences with spring having divided back plate and swiveling ends patented by Jonas Woodhead and Sons.

T. H. Sanders.
Automobile Springs. Automobile Engr., vol. 20, no. 265, Mar. 1930, pp. 103-107, 12 figs. Technical and economic aspects of problem of discovering practical form of suspension offering advantages over system of four semi-elliptic laminated springs; details of improvements in design of this type.

P. M. Heldt.
Coiled Versus Leaf Springs. Automotive Industries, vol. 63, no. 19, Nov. 8, 1930, pp. 692-693. Calculation of stresses and energy-storing capacity; advantage of coiled spring is uniform stress distribution over active length; designed with some factor of safety for absorbing same shocks or carrying same loads, weight is only half of leaf springs.

Anonymous 173.
Improving in Heavy Vehicle Springing. Elec. Ry., Bus and Tram Jl., vol. 62, no. 1, Jan. 17, 1930, pp. 36-38, 4 figs. Description of Fox patent swiveling coupling for six-wheeled vehicles.

P. M. Heldt.
Independent Springing Marks Progress Toward Perfection in Riding Comfort. Automobile Industries, vol. 63, no. 12, Sept. 20, 1930, pp. 400-402, 1 fig. Advantages of independently sprung wheels, particularly front wheels; principal types of design are defined.

M. d'About.
New Suspension (Une nouvelle suspension). Vie Automobile, vol. 26, no. 942, Mar. 25, 1930, p. 108, 2 figs. Improved design of independent wheel springing is described and illustrated with sketches of front and rear-axle arrangement; hard and soft transversal spring for each axle.

Anonymous. 174.
New Suspension System Abandons Use of Steel Springs. Automotive Industries, vol. 63, no. 20, Nov. 15, 1930, pp. 720-22, 6 figs. Principles of double-chamber cushion built up of fabric and rubber, and carrying air pressure of 12 lb.; graphs illustrate experiments with Model A Ford.

P. M. Heldt.
Steering Head Design for Independent Springing Exemplified Abroad. Automotive Industries, vol. 63, no. 13, Sept. 27, 1930, pp. 436-438, 5 figs. Lancia and Tracta solutions for independent wheel springing are discussed with regard to arrangement of coil springs and shock absorbers.

R. E. Faroux.
Suspension of Modern Car (La suspension sur la voiture moderne). Vie Automobile, vol. 26, nos. 954 and 955, Sept. 25, 1930, pp. 368-370 and Oct. 10, pp. 557-561, 13 figs. Fundamental problems; methods of spring arrangement, effect of tire, function of shock absorbers; relative merits of suspension methods used by Cottin-Desgouttes, Bucciali, Sensaud de Lavaud and Lancia-Dilambda.

W. M. Evans.
The Case for the Independently Sprung Wheel. Instn. Automobile Engr.—Proc., vol. 23, 1928-29, pp. 353-358 and (discussion) 359-360. Indexed in Engineering Index 1929, p. 216, from Automobile Engr., Aug. 1929.

Coil

F. Bahlecke.
Calculation of Coil and Conical Springs (Berechnung von Schrauben- und Kegelfedern). Maschinenbau, vol. 9, no. 24, Dec. 18, 1930, pp. 808-809, 4 figs. Methods and difficulties in calculating springs of circular cross section; advantages in using special slide rule.

Design

J. B. Reynolds and A. B. Schier.
Design of Conical Spring with Coils of a Uniform Slope. Am. Soc. Mech. Engrs.—Advance Paper, no. 60, for mtg. Dec. 1 to 5, 1930, 21 pp., 12

figs. partly on supp. plates. Progress report no. 8 of American Society Mechanical Engineers Special Committee on Mechanical Springs (Technological); investigation of two series of springs which differed only in respect to pitch and slope, and to compare performance of these springs; each was made in two cross-sections, rectangular and circular section of four active coils and two complete dead coils; proper heat-treatment and methods of handling springs during treatment.

A. M. Wahl.

General Considerations in Designing Mechanical Springs. Machine Design, vol. 2, nos. 5, 7 and 8, May 1930, pp. 26-31, July, pp. 24-27 and Aug., pp. 44-47, 21 figs. May: Method for determining working stresses in spring based on tensile and fatigue properties of material; graphs show distribution of stresses over cross section of springs of large index and results of stress test on helical spring; numerical example for valve spring is given. July: Commonly used formulas for designing helical springs of square and rectangular wire; more exact formulas are suggested. Aug.: Formulas for calculating torsional strength of springs with rectangular and circular cross section; formulas based on simple beam theory are corrected for springs of small index.

C. E. Squire.

The Design and Performance of Railway Springs. Ry. Engr., vol. 51, no. 610, Nov. 1930, pp. 409-413 and 429, 5 figs. Scientific study of design and operating characteristics of railway springs, as employed in construction of locomotives and rolling stock; calculation of stresses; spring failures and their causes; recording stresses; load deflection curves.

J. S. Beggs.

Time Required for the Action of a Spring. Machy. (N. Y.), vol. 36, no. 5, Jan. 1930, p. 376, 3 figs.; see also Machy. (Lond.), vol. 35, no. 909, Mar. 14, 1930, p. 781, 3 figs. Formulas for calculating time required for spring to perform its allotted function; examples illustrating application.

Grinding

Anonymous 175.

Semiautomatic Disk Grinders Increase Spring Production. Abrasive Industry, vol. 11, no. 1, Jan. 1930, pp. 26-27, 1 fig. Methods employed at plant of American Spiral Spring Mfg. Co., Pittsburgh; grinding of ends of heavy coil springs has been expedited through use of semi-automatic equipment.

Heat Treatment

D. W. Frye.
Heat Treating Spiral Springs with Natural Gas. Natural Gas, vol. 11, no. 10, Oct. 1930, pp. 32 and 34, 1 fig. Furnace installation at Pittsburgh is illustrated; data on production, total and unit gas consumption during three months operation of furnace for heat treatment of spiral springs made from bar steel.

R. W. Cook.
Spring Wire Special Heat Treated. Iron Age, vol. 126, no. 12, Sept. 18, 1930, pp. 764-766 and 828, 2 figs. Discussion of manufacturing process of Wallace Barnes Co., Bristol Conn.; spring materials having tensile strengths of 400,000 lb. per sq. in. are produced by combinations of cold work and heat treatment; physical properties for music wire, watch wire and tempered spring wire.

Helical

H. M. Brayton.
Designing Steel Springs for Two Loads. Machy. (N. Y.), vol. 36, no. 9, May 1930, pp. 679-681, 1 fig. Method of designing small springs when two loads and height of spring at which each load is applied.

A. M. Wahl.
Further Research on Helical Springs of Round and Square Wire. Am. Soc. Mech. Engrs.—Advance Paper, no. 24, for mtg. June 9 to 12, 1930, 8 pp., 21 figs. Proposed method of calculating stress in helical springs of square or rectangular wire is to use approximate formula, based on St. Venant's results for torsion of rectangular wire, and multiply by correction factor based on spring index; it is suggested that this new formula replace those commonly given in handbooks, which may lead to considerable error in certain cases. See Engineering Index 1929, p. 1709.

Anonymous.176.
Tentative Specifications for Heat-Treated Carbon-Steel Helical Springs. Am. Soc. Testing Matls.—Proc., part 1, vol. 29, 1929, pp. 566-573. Specifications cover manufacture; sampling; physical properties and tests; workmanship and finish; marking; inspection and rejection.

Anonymous.177.
Tentative Specifications for Heat-Treated Carbon-Steel Helical Springs. Am. Soc. Testing Matls.—Tentative Standards, 1930, pp. 34-41. Specifications cover hot-coiled, helical compression springs made of round bars 1/2-in. and larger in diameter and suitable for use in railway equipment.

Laminated

Anonymous 178.
Experiments on Laminated Springs. Engineering, vol. 129, no. 3338, Jan. 3, 1930, pp. 26-28, 17 figs. Review of recent reports of Department of Scientific and Industrial Research of experimental work at National Physical Laboratory; these deal respectively with their displacements while running; effect of nip on their mechanical properties; and, in continuation of latter work, further inquiry into their endurance.

Locomotive Springs

H. P. Leonard.
Locomotive Springs in Process. Am. Mach., vol. 72, no. 8, Feb. 20, 1930, pp. 340-341, 8 figs. Two pages of photographs showing genesis and evolution of heavy leaf-type locomotive springs in Milwaukee shops of Chicago, Milwaukee, St. Paul and Pacific Railroad.

Manufacture

S. Lewis.
Making and Repairing Railroad Springs. Ry. Jl., vol. 36, no. 1, Jan. 1930, pp. 26-28. Forming and hardening operation; schedule of heat treatment of spring steel necessary; practices on Canadian National railways; flexibility and friction of spring plates; preventable, economic waste. Before Railroad Master Blacksmiths' Convention.

J. Breakey.
Modern Spring Making in a Hamilton Plant. Can. Machy., vol. 41, no. 10, May 15, 1930, pp. 39-42, 5 figs. Methods and equipment by Wallace Barnes Co., Ltd., Hamilton, Ont.

T. F. Buckley.
Spring Manufacturing and Repairing. Ry. Mech. Engr., vol. 104, no. 10, Oct. 1930, pp. 569-570. Operations which have been followed in successful manufacture of new and reconditioned springs.

Anonymous 179.
Spring Production is Aided by Modern Grinding Practice. Abrasive Industry, vol. 11, no. 12, Dec. 1930, pp. 18-20 and 31, 6 figs. Manufacturing methods and equipment at plant of Raymond Mfg. Co., Corry, Pa.; production of springs of miscellaneous classes exceeds 100,000 tons per year; data on speeds, grit size and fixtures used in various grinding operations.

Anonymous 180.
Two New Spring-Making Machines. Machy. Market, no. 1530, Feb. 28, 1930,

pp. 187-188, 2 figs. Description of two new machines specially designed for spring manufacture which have been produced by Fairbank Brearley, York; new steel-plate frame forging machine is capable of dealing with spring plates of 55 tons tensile up to size of 4 by 5/8-in. cold; single-stroke eye-rolling machine, developed for forming eyes in spring plates for automobiles, is capable of dealing with spring plates up to 3 in. wide and 3/8 in. thick.

Motor Bus Springs And Suspension

M. W. Bourdon.
Bus and Coach Springing. Bus and Coach, vol. 2, nos. 22 and 23, Oct. 1930, pp. 388-391, 10 figs., and Nov. 1930, pp. 444-447, 13 figs. Relative merits of different designs; spring located by central assembly bolt and by projections on main leaf; interlocking domes and recesses for spring location; divided main leaf spring; anchorage and interleaf friction; main leaf solid (i.e., forged) eye; types of spring leaf ends; effect of load upon small number of leaves; spring pin lubrication; chamfered spring bed; types of oil-less bushes; roller and rubber block fixings; underslung springs; front spring shackles.

N. E. Henrickson.
Factors that Influence the Successful Operation of Bus Springs. Bus Transportation, vol. 9, no. 10, Oct. 1930, pp. 556-560, 8 figs. Problems of motor-bus suspension which can be solved by proper design, choice of materials, accurate heat treatment and proper attention to mechanical details of suspension.

Motor Truck Springs And Suspension

Anonymous 181.
An Important Contribution to Progress in Vehicle Suspension. Commercial Motor, vol. 50, no. 1297, Jan. 21, 1930, pp. 856-857, 3 figs. Explanation of Griffith A. E. F. Articulated Master leaf spring which eliminates need for shackles, is self-damping, and removes risk of main-leaf fracture.

Anonymous 182.
Developments in Spring Design. Motor Transport, vol. 50, no. 1296, Jan. 13, 1930, p. 47. Description of universal mounting which eliminates need for torque rods in 4-wheeled truck and torque-reaction distribution clip; designed for use on six-wheelers.

Oscillations

E. Lehr.
Oscillation Problems of Vehicle Springs (Schwingungsfragen der Fahrzeugfederung). V. D. I. Zeit., vol. 74, no. 32, Aug. 9, 1930,

pp. 1113-1119, 13 figs.; see also French translation in Science et Industrie, vol. 14, no. 202, Nov. 1930, pp. 860-862, 9 figs. In order to clearly illustrate effect of road surface upon vehicle, problem is analyzed into series of simple questions; graphic methods for determining paths and velocity curves of oscillating systems; effect of damping is investigated in detail.

Research

M. F. Sayre.
Elastic and Inelastic Behavior in Spring Materials. Am. Soc. Mech. Engrs.—Proc., vol. 30, part 2, June 23-27, 1930, pp. 546-558, 6 figs. Progress report no. 7 of A.S.M.E. Special Research Committee on mechanical springs; new method of work by using 52-ft. gage length with dead-weight loading, readings of elongation can be taken to one part in 15,000,000 on total length of wire sample; numerical values for rate of change of Young's modulus of elasticity with stress decrease in modulus of elasticity in tension as result of previous overstrain in tension; mechanical hysteresis values for unidirectional stress in tension for various materials.

Stresses

M. F. Sayre and A. Hoadley.
Stress Distribution and Hysteresis Losses in Springs. Applied Mechanics (A.S.M.E. Trans.), vol. 51, no. 30, Sept.-Dec., 1929, pp. 287-303 and (discussion) 303-305, 24 figs. Abstract of Progress Report No. 4, of special Research Committee on Mechanical Springs of American Society of Mechanical Engineers, covering first year of investigations carried on by Committee at Union College, Schenectady. Indexed in Engineering Index 1928, pp. 1726-1727, from Am. Soc. Mech. Engrs.— Advance Paper.

E. Latshaw.
Stresses in Heavy Helical Springs. Franklin Inst.—Jl., vol. 209, no. 6, June 1930, pp. 791-808, 7 figs. Theoretical, mathematical discussion with special reference to springs used in suspension of railroad rolling stock.

G. A. Hankins.
Stress Strain Relationships in Spring Steels. Engineer, vol. 150, no. 3892, Aug. 15, 1930, pp. 178-179, 1 fig. Discussion of stress strain under conditions which are often assumed to be elastic; experimental results on changes in elastic moduli after excessive overstraining of material. Communication from Springs Committee of Department of Sci. and Indus. Research. Bibliography.

Testing

E. Siebel and A. Pomp.
Determination of Elastic Limit and Creep Limit of Spring-Steel Wire by Means of Torsional Test (Die Bestimmung der Elastizitaetsgrenze und der Fleissgranze von Federstahldraht durch den Verwindungsversuch. Mitteilungen aus dem Kaiser-Wilhelm-Institut fuer Eisenforschung zu Duesseldorf, vol. 12, no. 7, 1930, pp. 85-91, 10 figs. Principles underlying comparison of tensile, compression and torsional tests; displacements as measure of deformation; comparison of flow curves for tension, compression and torsion; development of simplified testing method for spring-steel wire.

P. Grodzinski.
Simple Arrangement for Determining Spring Quality of Spring Strip Material (Sonderlehre zum Pruefen der Lagerschalen von Pleuelstangen). Maschinenbau, vol. 9, no. 24, Dec. 18, 1930, p. 809, 3 figs. Design of simple test fixture together with tables containing results for principal spring materials.

F. P. Zimmerli, W. P. Wood and G. D. Wilson.
The Effect of Temperature upon the Torsional Modulus of Spring Materials. Am. Soc. Testing Matls.—Proc., vol. 30, part 2, of mtg. June 23-27, 1930, pp. 350-360 and (discussion) 361-367, 10 figs. This investigation was carried out by applying simple torsion to wire sections in specially constructed furnace; having determined angle of twist for various loads, modulus was calculated by inversion of usual expression representing relation between twisting moment and resultant angle of twist in member subjected to pure torsion.

Torsional

J. K. Wood.
New Torsional Spring Formulas. Iron Age, vol. 125, no. 4, Jan. 23, 1930, pp. 303-306, 9 figs. Formulas for helically or spirally coiled springs, arranged to resist rotary motion or torque, which are called torsional springs; correction to standard stress formulas essential with small coil diameters; conventional methods may be far in error; basis of current design practice; formula for correction of deflection; cumulative effect is important; formulas for safe maximum stress and load-deflection rate.

M. F. Sayre.
Stresses and Deflections in Helical and Spiral Torsional Springs as Affected by Curvature. Am Soc. Mech. Engrs.—Advance Paper, no. 31, for mtg. June 9-12, 1930, 8 pp., 5 figs. on supp. plates. Investigation of effects of relatively sharp curvature on stress and deflection of curved beams such as would be used in torsional springs, stressed in bending; results with spring-steel bars of rectangular cross section justify

application of theoretically deduced correction factors to formulas; in springs of sharp curvature correction for maximum stress is as high as plus 30 per cent while for deflection it is only minus 3 per cent.

1931

Automobile Springs and Suspension

Anonymous 183.
Ein neues Federblattprofil (New Leaf-Spring Profile). Kruppsche Monatshefte, vol. 12, Jan. 1931, pp. 7-9, 4 figs. Advantages of leaf-spring profile in production by Fried. Krupp Aktiengesellschaft; springs can be loaded considerably in excess of calculated maximum load without permanent deformation; improved utilization of material combined with space for retaining lubricant.

W. L. Fisher.
Independent Springing. Autocar, vol. 66, no. 1851, Apr. 24, 1931, pp. 728-730, 8 figs. Characteristics of principal designs with constant track and linkage suspension of Sizaire-Naudin, Flexatic, Sterkenberg, Alvis, Cottin-Desgouttes, Lancia, Austro-Daimler, and Bucciali.

P. Balma.
Lancia Spring Said to Eliminate Shimmy and Wobble. Automotive Industries, vol. 65, no. 7, Aug. 15, 1931, pp. 232-233, and 236, 1 fig. Advantages of Lancia design, with particular regard to low unsprung weight obtained by use of coil springs; independent springing with stiff frame and axle result in important improvements in riding qualities.

Comparative Tensile and Shearing Behavior

M. F. Sayre.
Comparative Tensile and Shearing Behavior in Springs. Am. Soc. Mech. Engrs.--Advance Paper, for mtg. June 1-3, 1931, 8 figs. Progress report no. 9 of A.S.M.E. Special Research Committee on Mechanical Springs (Technological); experimental values of modulus of elasticity in torsion and of decrement ratio or logarithmic decrement, for three different sizes of 0.67 per cent carbon heat-treated steel wire are given in tables; approximate average values of decrement ratio and of modulus in shear, for various materials.

M. F. Behar.
Instrument Springs and Diaphragms. Instruments, vol. 4, no. 3, Mar. 1931, pp. 173-181. Status of experimental knowledge of their endurances, elastic, thermal and other properties affecting service-life and accuracy.

Anonymous 184.
Springs and Spring Steel. Engineering. vol. 132, no. 3441, Dec. 25, 1931,

p. 795. Review of (Great Britain) Department of Scientific and Industrial Research, Report of Springs Research Committee, published by H. M. Stationery Office, London, price 1s. 3d.; investigations directed particularly to laminated bearing springs for mechanically propelled vehicles, and to helical engine-valve springs.

T. H. Sanders.
Springs and Suspension. Lond., Locomotive Publishing Co., 1930, 788 pp., illus., diagrs., tables. 30s. Review of spring arrangements for locomotives, railroad cars and coaches, street cars, and automobiles, and of springs for buffer and traction gear; past and current methods of springing vehicles; practice of many railroads and vehicle builders; continuation of author's book on design and manufacture of laminated springs. Eng. Soc. Lib., N. Y.

E. E. Thum.
Why. . . Did That Spring Break? Metal Progress, vol. 19, no. 3, Mar. 1931, pp. 56-63, 7 figs.; see also Metallurgist (Supp. to Engineer), Aug. 28, 1931, pp. 119-120. Design, performance, and manufacture of helical springs with data on physical properties and treatment of different materials, particularly steel.

Conical

J. B. Reynolds and O. B. Schier.
Design and Investigation of Conical Springs with Coils of Constant Slope. Am. Soc. Mech. Engrs.—Advance Paper, for mtg. Nov. 30-Dec. 4, 1931, 24 pp., 15 figs. Conical springs of constant slope behave more like helical springs than do conical springs of constant pitch as regards load-deflection characteristics; formulas to predict with accuracy behavior of conical springs; chrome-vanadium-steel heat treatments.

J. B. Reynolds and O. B. Schier.
Design and Investigation of Spring in Which All Coils Nest Simultaneously. Am. Soc. Mech. Engrs.—Advance Paper, for mtg. Nov. 30-Dec. 4, 1931, 16 pp., 3 figs. Distribution of stresses on inside of coils for each half turn; stresses increase directly with loads and by equal intervals for successive half-coils; stresses proportional to radii of coils.

Design

K. Kourian.
Spring Calculations from First Principles. Ry. Engr., vol. 52, no. 620, Sept. 1931, pp. 354-355 and 364, 1 fig. Fundamental design features of springs, mainly for railroad rolling stock; definitions and symbols; moment of inertia; steel as spring material; moment of resistance; energy of springs; tempering and testing.

Galvanometer Suspension

M. J. Brevoort.
Note on Julius Suspensions. U. S. Bur. Mines—Report of Investigations, no. R. I. 3086, Mar. 1931, 2 pp., 1 fig. on supp. plate; see also Instruments, vol. 4, no. 5, May 1931, pp. 277-278, 1 fig. and Rev. Sci. Instruments, vol. 2, no. 8, Aug. 1931, pp. 447-449, 1 fig. Research work in Bureau of Mines cryogenic laboratory requires use of high-sensitivity galvanometers of d'Arsonval type in building that is subject to unusually severe vibrations; modified form of galvanometer suspension described by Julius in Annalen der Physikalischen Chemie of 1895, has damped vibrations successfully.

Helical

A. N. Lukens.
Active Portion of Large Helical Springs. Am. Soc. Mech. Engrs.—Advance Paper, for mtg. Nov. 30-Dec. 4, 1931, 6 pp., 7 figs. on supp. plate. Method of calculating hot-wound helical compression springs with particular regard to dangers involved in using faulty assumptions.

E. Honegger.
Calculation of Helical Springs of Round Wire. Brown Boveri Rev., vol. 18, no. 3, Mar. 1931, pp. 120-125, 7 figs. Simplified method of calculation; development of equations; examples of application; assumptions; deduction of most important formulas.

H. M. Brayton.
Designing Steel Springs for Two Loads. Machy. (Lond.), vol. 37, no. 952, Jan. 8, 1931, pp. 481-482. Indexed in Engineering Index 1930, p. 1641, from Machy. (N. Y.), May 1930.

J. W. Rockfeller, Jr.
Determining Stresses in Helical Springs. Machy. (N. Y.), Vol. 38, no. 3, Nov. 1931, pp. 206-207. Wahl's stress multiplication factor applied to correct usual discrepancy; chart for determining stresses in helical springs wound with wire in sizes ranging from 0.14 to 1 in. in diam.

M. G. Van Voorhis
Developing Springs Graphically. Machine Design, vol. 3, no. 4, Apr. 1931, pp. 48-49, 1 fig. Computation and use of nomographic chart for quick designing of helical round wire springs.

S. Grosz.
Druckbeanspruchte Kegelstumpffedern mit gerader Kraft-Weg-Linie (Helical Springs for Compression Loading with Straight-Force-Path Characteristics) V.D.I. Zeit., vol. 74, no. 52, Dec. 27, 1930, pp. 1759-1762, 8 figs.

Investigation of formulas for calculating helical springs of truncated cone shape; comparison of three types of springs with straight characteristics by means of space utilization number.

L. E. Adams.
Shear Stresses in Helical Springs. Engineer, vol. 151, no. 3937, June 26, 1931, pp. 698-699, 2 figs. Theory developed is based on what writer has called "Roever Effect," after A. Roever, who in 1913, was perhaps first to realize that stress distribution in spring, due to pure torsion, was not directly proportional to distance of spring fiber from geometric center of section of wire; theoretical results are in very close agreement with careful experimental work of Special Research Committee on Springs of American Society Mechanical Engineers.

Anonymous 185.
Tentative Specifications for Heat-Treated Carbon-Steel Helical Springs (A125-31T). Am. Soc. Testing Matls.— Tentative Standards, 1931, pp. 51-58.

Manufacture

O. C. Schmid.
Federnwindesmaschinen (Spring Winding Machine). Werkstattstechnik, vol. 25, no. 5, Mar. 1, 1931, pp. 140-143, 19 figs. Automatic winding machines for coil springs; methods of winding spring without mandrel.

E. F. Davis.
Heat Treatment and Manufacture of Springs. Fuels and Furnaces, vol. 9, nos. 4 and 5, Apr, 1931, pp. 417-428 and May, pp. 571-576, 7 figs. Two general classifications of springs; steels for helical springs, their chemical and physical properties; music wire, hard drawn-wire, heat-treated wire, annealing wire, alloy spring steels and defects in spring wire.

T. F. Buckley.
Railroad Spring Manufacturing and Repairing. Ry. Jl., vol. 37, no. 1, Jan. 1931, pp. 38-39, 1 fig. Indexed in Engineering Index 1930, p. 1641, from Ry. Mech. Engrs., Oct. 1930.

Anonymous 186.
Spring Production for Railway Rolling Stock. Metallurgia, vol. 3, no. 18, Apr. 1931. pp. 199-203, 11 figs. Features of Swindon Works of Great Western Railway Co.; newly installed equipment has improved quality, reduced repairs, and effected economy; manufacturing details; tempering; testing machine; pyrometers for checking working temperature.

Phosphor-Bronze

M. Tanaka and T. Ogawa.
On Properties of Phosphor-Bronze for Springs. Electrotech. Laboratory Japan—Researches, no. 301, Jan. 1931, 85 pp., numerous figs. Results of test with metal containing less than 10 per cent of tin and 0.5 per cent of phosphor; test specimen of different compositions were annealed at various temperatures; melting point, density, coefficient of linear expansion, ultimate tensile strength, Young's modulus, elastic limit, specific resistance, and temperature coefficient of resistance were determined. (In Japanese, with English abstract.)

Railroad Repair

W. J. Wiggin.
Spring Making and Repairing. Ry. Jl., vol. 37, no. 4, Apr. 1931, pp. 23-25, 1 fig. Fundamentals involved in obtaining correct physical characteristics of spring steel; procedure of springs manufactured for test purposes; limiting plate thickness; spring-shop equipment. Before Int. Railroad Master Blacksmiths' Assn.

Spiral

M. Ensslin.
Belastungsversuche mit zylindrischen Schaubenfedern aus Stahl (Load Tests with Cylindrical Coil Springs of Steel). Maschinenbau, vol. 10, nos. 15 and 16, Aug. 6, 1931, pp. 496-500 and Aug. 20, 536-540, 15 figs. Experimental determination of modulus-of-elasticity tests of spring calculations; effects of heavy overload; hysteresis effects and recovery; characteristics of cold wound springs with and without subsequent heat treatment.

E. Langhans.
Einfache Kurventafeln zur Berechnung von Zylindrischen Schraubenfedern mit kreisfoermigem Querschnitt (Simple Alignment Charts for Calculation of Cylindrical Spiral Springs with Circular Cross-Section). Werft-Reederei-Hafen, vol. 12, no. 21, Nov. 1, 1931, pp. 367-368, 3 figs. Simplification of former complicated system of charts, which permits simple and accurate calculation of springs.

J. A. Van Den Broek.
Spiral Springs. Am. Soc. Mech. Engrs.—Advance Paper, for mtg. June 15-16, 1931, 13 pp., 12 figs. New theory relative to stress, strain, and energy functions of spiral springs, taking into account large deformations implied in action of spiral springs; recommendations with reference to design and mounting; springs may be loaded in such manner as to eliminate all locally overstressed points as well as all friction between leaves; no grease or graphite, therefore, need to be employed and efficiency of spiral springs may be increased.

Testing Machines

Anonymous 187.

Spring-Testing Machines with Hydraulic Drive. Ry. Engr., vol. 52, no. 622, Nov. 1931, pp. 415-416, 7 figs. Design, construction and operating characteristics of Losenhausenwerk machine; instruments for measuring tractive effort of locomotives.

Vibrations

J. P. Denhartog and S. J. Mikina.

Forced Vibrations with Non-Linear Spring Constants, Am. Soc. Mech. Engrs.—Advance Paper, no. 10, for mtg. Nov. 30-Dec. 4, 1931, 6 pp., 9 figs. Exact theory of couplings which have springs with initial set; shift in critical speed with amount of initial set; case of coupling with stops.

1932

Automobile Springs and Suspension

R. Slaby.

Ausgleichvorgaenge bei Automobilfedern. Automobiltechnische Zeit v 34 n 34-5 Dec. 15, 1931, p. 775-80. Mathematical analysis of oscillations with particular regard to superimposition of oscillations due to tire and spring characteristics.

Anonymous 188.

Der Hanft-Stabilisator. Automobiltechnische Zeit v. 35, n. 17, Sept. 10, 1932, p. 416-17. Hanft stabilizer for uniform distribution over both springs of loads applied on one side of car either by turning corner, road shock or uneven road surface; reduction of torsional stresses in springs; automatic lowering of center of gravity in curves while horizontal position of body is maintained.

E. Carlberg.

Om roerelsen hos automobilaxlar med haensyn till fjaedrarna. Teknisk Tidskrift, v 62, n. 34, Aug. 20, 1932 (Mekanik) p. 98-100. Mathematical analysis of movement of axles relative to springs and effect of braking on spring deformation.

Anonymous 189.

Springing—Next Development, Motor (Lond.), v. 62, n. 1609, Oct. 25, 1932, p. 634-7. Progress in independent wheel springing, use of oscillating rear axles and elimination of front axles as represented by designs of Lancia, Derby, Darracq, Mathis, Harris-Leon-Laisne, Dubonnet and others.

Anonymous 190.
Spring Problems. Ry. Gaz. v. 56, n. 7, Feb. 12, 1932, p. 221-2. Devices introduced by Jonas Woodhead and Sons, to meet arduous conditions under which heavy vehicles have to be operated.

P. M. Heldt.
33 Cars Use Independent Springing As Suspension Design Sweeps Europe. Automotive Industries, v. 67, n. 5, July 30, 1932; p. 134-7. Advantages of independent wheel springing with particular regard to designs by Tatra, DKW, Mercedes, Cottin-Desgouttes, and Steyr.

Beryllium-Copper Alloys

K. G. Frank.
Wrought Beryllium-Copper for Electrical Parts and Springs. Product Eng., v. 3, n. 3, Mar. 1932, p. 108. Further developments in wrought metals of new physical and electrical characteristics; springs of beryllium-copper alloys have been stressed 25,000,000 times without apparent fatigue while standard phosphor spring bronze failed after 400,000 compressions.

Electric Machinery

W. C. Hirsch.
What It Pays to Know About Springs. Elec. Mfg., v. 9, n. 3, Mar. 1932, p. 19-20. Types of springs; distinction between flat and spiral springs; shaping of general run of electrical springs; ferrous and non-ferrous alloy springs; spiral springs of beryllium copper.

Electric Measuring Instruments

P. MacGahan and R. W. Carson.
Aging and Elastic Hysteresis in Instrument Springs. Instruments, v. 5, n. 4, Apr. 1932, p. 89-90. Manufacture of instrument springs; aging effects; elastic hysteresis effects; curves showing effect of operating temperature on rate of uncoiling of untreated spiral springs and effect of load time on elastic recovery of spring ribbon. Before Am. Inst. Elec. Engrs.

Design

J. J. Pesqueira.
Cylindrical Springs of Variable Pitch. Gen. Elec. Rev., v. 35, n. 5, May 1932, p. 271-4. Theoretical mathematical design analysis and examplification.

W. W. Boyd.
Deflection and Capacity of Belleville Springs. Product Eng., v. 3, n. 9, Sept. 1932, p. 361-3. Curves for load capacity of springs 0.02 to 0.04 in., 0.06 to 0.26 in., 0.12 to 0.30 in. and 0.35 to 0.60 in. thick; deflection curves for 4, 5 and 6° angle of dish; charts for determining spring proportions with minimum amount of arithmetical work.

O. Goehner.
Die Berechnung zylindrischer Schraubenfedern. VDI Zeit v. 76, n. 11 and 30, Mar. 12, 1932, p. 269-72, and July 23, p. 735. Formulas for calculating stresses in closely wound cylindrical springs of circular and square cross-sections; relations between load and deformation.

E. Aster and P. Knechtel.
Ueber die Ermittlung der erforderlichen Ventilfederkraft. Automobiltechnische, Zeit v. 35, n. 1 and 2, Jan. 10, 1932, p 11-14 and Jan. 25, p. 49-51. Design of springs for poppet valves with particular regard to effects of different types of valve-lifting mechanisms, vibrations, etc.

Helical

A. Hutton.
Chart for Use in Designing Helical Springs. Machy, (N. Y.), v. 38, n. 12, Aug. 1932, p. 893-4. Alignment chart for designing springs made from round bar stock based on max shear stress of 70,000 lb. per. sq. in.

C. Susa.
Determining Range of Helical Bourdon Springs. Instruments, v. 5, n. 4, Apr. 1932, p. 85-6 and 88. Time and material can be saved in manufacturing Bourdon springs of specific range, by calculating range of helical springs according to method explained.

C. T. Edgerton.
Fatigue Tests of Helical Springs, and Number of Inactive Coils in Compression. Am. Soc. Mech. Engrs.—Advance Paper, n. 54, mtg. Dec, 5-9, 1932, 6 p. Formulation of program for fatigue tests; results from preliminary runs; number of dead or inactive coils in helical compression spring; analysis for development of this number from data taken in connection with fatigue tests; special tests supporting accuracy of results of analysis.

V. Tatarinoff.
Helical Spring Calculations. Machy. (Lond.), v. 41, n. 1049, Nov. 17, 1932, p. 194-6. Graphical method corrected for supplementary concentration of fiber stress on inside surface of coils; formulas based on outside diameter of spring instead of mean or pitch diameter.

I. Musatti and G. Calbiani.
Le molle elicoidali. Metallurgia Italiana, v. 24, n. 6 and 7, June 1932, p. 465-84 and July, p. 549-572, 6 supp. plates. Design, manufacture and heat treatment of helical springs; physical properties and composition of materials; testing methods and causes of failure.

A. M. Wahl.
New Helical Spring Formulas and Tables. Machy, (N. Y.), v. 38, n. 10, June 1932, p. 731-4; see also Machy. (Lond.), v. 40, n. 1032, July 21, 1932, p. 496-8. Formulas and tables for determining max loads, in pounds, and deflections per coil, in inches, for helical springs 1/8 to 7/8 in., 1 to 2-1/2 in. and 2-3/4 to 7-1/2 in. outside diam.

R. F. Vogt.
Number of Active Coils in Helical Springs. Am. Soc. Mech. Engrs.—Advance Paper n. 52 mtg. Dec. 5-9, 1932, 5 p.; see also Machine Design, v. 4, n. 12, Dec. 1932, p. 37-9. Exact amount of spring deflection corresponding to influence of "inactive" coils can be calculated for known loading conditions and closely estimated for all springs subjected to conventional practive loads; deflections of end coils calculated in terms of deflection of active coils; tests to determine actual number of active coils suggested and examples given.

R. Marty.
Sur le calcul des resorrts à boudin chargés transversalement. Académie des Sciences—C R v. 195, n. 2, July 11, 1932, p. 105-7. Theoretical mathematical discussion of design of helical springs, transversely loaded.

Laminated

H. Stark.
Untersuchungen an Blattfedern. VDI Zeit, v. 75, n. 51, Dec. 19, 1931, p. 1521-6; see also Automobiltechnische Zeit v. 25, n. 6, Mar. 25, 1932, p. 151-4; and English abstract in Mech. World, v. 92, n. 2382, Aug. 26, 1932, p. 193. Progress report of Spring Committee of VDI on graphic experiments; stress distribution in vertically loaded leaf springs and comparison with data obtained from various laminations; satisfactory agreement of calculation with experiments.

Manufacture

A. Blashill.
Ring-Lock Wire-Fence Making Machine. Engineering, v. 133, n. 3452, Mar. 11, 1932, p. 309. Machine, somewhat akin to loom is invention of Canadian engineer. Wire employed in this type of fence is harder than that usually employed in other types, and is 60% stronger; material is 0.20 to 0.30% carbon steel and is hand drawn; machine will make single fence

up to max width of 61 in. or min of 26 in., and with up to 10 horizontal wires, pitched as required.

Materials

Anonymous 191.

Steel and Rubber Springs. Mech. World, v. 92, n. 2384, Sept. 9, 1932, p. 243-4. Spring for reducing shock should have maximum amount of stroke, and should be capable of storing energy; springs for this purpose can be divided into two kinds, those in which length is less than diameter and for which rubber is superior, and those in which length is greater than diameter, and for which steel is best used.

Railroad Repair

Koeniger.

Note sur la réparation et la confection des ressorts à lames aux Chemins de fer d'Alsace et de Lorraine à Bischheim. Revue Générale des Chemins de Fer, v. 51, n. 2, Feb. 1932, p. 112-19. Shop layout and operations at plant of Alsace et de Lorraine railroad at Bischheim for manufacture and reconditioning of springs for locomotives and cars.

Railroad Rolling Stock

Anonymous 192.

British Standard Specifications for Railway Rolling Stock Material. Pt. 3 Laminated, Volute and Helical Springs and Steel for Laminated, Volute and Helical Springs. Brit. Standards Instn. — Standard Specification n. 24, pt. 3, May 1932, 27 p.

Anonymous 193.

Springs for Rolling Stock. Engineer v. 154, n. 3999, Sept. 2, 1932, p. 232. Extracts from booklet issued by Coil Spring Makers' Assn. Sheffield, entitled "Steel Springs or Rubber Springs," recording researches by Committee of leading manufacturers of coil springs into comparative advantages of two types.

Anonymous 194.

Steel versus Rubber. Ry. Engr., v. 53, n. 633, Oct. 1932, p. 363. Conclusions drawn from brochure dealing with relative merits of steel springs and rubber springs as used in railway rolling stock, issued by Coil Spring Makers' Assn. of Sheffield.

Specifications

P. Pimenov.
Standardization of Springs. Vestnik Standartizatzyi in 8 Aug. 1931, p. 25-9. Review of spring standards of Russia and other countries; standardization of spring materials, heat-treatment process, methods of spring testing; instruments. (In Russian)

Spiral

A. Wolff.
Die Berechnung der Schraubenfedern. Werkzeugmaschine, v. 36, n. 7 and 8, Apr. 15, 1932, p. 117-19 and Apr. 30, p. 141-4. Principal calculations in designing cylindrical coil springs for compression and tension with particular regard to buckling of springs made of wire of square and rectangular cross-sections.

J. A. Van Den Broek.
Spiralfedern. VDI Zeit v. 76, n. 39, Sept. 24, 1932. p. 930. Spiral springs. Indexed in Engineering Index, 1931, p. 1330 from Am. Soc. Mech. Engrs.—Advance Paper mtg. June 15-16, 1931.

J. Jennings.
Springs for Maximum Effort. Mech World, v. 91, n. 2364, Apr. 22, 1932, p. 390-1. To put spring into given space and obtain maximum effort throughout working range is problem solved; method eliminates frequently wasteful trial-and-error method.

Spring Steel

E. Houdremont and H. Bennek.
Federstaehle. Stahl und Eisen, v. 52, n. 27, July 7, 1932, p. 653-61, (discussion) 661-2; see also English in Metallurgist (Supp. to Engineer) Sept. 30, 1932, p. 141-3; and Iron and Coal Trades Rev. v. 125, n. 3363, Aug. 12, 1932, p. 235. Results of investigation on spring steels shown in tables; addition of alloying elements does not greatly increase fatigue resistance of unmachined springs and, in general, laminated springs can safely be designed on limiting fatigue stress in material of plus or minus 9-1/2 t per sq. in., and helical springs on fatigue stress (torsional stress) of plus or minus 6-1/2 t per sq. in.

Deformation.

E. Grieb.
Verformung des Federstahles mit quadratischem oder rundem Querschnitt beim Warmrollen zylindrischer Schraubenfedern. Stahl und Eisen v. 52, n. 37, Sept. 15, 1932, p. 904-5. Deformation of spring steel with square or

round cross-section with hot rolling of cylindrical spiral springs.

Manufacture.

H. Wiesecke.
Herstellung von Springfederdraht aus weichem Flusstahl. Stahl und Eisen v. 52, n. 18, May 5, 1932, p. 433-9. Manufacture of spring wire from soft ingot steel; review of literature; field of application of hardened soft steel; temperature conditions with normal wire rolling; equipment for quenching of rolled wire; influence of chemical composition, hardening temperature and water temperature on hardening process; operating results.

Properties.

G. A. Hankins and M. L. Becker.
Effect of Surface Conditions Produced by Heat Treatment on Fatigue Resistance of Spring Steels. Iron and Steel Inst.—J v. 124, n. 2, 1931, p. 387-428 (discussion) 529-60, 2 supp. plates; see also Engineering, v. 133, n. 3446, Jan. 29, 1932, p. 141-4; and discussion in Iron and Coal Trades Rev., v. 123, n. 3326, Nov. 27, 1931, p. 834 and v. 125, n. 3370, Sept. 30, 1932, p. 502. Indexed in Engineering Index, 1931, p. 1330 from Iron and Coal Trades Rev., Oct. 2, 1931.

N. P. Goss.
Practical Application of X-Ray Diffraction Methods in Study of Quench and Temper Structures of Carbon Spring Steels. Am. Soc. Steel Treating—Trans. v. 19, n. 2, Dec. 1931, p. 182-92. Ill effects due to improper quenching cannot be removed by tempering; type of grain structure developed depends upon chemical composition, thickness and shape of specimen, temperature quenching medium, kind of medium (water, oil, etc.).

Anonymous.195.
Springs Research Committee. Dept. Sci. and Indus. Research—Report, n. 47-90, 1931, 75, p. 1s 3d. Investigations include survey of intrinsic mechanical and fatigue properties of wide range of British spring steels. Appendices include bibliography on springs and list and abstracts of papers and reports dealing with researches.

Testing.

Bonzel.
L'essai de torsion elastiqué des fils d'acier pour ressorts. Revue de Metallurgié, v. 29, n. 5, May 1932, p. 229-37. Elastic torsion test of steel wire for springs; examples of diagrams of torsion; it is concluded that this test is much better adapted to control of spring-steel wire than tension test, as it indicates more accurately good and bad properties of this material; its adaptation in standard specifications is recommended.

A. V. De Forest.
Magnetic Test Locates Flaws in Valve Springs. Iron Age, v. 130, n. 3, July 21, 1932, p. 107 and (adv. sec.) 18; see also Mech. World, v. 92, n. 2380, Aug. 12, 1932, p. 145-6. Airplane-engine valve springs were found to have better resistance to fatigue if they had polished surfaces than if they had been sand blasted or etched; therefore it was advantageous to find test for defects that left surface unimpaired; such test, magnetic dusting, is employed to locate flaws and is giving satisfactory results.

Stresses

H. Stark.
Ueber die Ermittlung der statischen Biegespannungen in geschichteten Federn. Automobiltechnische Zeit v. 34, n. 33, Nov. 30, 1931, p. 751-6. Determination of unknown forces acting between leaves by means of measurement of deformation of leaves of vertically loaded leaf springs with subsequent calculation of actual bending stresses in individual leaves of this springs.

Testing

K. Gehlen.
Pruefung von Uhrenfedern. Werkstattstechnik, v. 26, n. 20, Oct. 15, 1932, p. 402-4. Instruments for taking torque diagrams of springs for clocks and watches; measurement of friction losses in clock work.

Vibrations

J. Jaumann.
Ein eigenartiger Schwingungszustand einer Blattfeder. Zeit fuer Physik, v. 79, n. 3/4, Nov. 14, 1932, p. 235-47. Mathematical analysis of vibrations of leaf spring in which spring assumes curved neutral position.

J. P. Den Hartog and S. J. Mikina.
Forced vibrations with Non-Linear Spring Constants. Am. Soc. Mech. Engrs.— Trans., v. 54, n. 8 (Applied Mechanics), Sept. 30, 1932, p. 157-62 (discussion) 162-4. (APM-54-15). Indexed in Engineering Index 1931, p. 1330 from Am. Soc. Mech. Engrs.— Advance Paper, n. 10, mtg. Nov. 30-Dec. 4, 1931.

1933

Aging

R. W. Carson.
Aging of Springs. Am. Mach., v. 77, n. 7, Mar. 29, 1933, p. 202-3. Survey

of investigations of aging of springs with particular regard to temperature effect on principal metals. Bibliography.

Automobile Springs and Suspension

Anonymous 196.
Important Springing Developments. Motor (Lond.), v. 63, n. 1626, Feb. 21, 1933, p. 79-80. Comparison of principal methods of independent springing of front and rear wheels, with particular regard to use of non-rigid axles.

Smith-Clarke.
Independent Front-Wheel Springing. Motor (Lond.), v. 64, n. 1660, Oct. 17, 1933, p. 589-90. Advantages of some modern designs over conventional front-axle layout.

R. F. Colell.
Possibilities of Independently-Sprung Wheel. Engineering, v. 136, n. 3543, Dec. 8, 1933, p. 619-21. Typical arrangement of separate front-wheel suspension illustrated diagrammatically showing principle and essential features; advantages and difficulties.

Anonymous 197.
Steel Bars in Torsion Used as Springs in New Mathis Models. Automotive Industries v. 69, n. 17, Oct. 21, 1933, p. 482. Note on suspension said to make for light weight and economy in manufacture.

Beryllium-Copper

C. H. Davis.
Beryllium Copper Challenges Existing Materials. Machine Design, v. 5, n. 3, Mar. 1933, p. 23-4. Physical properties and application of beryllium-copper alloys with particular regard to springs and wires; forging, heat treatment and welding.

Car Springs and Suspension

T. H. Sanders.
Asspi Spring Steel Section. Ry. Engr. v. 54, n. 638, Apr. 1933, p. 102-5. Description of new spring steel section which has actually been adopted as practical section for rolling and spring manufacture and from which some thousands of springs have been made to date.

C. J. Holland.
Better Railway Car Truck Springs. Ry. Mech. Engr., v. 107, n. 4, Apr. 1933, p. 125-7. It is now generally recognized that one of primary causes of unsatisfactory performance of present standard truck springs is bouncing; given correct analysis of problem, solution can be found;

compression and release lines for helical springs and for helical-volute springs.

L. E. Endsley.
Draft Gear Springs—Past and Present. Ry. Mech. Engr., v. 107, n. 7, July 1933, p. 253-5. A few years ago ring spring consisting of series of outer and inner integrally closed rings was brought out and capacity of 200-ft-lb per lb. of steel in spring developed; capacity of draft gear made up on these principles depends upon size of pocket in which it is to go and upon what stress can be safely carried by steel; sectional view given. Before Ry. Club Pittsburgh.

Design

G. Liesecke.
Berechnung zylindrischer Schraubenfedern mit rechteckigem Drahtquerschnitt. VDI Zeit, v. 77, n. 16, Apr. 22, 1933, p. 425-6. Calculation of cylindrical helical springs of rectangular cross-section; theoretical mathematical design analysis.

O. Goehner.
Die Berechnung zylindrischer Schraubenfedern. VDI Zeit, v. 77, n. 8, Feb. 25, 1933, p. 198. Discussion, by M. Bergstrasser, of paper on formulas for calculating stresses in closely wound cylindrical springs of circular and square cross sections, indexed in Engineering Index 1932, p. 1224 from issue of Mar. 12, 1932.

Diesel Engines-Spring Valves

H. J. Scholtze.
Design of Diesel Valve Springs. Diesel Power, v. 11, n. 1, Jan. 1933, p. 46-7. Simplified procedure in designing valve springs illustrated by example of 4-cycle engine of 700 rpm.

Elastic Hysteresis

R. W. Carson.
Hysteresis in Springs. Am. Mach., v. 77, n. 16, Aug. 2, 1933, p. 494-5. In applications where spring deflections must be controlled within a few per cent elastic hysteresis, time lag of strain in relation to stress may present serious problem; factors controlling hysteresis and relative hysteresis of several spring materials given; design considerations and heat treatments minimizing effect of hysteresis recommended. Bibliography.

Electric Measuring Instruments-Springs

R. W. Carson.
Better Instrument Springs. Am. Inst. Elec. Engrs.—Advance Paper, n. 33-89, mtg, June 26-30, 1933, 7 p. Information resulting from torsional pendulum tests, hardness tests, spring-uncoiling tests, various forming and stabilizing treatments, and measurements of hereditary hysteresis with grid glow-micrometer; results of tests presented graphically. Bibliography.

Electroplating

L. V. Williams.
Music Wire Springs. Wire v. 8, n. 4, Apr. 1933, p. 104-5. Study to ascertain most satisfactory coating for such springs; results of tensile and torsional tests for this purpose.

Helical

W. M. Griffith.
Engineering Standards for Design of Springs. Product Eng., v. 4, n. 7, July 1933, p. 242-6. Formulas, data and specifications required for design of helical springs for tension, compression and torsion; tables of commerical tolerances and samples of standard drawings included.

C. T. Edgerton.
Fatigue Tests of Helical Springs and Notes on Sundry Results of Tests. Wire v. 8, n. 7, July 1933, p. 210-1 and 220-1. Progress report No. 2 on special committee of heavy helical springs of A.S.M.E. Special Research Committee on Mechanical Springs.

G. P. Pearce.
How to Select a Helical Springs. Am. Mach. v. 77, n. 19, Sept. 13, 1933, p. 588-9. Spring calculation simplified for shop usage by means of two charts.

F. P. Zimmerli, W. P. Wood and G. D. Wilson.
Load Losses in Small Helical Springs at Elevated Temperatures. Am. Soc. Steel Treating—Trans., v. 21, n. 9, Sept. 1933, p. 796-806. Results of investigation of load losses sustained by small helical springs in stressed condition when exposed to elevated temperatures for periods of 72 hr.; for each material studied there appears to be limiting temperature below which stress and temperature are controlling factors and above which time is important factor.

Anonymous.198.
Making Helical Springs According to A.S.T.M. Specifications. Machy.

(Lond.), v. 40, n. 4, Dec. 1933, p. 216 and supp. data sheets 263 and 264. Extracts from American Society for Testing Materials publication "A 125-33", which describes procedure for manufacturing, sampling, testing, finishing, and marking hot-coiled heat-treated carbon-steel helical compression springs.

R. F. Vogt.
Stresses in Helical Springs. Wire, v. 8, n. 7, July 1933, p. 201-7 and 217. Paper suggests new formulas for calculating dimensions and stresses of helical springs, taking proper recognition of influence of curvature of wire or bar and also of accompanying bending and shearing stresses due to regular load. Before Am. Soc. Mech. Engrs.

Internal Combustion Engines-Valve Springs

E. Lehr.
Schwingungen in Ventilfedern. VDI Zeit, v. 77, n. 18, May 6, 1933, p. 457-62. Test results show that vibrations occurring in valve springs, particularly of automotive engines, are forced oscillations, brought about by harmonics of valve lifting curve; equation for forced oscillations of valve springs with sinusoidal excitation is developed and solved in simple manner; various possibilities of overcoming valve-spring surging discussed.

J. Dick.
Surging in Helical Valve Springs. Roy Aeronautical Soc.—J v 37, n. 271, July 1933, p. 641-54. Surging leads to increased stresses and thereby contributes to spring fractures; theoretical treatment of distribution of surge stresses, not only in uniform springs, but in tapered and barrel-shaped springs, with suggestions for methods of minimizing effect of these stresses; speed of propagation of surge wave; characteristics of disturbance.

Laminated

Anonymous 199.
Bending and Hardening Machine for Laminated Springs. Metallurgia v. 8, n. 47, Sept. 1933, p. 157-8. Features of single and double automatic machines designed and built by Collet and Englehard, Offenbachmain Germany.

H. Stark.
Ueber ein graphisches Verfahren zur Bestimmung von gleicharmigen Blattfedern mit gleich dicken Blaettern. Glasers Annalen v. 112, n. 10, May 15, 1933, p. 81-3. Graphical method for determination of symmetrical springs consisting of laminations of equal thickness; theoretical graphical design analysis; intermediary report of Committee for Springs of Verein deutscher Ingenieure and Verein deutscher Eisenhuettenleute.

Locomotive Springs and Suspension

K. F. McCall.
Principles in Design of Locomotive Spring Rigging. Ry. Mech. Engr., v. 107, n. 9, Sept. 1933, p. 318-22 and 325. Fundamental principles in design of spring rigging for steam locomotives; diagram of spring rigging of 4-6-2-type locomotive; formulas, tables and diagrams of design problems.

Anonymous 200.
Interlocking Spring Rigging Developed on T. and P. Ry. Mech. Engr. v. 107, n. 2, Feb. 1933, p. 50-2. During past 5 yr. mechanical department of Texas and Pacific has been working on development of interlocking-type driving spring rigging; this type now in use on various locomotives.

Manufacture

Anonymous 201.
Bending and Hardening Machine for Large Laminated Springs. Eng. Progress, v. 14, n. 6, June 1933, p. 111-2. Illustrations and details of automatic double bending and hardening machine built by Collet and Engelhard, of Offenbach/Main, for reconditioning fatigued springs of railroad vehicles, or bending and hardening new springs.

H. Eckardt.
Bestimmung des Walzprofils bei Schraubenfedern mit rechteckigem Querschnitt. Stahl u Eisen v. 53, n. 45, Nov. 9, 1933, p. 1161-2. Determination of pass section for manufacture of coil springs with rectangular cross-section; method of measuring depth, center line and wedge angle of sides, and its advantages; alignment chart for determining incline of pass.

H. Maas.
Blattfeder-Biege- und Haertemaschinen. Glasers Annalen, v. 112, n. 1, Jan. 1, 1933, p. 3-5. Machines for bending and hardening of vehicle leaf springs built by Collet and Engelhard, Offenbach.

F. Klein.
Das Abstechen von Federrollen auf Einem Umgebauten Automaten. Werkstattstechnik, v. 27, n. 19, Oct. 1, 1933, p. 378-80. Cutting-off of helical spring on redesigned automatic machine tools; requirements for obtaining exact results from long wound springs; redesigning of equipment; tools; cutting speed; exactitude obtained.

C. H. Baer.
Springs and Spring Coiling. West Machy. and Steel World, v. 24, n. 3, Mar. 1933, p. 76-7. Machinery and methods in plant of Connor Spring Manufacturing Co., San Francisco.

Railroad Tracks-Springs

Rosteck.
Federoberbau auf Bruecken? Organ fuer die Fortschritte des Eisenbahnwesens, v. 88, n. 9, May 1, 1933, p. 190-5. Tests on performance of experimental railroad track on bridge of Dortmund-Ems canal, Germany, having rails resting on springs which, in their turn, rest on wooden ties; car was driven over experimental track with speed of 80 km. per hr.; determination of oscillations and deflections of rails, also impact stresses.

Spring Steel

E. Houdremont and H. Bennek.
La fabrication et les propriétés mécaniques des aciers a ressorts. Génie Civil, v. 102, n. 10, Mar. 11, 1933, p. 238. Abstract of paper on composition, manufacture and behavior of spring steels with rolling and heat treating, indexed in Engineering Index, 1932, p. 1225 from Stahl und Eisen, July 7, 1932.

H. Wiesecke.
Spring Wire Practices in Germany. Wire, v. 8, n. 12, Dec. 1933, p. 396-8 and 409-10. Analysis of study of German spring-wire manufacturing methods, translated from paper indexed in Engineering Index 1932, p. 1225 from Stahl u Eisen, May 5, 1932.

J. W. Urquhart.
Steel Used in Racing Automobiles. Blast Furnace and Steel Plant, v. 21, n. 3, Mar. 1933, p. 159-60 and 170. Analysis, heat treatment and forging of steel springs in Malcolm Campbell's car.

Tapered Springs

W. W. Boyd.
Radially Tapered Steel Disk Springs. Product Eng. v. 4, n. 2, Feb. 1933, p 63-5. Simplification and graphical representation of formulas developed in paper entitled: Radially Tapered Disk Spring, W. A. Brecht and A. M. Wahl of Westinghouse Electric and Mfg. Co., of East Pittsburgh, Pa., indexed in Engineering Index 1930, p. 1640, from Am. Soc. Mech. Engrs.— Trans. (Applied Mechanics), n. 15, May-Aug. 1930.

Telephone Equipment

L. V. Williams.
Music Wire Springs. Bell Laboratories Rec., v. 11, n. 5, Jan. 1933, p. 134-6. Mechanical properties, working and testing of springs made of music wire.

Quenching

S. Matsunawa and M. Suzuki.
Quenching Springs in New Emulsified Oils. Soc. Mech. Engrs., Japan—J v 36, n. 196, Aug. 1933, p. 503-17. For purpose of improving hardening effect, study was made by Railway Research office of use of special emulsified oil, newly invented as substitute for expensive rape oil or fish oil; by this method springs of good quality can be obtained with only one operation, that is, quenching springs in emulsified oil from required temperature. (In Japanese.)

Windings

H. W. Weinhart.
Machine for Winding Springs of Vitreous Silica. Rev. Sci. Instruments, v. 4, n. 6, June 1933, p. 350-2. By means of machine described, springs can be wound which are far more uniform in structure than those made by hand; furthermore, considerable time is saved as machine, once started, can be left without attention until spring is completed.

1934

Applications

J. S. Carpenter.
Graphs Facilitate Solution of Spring Problems. Machine Design, v. 6, n. 5, May 1934, p. 34-5. Deflection characteristics of mechanical springs better understood, and scale of spring determined correctly by use of diagram of spring action. Bibliography.

E. W. Weaver.
Practical Aspects of Spring Applications. Machine Design, v. 6, n. 6, June 1934, p. 31-2. Interesting and useful applications of springs.

Automobile Springs and Suspension

E. Lehr.
Die schwingungstechnische Eigenschaften des Kraftwagens und ihre messtechnische Ermittlung. VDI Zeit, v. 78, n. 10, Mar. 10, 1934, p. 329-35. Vibratory characteristics of automobiles and their measurement demands knowledge of laws of vibrations; author shows how principal vibratory characteristics and their effect on automobiles may be measured by aid of simple means and applied to design of springs.

M. W. Bourdon.
Floating Helical Springs Used in New Singer Front Suspension. Automotive

Industries, v. 70, n. 20, May 19, 1934, p. 618. Details of Gordon-Armstrong design using helical springs.

A. F. Denham.
Leaf Spring Institute Designs Independent Front Suspension. Automotive Industries, v. 70, n. 20, May 19, 1934, p. 616-7. Design details of transverse spring construction which reduces both total and unsprung weights; two leaf springs side by side are substituted for lower wishbone arms, and coil spring is eliminated.

A. F. Denham.
Leaf Spring Institute Shows Its New Independently Sprung Car with Double Wishbone, Backbone Frame. Automotive Industries, v. 71, n. 8 and 11, Sept. 1, 1934, p. 262-3 and Sept. 15, p. 318-20. Car design virtually from ground up is outgrowth of experimental work carried on by LSI under guidance of J. H. Shoemaker; details of front and rear suspension and frame, which has double wishbone ends with tubular backbone.

Anonymous 202.
Objects of Independent Wheel Springing. Motor (Lond.), v. 65, n. 1676, Feb. 6, 1934, p. 1-3. Critical review of new springing systems; ways in which wheels can be carried individually by radium arms, transverse springs, etc; advantages claimed for new systems; influence of road conditions; gyroscopic reactions; lateral stability on corners; constant track or parallel motion; weight distribution.

A. Kindler.
Schraubenfeder an Parallelogramm-Radaufhaengung. Automobiltechnische Zeit, v. 37, n. 14, July 25, 1934, p. 370. Coil springs for parallelogram wheel suspension; design analysis.

Anonymous. 203.
Buick Coil Springs Held Within Close Manufacturing Limits. Iron Age, v. 133, n. 10, Mar. 8, 1934, p. 25D-26. Manufacture of coil springs which are part of so-called "knee-action" independent springing of front wheels on Buick cars made in plant at Flint, Mich.; in manufacturing process they are held within limits of 0.002 in., exacting tolerance in production of springs; ends of springs are ground.

J. M. Bonbright.
Chevrolet's Knee-Action. Heat Treating and Forging, v. 20, n. 3, Mar. 1934, p. 117-20. Method of manufacture of coil springs, for independent front wheel suspension.

J. Geschelin.
How Chrysler Makes Coil Springs. Automotive Industries, v. 70, n. 13, Mar. 31, 1934, p. 394-6. Spring has 8-1/2 active coils and 10-1/2 total coils

wound on mandrel to produce inside diam. of 3-3/4 in.; it takes total of 21 operations to complete spring starting with bar as delivered from mill.

A. H. Allen.
Manufacturing "Knee-Action" Spring Suspensions. Steel, v. 94, n. 25, and 26, June 18, 1934, p. 31-4 and June 25, p. 27-30. June 18: Materials, methods and equipment used in manufacture of independent springing systems for General Motors Corp. automobiles. June 25: Details of enclosed "knee-action" unit, found on Chevrolet and Pontiac models.

Car Springs and Suspension

R. Kuehnel.
Eisenbahn-Federn und ihre Fertigung. Stahl u Eisen, v. 54, n. 2, Jan. 11, 1934, p. 25-9. Railroad springs and their manufacture; investigations of causes of fractures in laminated, spiral and helical springs for railroad cars; conclusions with view of improvement of springs.

H. Roemmelt.
Inspection and Testing of Laminated Bearing Springs for Railway Vehicles. Eng. Progress, v. 15, n. 11, Nov. 1934, p. 232-4. Mannheimer Maschinenfabrik Mohr and Federhaff, working in cooperation with plants of German Railroad, has developed number of special machines for carrying out tests; of these, purely static machine and dynamic machine for running-in and determining mean characteristic are shown.

Design

F. Franz.
Charts for Obtaining Spring Dimensions Directly. Product Eng., v. 5, n. 6, June 1934, p. 215-7. Procedure which eliminates trial and error computations for obtaining desired maximum and minimum loads and lengths.

H. L. Wynn.
Recording Spring Data. Am. Mach., v. 78, n. 24, Nov. 21, 1934, p. 801. Spring chart consisting of graphic illustration of those values that are paramount for future reference, either for future consideration or for reviewing problems that are similar in general character.

Elastic Hysteresis

M. F. Sayre.
Laws of Elastic Behavior in Metals. Am. Soc. Mech. Engrs.—Trans. v. 56, n. 7, July 1934, p. 555-8 (RP-56-7). Summary report on experimental program at Union College by American Society Mechanical Engineers Special Research Committee on mechanical springs.

Electric Measuring Instruments

R. W. Carson.
Better Instrument Springs. Elec. Eng., v. 53, n. 2, Feb. 1934, p. 282-6. Indexed in Engineering Index 1933, p. 391, from Am. Inst. Elec. Engrs.— Advance Paper n. 33-89.

G. Keinath.
Federn fuer Messgeraete. Archiv fuer Technisches Messen, v. 3, n. 35, May 1934, p. T64-5 (4 p.). Springs for measuring equipment; notes on shape of springs, materials and manufacture; irregularities noted in instrument springs; elastic after effects; various curves.

Helical

F. Lancaster.
Design Chart for Oil-Tempered Helical Springs. Machy. (Lond.), v. 44, n. 1142, Aug. 30, 1934, p. 644-6. Method and chart used by author for determining spring proportions.

Aster.
Ein Nomogramm zur Schraubenfeder-Berechnung. Automobiltechnische Zeit, v. 37, n. 13, July 10, 1934, p. 354-5. Alignment chart for calculation of helical springs; application.

R. F. Vogt.
Number of Active Coils in Helical Springs. Am. Soc. Mech. Engrs.— Trans. v. 56, n. 6, June 1934, p. 467-72 (discussion) 472-6. (RP-56-4). Indexed in Engineering Index 1932, p. 1224 from Advance Paper n. 52, mtg. Dec. 5-9, 1932.

F. P. Zimmerli.
Permissible Stress Range for Small Helical Springs. Univ. Mich. Dept. Eng. Research—Bul., n. 26, July 1934, 77 p. Research undertaken to determine stress ranges to which commercial steels can be subjected when tested in form of small helical compression springs.

F. Thiersch.
Spannungsmessungen an Schraubenfedern. Forschung auf dem Gebiete des Ingenieurwesens—Ausgabe A v 5 n. 2, Mar./Apr. 1934, p. 53-9. Stress measurements on helical springs; Goehner's theory as basis for calculation; procedure and analysis of tests; annular bars; parts of helical spring; complete helical spring.

Laminated

H. S. Rowell.

Theory and Design of Laminated Springs, Instn. Automobile Engrs.—J v 2 n. 7, Apr. 1934, p. 41-56. Consideration of laminated spring as complex structure composed of several continuous beams; underlying principles of design checked by various experiments and practical applications.

Manufacture

S. Hattori.

Status of Manufacture of Springs for Machinery. Soc. Mech. Engrs, Japan—J v 37, n. 203, Mar. 1934, p. 131-3. Review of manufacturing processes; for coiled springs, carbon steel, silicon-manganese, silicon-chromium, and chrome-vanadium steels, etc., are used, but carbon steel with carbon content of 0.75 to 1.10% is used in majority of springs. (In Japanese, with English abstract p. S-13-4.)

Railroad Springs and Suspension

Anonymous 204.

New Liechty Bogies for High Speeds. Railway Engr. v. 55, n. 2, Feb. 1934, p. 50-1. New European construction, by H. Liechty, claimed to offer advantages as regards steadiness of running and uniformity of wheel loads; body supported by central ball and socket swivel and at each side, by inclined leaf springs on platform rotatable on bearing; 75% of weight is carried by spherical seating and 25% by special table; Liechty method of "steering" axles by mechanism actuated from drag and buffer gear reduces rolling.

W. E. Frost.

Notes on Railway Laminated and Coiled Springs. Inspection v. 5, n. 2, Apr. 1934, p. xxiv-xxix (comment) xxix-xxx. Analysis of spring steels; Brinell and impact values; design of laminated and coil springs; testing of laminated springs; alloy steel for coil springs.

Scientific Instruments

R. W. Carson.

Hook's Law Amended. Instruments, v. 7, n. 6, June 1934, p. 109-12. Aging and lag effects in instrument springs; tables showing modulus of elasticity in tension; characteristics of aging and lag; internal stresses cause aging; table showing heat treatment to reduce internal stresses; load and time influence elastic lag; etc. Bibliography.

Spiral

E. Rausch.
Die Steifigkeit von Schraubenfedern senkrecht zur Federachse. VDI Zeit, v. 78, n. 12 and 32, Mar. 24, 1934, p. 388-9 and Aug. 11, p. 964. Rigidity of spiral springs perpendicular to spring axis; theoretical mathematical investigation.

Spring Steel

E. Houdrement and H. Bennek.
Federstaehle. Technische Mitteilungen Krupp, n. 1, Feb. 1934, p. 7-9. Results of investigation on spring steels. Abstract of paper indexed in Engineering Index 1932, p. 1225 from Stahl u Eisen July 1932.

Fatigue.

J. B. Johnson.
Fatigue Characteristics of Helical Springs. Iron Age, v. 133, n. 11 and 12, Mar. 15, 1934, p 12-5 and Mar. 22, p. 24-6. Mar. 15: Experimental data for proper evaluation of commercial spring characteristics; as spring action is primarily affected by material used, article concerns itself with permanent set, stress, and fatigue measurements of more usual spring compositions; steel springs examined by Magnaflux, apparatus by A. V. DeForest; use of stress formulas. Mar. 22: Proper evaluation of commercial springs; it is shown that high fatigue limit as determined on polished specimens is not sole criterion of spring life.

Manufacture.

E. J. P. Fisher.
Cold Drawn Steel Spring Wire. Wire and Wire Products, v. 9, n. 9, Sept. 1934, p. 287 and 289-97. Application of certain scientific principles to art of making quality high-carbon steel wire. Before Wire Assn.

C. T. Eakin.
Review of Spring Wire Characteristics. Iron Age, v. 134, n. 7, Aug. 16, 1934, p. 16-9, 76 and 78. Review of metallurgy sufficiently broad to simplify task of choosing optimum spring steel for given operation.

Properties.

E. Grieb.
Eigenschaften der Federwerkstoff und hoechstzulaessige Beanspruchungen fuer Federn. Stahl u Eisen, v. 54, n. 18, May 3, 1934, p. 449-50. Properties of spring materials and maximum permissible stresses for spring steel and of naturally hard drawn spring steel and of hardened and tempered steels; graphic and tabular data.

Quenching.

E. Nagayasu and J. Matsunaga.
Matsunaga's Automatic Devices for Quenching Spring Plates. Japanese Gov. Rys.— Bul., v. 22, n. 23, July 25, 1934, 16 p. By use of Matsunaga's quenching machine at Oi Works, Japan, it was possible to substitute old cheap mineral oil for expensive rape oil and effect automatic hardening and tempering in one operation, thus securing uniform quanitity of production, higher efficiency and great economy of quenching liquid.

Temperature Effect.

J. W. Ludewig.
Torsional Moduli Variations of Spring Materials with Temperature. Am. Soc. Metals—Trans., v. 22, n. 9, Sept. 1934, p. 833-60. Summary of previous work; torsional moduli of number of materials plotted against temperature; results. Bibliography.

Testing

E. B. Hare.
Determining Hardening and Tempering Temperatures for Springs. Machy. (N. Y.) v. 40, n. 8, Apr. 1934, p. 458-9. Results of test on flat springs hardened and tempered at different temperatures and finished by plating.

P. G. Pimenov.
Tests of Spiral Springs of Holt Combine. Trudi Vse-Sonyuznovo Nauchno-Issledovatelskovo Instituta Selsko-Khozyaistvennovo Machinostroyenyia 1932, p. 3-22. Critical review of strength tests and properties of main springs of Holt (No. 34) and Caterpillar combines in light of detailed laboratory tests by author; Russian modifications in design and heat treatment of springs; recommendations for further improvements and research. (In Russian, with brief English abstract on p. 22.)

Winding

H. W. Weinhart.
Winding Silica Springs. Bell Laboratories Rec. v. 12, n. 10, June 1934, p. 316-8. Illustrated description of equipment used for winding of springs; silica springs are so generally useful in scientific work that Bell Laboratories have felt it desirable to make available to others unusually perfect springs produced by winding machine.

1935

Automobile Springs and Suspension

W. Samuels.
Analytical Determination of Flexibility of Leaf Springs. Automotive Industries, v. 72, n. 16, Apr. 20, 1935, p. 544-50. Precise and simple method of calculating rates of leaf springs; theoretical mathematical design analysis.

Anonymous 205.
Quiet Uniform Spring Action— Aim of New Silenite Damper-leaves. Automotive Industries, v. 72, n. 7, Feb. 16, 1935, p. 210-1. Method of stabilizing leaf spring action which is asserted to give and maintain uniform inter-leaf friction and freedom from squeaks over long periods of time and with practically no service attention, developed by John Warren Watson Co.; known as Silenite System of fixed lubrication.

T. H. Sanders.
Suspension of Road Vehicles. Instn. Automobile Engrs.— Proc., v. 28, Session 1933-34, p. 410-32 (discussion) 433-8. Table of stresses in automobile springs; schematic presentation of torque reactions, six-wheel suspension and Kirkstall forge freight truck; roller-bearing-auxiliary spring curve; independent suspension diagram; etc.

R. Mertz.
Ueberschlaegige Berechnung von Stabfedern. Automobiltechnische, Zeit, v. 38, n. 21, Nov. 10, 1935, p. 534-7. Approximate calculation of bar-type springs; development of diagrams by aid of which automobile engineer will be in position to determine quickly dimensions for spring bar as used for each individual case in which this type of spring is to be applied.

J. B. Nealey.
Furnaces for Making Knee Action Springs. Heat Treating and Forging, v. 21, n. 1, Jan. 1935, p. 37-9. Details of manufacturing process, featuring use of gas-fired furnaces with automatic ignition, pilot control, and safety devices to prevent overheating.

J. M. Bonbright.
Knee-Action Manufacture Refined by Use of New Equipment. Iron Age, v. 135, n. 12, Mar. 21, 1935, p. 24-9, 82 and 84; see also Steel, v. 96, n. 12, Mar. 25, 1935, p. 30-3. Adoption of machines of new design, built especially for operations peculiar to manufacture and assembly of enclosed-type individual front-wheel suspension (knee-action) units; and revision of plant layout to procure orderly progress of component

parts from raw material to finished units, were combined to facilitate production and improve product at Chevrolet gear and axle plant, Detroit.

Anonymous.206.
Toledo Automatic Testing Device, il, Automotive Ind., v. 72, June 1, 1935, p. 746-747.

Anonymous.207.
Air Springs used in New Independent Suspension. Diags. Automotive Ind., v. 73, Aug. 3, 1935, p. 148-149.

Anonymous.208.
Brunemar Front-Wheel Independent Springing, il. Automotive Ind., v. 71, Dec. 29, 1934, p. 807.

Anonymous 209.
Dodge 1935 has Semi-Elliptic Front Springs. Il diag. Automotive Ind., v. 71, Dec. 22, 1934, p. 764-766.

Anonymous.210.
Leaf Springs used in new Four Wheel Independent Suspension Design. Il. Automotive Ind., v. 72, May 4, 1935, p. 615.

J. Geschelem.
New Standardized Specifications for Leaf Spring Plates are proposed by Chrysler. Automotive Ind., v. 73, July 20, 1935, p. 76-77.

Anonymous.211.
Plymouth Drops Independent Front Springing for Soft Semi-Elliptics. Il. Automotive Ind., v. 71, Dec. 4, 1934, p. 689-692.

Anonymous.212.
Spring Motion; Deflection and its Relation to Laminated Spring Movements. Diags., Automobile Eng., v. 25, Aug. 1935, p. 306.

A. F. Denham.
Transverse-Leaf-Spring Independent Suspension Features. 1935 Studebakers. Il. diags., Automotive Ind., v. 71, Dec. 1, 1934, p. 672-675.

Anonymous.213.
Transverse Leaf Springs; Leaf Spring Institute and Ford Types. Il. diag., Automobile Eng., v. 25, March 1935, p. 101.

Anonymous.214.
Data on the Replacement and Repair of Bus Springs. Transit Journal, v. 79, April 1935, p. 130-131.

Anonymous. 215.
Heat Treatment developed for Springs; Toronto Transportation Commission, il, Transit Journal, v. 79, June 1935, p. 188-189.

Counters

L. G. Randall.
Flat Springs Regulate Counter Operation. Machine Design, v. 7, n. 7, July 1935, p. 34-6. Development of counter by Mills Novelty Co., Chicago, which discards entirely previous conception by employing springs instead of ratchets, and takes advantage of economical stamping process for majority of remaining parts.

Design

C. H. Kent.
Don't overlook Surge in Designing Springs! Machine Design, v. 7, n. 10, Oct. 1935, p. 37-9. Investigation of phenomenon known as surge, such as occurs in valve springs of internal combustion engine; apparatus for study of phenomenon, at Pennsylvania State College; application to spring and cam assembly used on knitting machine.

C. Reynal.
Note sur le fonctionnement et le calcul des ressorts coniques. Arts and Metiers, n. 175, Apr. 1935, p. 65-73. Function and calculation of conical springs; design analysis and notes on strength testing; curves; equations; practical examples.

J. O. Almen and A. Laszlo.
Uniform Section Disc Spring. Am. Soc. Mech. Engrs.—Advance Paper, Dec. 1935, 8 p. Attempt to present formulas in manner to aid designer in arriving at suitable characteristics by choice of spring geometry; these formulas have been in use for several years at General Motors Corporation Research Laboratories Section, and their reliability checked by tests of springs used in variety of special test equipment.

H. Bock.
Zur Theorie der Zugfedern. Zeit fuer Instrumentenkunde, v. 55, n. 6, June 1935, p. 255-62. Theory of draft springs; theoretical mathematical analysis pertaining to precalculation and design of springs for clocks and other spring-operated devices.

S. Gross.
Beitrag Zur Berechnung der Kegelstumpffedern. Zeit. ver Deutsch Ing., v. 79, July 13, 1935, p. 865-870.

K. Armleder.
Nahtlose Metallische Federkörper. Il diags., Zeit ver Deutsch Ing., v. 79, Sept. 38, 1935, p. 1175-1176.

H. Stark.
Die Ermittlung der Formänderungen und des spannungszustandes von Pufferfedern. Diags., Zeit. ver Deutsch Ing., v. 79, June 8, 1935, p. 727-731.

Electric Measuring Instruments

F. E. J. Ockenden.
Control Springs for Electrical Measuring Instruments. J. Sci. Instruments, v. 12, n. 3, Mar. 1935, p. 69-75. Difficulties encountered in design of springs for use in electric instruments determined by electric resistance permissible; when this is of no importance, as in case of systems where resistance of moving element is extremely high etc., it is possible to find material for spring which is so robust in its qualities as to be practically foolproof as regards coiling heat treatment, and method of mounting. Bibliography.

Energy Utilization

W. M. Emery.
Utilizing Stored Energy in Mechanical Springs. Machine Design, v. 7, n. 3, Mar. 1935, p. 21-2. Stored energy in springs may be used to produce high pressures with only enough applied force to overcome frictional losses; with proper balance inverted pendulum oscillating between two opposing compression springs will continue to oscillate for long interval incident to alternate transference of stored energy from one spring to another; practical example given in description of Scot-Ironer.

Fatigue

V. Prever and L. Locati.
I fenomeni di fatica nelle molle ad elica in acciaio "superarmonico". Metallurgica Italiana, v. 27, n. 3 and 4, Mar. 1935, p. 188-204, and Apr., p. 255-74. Mar.: Experimental study of fatigue phenomena observed in helical springs of superharmonic steel; stresses in spring wire; properties of spring wire and methods for testing them. Apr.: Examinations and diagnosis of causes of failure in practice.

Heat Treatment

J. B. Nealey.
Heating for Coiling and Toughening Springs. Heat Treating and Forging, v. 21, n. 6, June 1935, p. 295-6 and 303. Equipment of American Spiral Spring and Manufacturing Co., Pittsburgh, Pa.

F. L. Prentiss.
Continuous Controlled-Atmosphere Furnace Used to Harden Automobile Valve and Clutch Springs. Iron Age, v. 135, n. 5, Jan. 31, 1935, p. 33-5. Electric furnace used for hardening high-grade automobile valve and clutch springs and other mechanical coil springs at plant of Cleveland Wire Spring Co., Cleveland.

W. C. Owen.
Heat Treatment of Spring Leaves. Metal Progress, v. 27, n. 3, Mar. 1935, p 51-5, and 64. Features of special equipment and practice at plant in Detroit; cross-section of hardening furnace; radiant-tube heaters; "DSP" forming machine; new draw furnaces.

B. Otsuki.
Matsunaga's Automatic Devices for Quenching Spring Plates. Soc. Mech. Engrs., Japan—Trans., v. 1, n. 1, Feb. 1935, p. 70-6. Ohi works of Japanese Government Railways succeeded, through use of Matsunaga's automatic machine, in substituting old cheap mineral oil for expensive rape oil and effecting automatic heat treatment of hardening and tempering in one operation, thus securing uniform quantity of production, higher efficiency of working and great economy of quenching liquid. (In Japanese.)

B. W. Gelb.
Heat Treatment of Precision Springs. Industrial Gaz., Jan. 1935, p. 22.

Anonymous 216.
Duer Manufacturing Co. installs New Equipment for Heat Treating Springs., il. Steel, v. 96, April 22, 1935, p. 36-37.

Helical

Anonymous 217.
Die Berechnung zylindrischer Schraubenfedern. Automobiltechnische, Zeit, v. 37, n. 24, Dec. 25, 1934, p. 624. Calculation of cylindrical helical springs; design analysis on basis of curves.

A. M. Wahl.
Helical Compression and Tension Springs. Am. Soc. Mech. Engrs.— Trans., (J. Applied Mechanics), v. 2, n. 1, Mar. 1935, p. A-35-7. Formulas; inactive turns; charts for helical tension or compression springs; working stresses. Bibliography.

F. P. Zimmerli.
Permissible Stress Range for Small Helical Springs. University of Michigan Engineering Research Bulletin No. 26, July 1934, 135 pages. (Out of print.)

A. Nadai.
Review of Recent Papers on Plasticity. Am. Soc. Mech. Engrs.— Trans., (J. Applied Mechanics), v. 2, n. 1, Mar. 1935, p. A-33-4. Tensile tests under high velocities of deformation; recent progress in design of helical springs; spiral cracks of Fuji volcano. Bibliography.

C. P. Nachod.
Nomograms for Period of Helical Springs and Torque of Flat Spiral Springs. Gen. Elec. Rev., v. 38, n. 9, Sept. 1935, p. 431-3. Two nomograms for period of vibration, presented and their application described.

Laminated

H. S. Rowell.
Theory and Design of Laminated Springs. Instn. Automobile Engrs.— Proc., v. 38, Session 193-34, p. 498-513 (discussion) 514-22. Indexed in Engineering Index 1934, p. 1022 from their Journal Apr. 1934.

Manufacture

A. King, C. G. Lawson, J. S. Tapp and G. H. Watson.
Manufacture of Helical Silica Springs. J. Sci. Instruments, v. 12, n. 8, Aug. 1935, p. 249-52. Machine for automatically winding fine helical silica springs described, and also apparatus for mechanically drawing fibers from which springs are made; details of procedure given, together with table showing sensitivity of typical springs; some uses of these springs are suggested.

J. B. Nealey.
Variety of Furnaces Required in Forming and Heating Steel Springs. Steel v. 95, n. 27, Dec. 31, 1934, p. 16-8. Processes employed at American Spiral Spring and Mfg. Co.; gas-fired furnaces and heavy mechanically operated coiling machines occupy bulk of material.

L. N. Stewart.
Delicate Lapping Operation for a Small Spiral Spring. Diags., Machinery v. 42, Oct. 1935, p. 127.

L. E. Browne.
Mechanical Skill paramount in Production of Small Springs. Il., Steel v. 96, April 15, 1935, p. 42-43.

Patents

Floyd E. Harris.
Furnace for Heat Treating Steel Leaf Springs etc. U. S. patent 2,007,604, July 9, 1935. Structural Features.

Joseph Gogan.
Apparatus for Testing the Hardness or Distortion Resistance of Materials such as Metal Springs etc. U. S. patent 1,978,302, Oct. 23, 1935. Structural and Mechanical Features.

Rubber

C. Macbeth.
Rubber Suspension. Automobile Engr., v. 25, n. 336, Sept. 1935, p. 339-42. Brief survey of various schemes; independent wheel suspensions; front-end suspension application; wheel control; torque loaded spring.

Specifications

M. G. Demougeot.
Spring Data. Product Eng., v. 6, n. 3, Mar. 1935, p. 110-1 Specifications required for extension, compression, torsion and flat springs, together with various types of end constructions.

Spiral

E. C. Wadlow.
Spiral Springs. Machy., (Lond.), v. 46, n. 1197, Sept. 19, 1935, p. 775-8. Uses of spiral springs and their advantages; formula for calculating skin stress at any point along spring; maximum torque of fully wound spring; lubricants and efficiency; physical properties of material for mainsprings.

Springs (General)

H. L. Wynn.
Recording Spring Data. Chart., Am. Mach., v. 78, Sept. 1935, p. 801.

R. W. Carson.
Why Spring Stiffness Varies. Am. Mach., v. 78, Feb. 27, 1935, p. 206-208.

Steel

J. H. Andrew and G. T. Richardson.
Investigation of Spring Steels. Iron and Steel Inst.—J v 131, n. 1, 1935, p. 129-48 (discussion) 150-64, 5 supp. plates; see also Iron and Steel Industry, v. 8, n. 11, Aug. 1935, p. 440-3; Iron and Coal Trades Rev., v. 130, n. 3505, May 3, 1935, p. 756-8 and 766; and Engineering, v. 139, n. 3618, May 17, 1935, p. 530-2. Silico-manganese steel containing 0.45% carbon, 2.02% silicon and 0.78% manganese was

selected for research; depth of decarburization; influence of maximum temperature on decarburization; comparison of silico-manganese, chromium-vanadium and plain carbon spring steels; influence of rolling on properties of as-rolled plate; additional experiments.

V. N. Konstantinov.
Properties of Spring Steel, Metallurgia, v. 9, No. 8, 1934, p. 55-75.

Testing

E. E. Weibel.
Correlation of Spring-Wire Bending and Torsion Fatigue Tests. Wire and Wire Products, v. 10, n. 12, Dec. 1935, p. 560-77 and 588-9. Investigation and attempt to test results for tempered Swedish valve-spring wire. Bibliography. Before Am. Soc. Mech. Engrs.

G. A. Hankins and H. R. Mills.
Resistance of Spring Steels to Repeated Impact Stresses. Iron and Steel Inst.— J v 131, n. 1 1935, p. 165-75 (discussion) 176-80; see also Heat Treating and Forging, v. 21, n. 7, July 1935, p. 322-6; and Engineering v. 139, n. 3621, June 7, 1935, p. 611-3. Test results show that Stanton and Bairstow's conclusions for notched testpieces apply to both machined and unmachined spring steels in that behavior under very small number of impacts is indicated by result of single-blow test, but that repeated-impact endurance limits correspond to results of cyclic-fatigue endurance tests.

Anonymous.218.
Coates Intermediate Spring Tester has Pendulum Scale. Il., Iron Age, v. 136, July 18, 1935, p. 136-145.

Anonymous.219.
Running Characteristics of Rolling Stock. Engineering, v. 139, n. 3608, Mar. 8, 1935, p. 244-5. Review of progress report of Mechanical Division of American Railway Assn., on tests of trucks and truck springs designed to promote easier riding and reduce harmonic motion; investigation with view to examining ways and means of reducing damage to rolling stock by vertical oscillation of springs and car bodies and of drawing up specification for constructing and testing springs of freight cars.

Torsion Bar

Anonymous.220.
Variable Rate Spring provided by New Torsion Bar Suspension using Rigid Axles. Diags., Automotive Ind., v. 73, July 13, 1935, p. 54-55.

Watches

W. Rohn.
Verwendung von Berylliumlegierungen in Uhren. VDI Zeit, v. 79, n. 1, Jan. 5, 1935, p. 22-3. Use of special beryllium alloys for manufacture of watch mechanisms; effect of temperature on running of watches; manufacture of non-magnetic spiral springs of high elasticity and low temperature coefficient of modulus of elasticity; application of beryllium alloys to manufacture of other parts of watch mechanisms.

1936

Air Springs

R. W. Brown.
Air Springs—Tomorrow's Ride. Soc. Automotive Engrs.—J v 38, n. 4, Apr. 1936, p. 126-32. Results of extensive research in motor-car suspension fundamentals presented with description of new-type spring member using air as load-carrying means; methods of actually realizing extremely low spring rates with attendant comfort to passenger are shown; shock absorption and anti-body-roll devices are incorporated in, and function as integral parts of new suspension.

Anonymous. 221.
Firestone Introduces New Air Spring Suspension. Il.,diag. Rubber Age, v. 38, Feb. 1936, p. 273-274; India Rubber, v. 94, April 1936, p. 44.

Automobile Springs and Suspension

F. W. Lanchester.
Motor-Car Suspension and Independent Springing. Engineering, v. 141, n. 3665 and 3667, Apr. 10, 1936, p. 394-6 and Apr. 24, p. 464-5. Analysis of problems of design. Before Instn. Automobile Engrs.

Anonymous. 222.
Coiling Springs for Independent Front Suspension; Chrysler Corp., il., Am. Mach., v. 80, May 20, 1936, p. 498-500.

Anonymous. 223.
Automotive Type Trucks. P.C.C. Car. Il., Mass Transportation, v. 32, July 1936, p. 197-201.

Anonymous. 224.
Rubber Springing Characterizes Truck Design. P.C.C. Car. Il., Transit Journal, v. 80, July 1936, p. 220-223.

Beryllium Copper Alloy

L. L. Stott.
Beryllium Copper Springs Require Modified Design. Machine Design, v. 8, n. 5, May 1936, p. 31-3 and 85. Methods of precipitation hardening treatment by which physical properties of steel combined with corrosion resistance and conductivity of bronze can be obtained. Bibliography.

Car Springs and Suspension

Anonymous.225.
Heavy Spring Coiling Machine. Ry. Gaz., v. 64, n. 13, Mar. 27, 1936, p. 624-6. Illustrated description of Brearley coiled spring machine for hot coiling of railway springs.

R. Spies.
Presstempel und Maschinen zum Biegen der Tragblattfedern von Schienenfahrzeugen. Werkzeugmaschine, v. 40, n. 18, Sept. 30, 1936, p. 437-43. Dies and machines for bending of laminated springs of railroad rolling stock; design data on dies and presses; theory of process involved; description of machine manufactured by A. Hering in Nuernberg.

J. B. Nealey.
Spring Manufacture at Altoona Shops. Il., Railway Mech. Eng., v. 110, April 1936, p. 165-167.

Clocks

F. L. Tingle.
Treatment of Steel for Clock and Gramophone Mainsprings. Iron and Steel Industry, vol. 9, Dec. 1935, pages 121-124. The material used may be either straight C steel, Si-Mn, or Cr-V, produced either in the open-hearth or electric furnaces; the precise material which is used being determined by the requirements which have to be met and the price the customer is prepared to pay for the product. Attention is restricted to plain C steels; typical composition 1.05% C; 0.42% Mn; 0.25% Si; 0.02% P; 0.015% S. Billets from which the strip is produced are hot rolled to strip finishing at about 14 to 16 gage thickness. Further reduction in thickness then takes place by cold rolling, with intermediate annealings. For correct hardening quenching is done from 760° to 780° C. at the Ac point.

Design

J. W. Rockefeller, Jr.
Design of Mechanical Springs. Wire and Wire Products, v. 11, n. 8, Aug. 1936, p. 373-7, 399-401 and 404. It is pointed out that spring

formulas sometimes get out of order and produce results that are far from perfect; article gives some of reasons why.

V. Tatarinoff.
Design of Springs Made of Square or Flat Material. Machy., (Lond.), v. 47, n. 1212, Jan. 2, 1936, p. 407-10. Equations and diagrams given; table of safety factors.

S. Gross.
Die Berechnung der gewundenen Biegungsfedern. Technische Mitteilungen Krupp, v. 4, n. 3, June 1936, p. 105-14. Calculation of wound flexural springs, with special reference to cylindrical helical or spiral springs employed in torsional couplings, watches, etc.; examples of calculation given.

J. W. Rockefeller, Jr.
Factors Affecting Performances of Springs. Wire and Wire Products, v. 11, n. 9, Sept. 1936, p. 426-9, 460-1 and 463-4. Fatigue, corrosion, surface defects and stress concentration, discussed.

C. P. Nachod.
Nomograms for Cantilever Springs. Gen. Elec. Rev., v. 39, n. 4, Apr. 1936, p. 186-8. Examples of how to determine maximum permissible deflection for steel or phosphor bronze cantilever spring of rectangular cross-section and uniform width, carrying load concentrated at free end, are shown by nomograms.

J. O. Almen and A. Laszlo.
Uniform-Section Disk Spring. Am. Soc. Mech. Engrs.—Trans., v. 58, n.4, May 1936, p. 305-14, (RP-58-10); see also Machine Design, v. 8, n. 6, June 1936, p. 40-2. Indexed in Engineering Index 1935, p. 1007 from Advance Paper Dec. 1935.

F. Wunderlich.
Zulässige Beansprunchung von Schraubenfedern. Zeit Vur Deutsch. Ing. v. 80, June 20, 1936, p. 787-789.

W. Marti.
Spring Surge Investigated: Abstract. Automotive Industry, v.74, March 14, 1936, p. 411-412.

Die Springs

Anonymous 226.
Danly Flat-Rounded Die Spring, il. Machinery, v. 42, Aug. 1936, p. 817.

Anonymous.227.
Die Springs Coiled from Wire of Keystone Cross Section, il. Steel, v. 99, July 27, 1936, p. 43.

Electrical Switchgear

A. L. Riche.
Beryllium Copper Used in Electrical Switch Spring. Electrochem. Soc. — Trans., v. 69, mtg. Apr 22-25, 1936, p. 493-4. Springs made of 2-1/4% beryllium-copper alloy heat treated at 260 C have withstood many million flexures; these springs are mechanically superior to those made of phosphor bronze; they are furthermore resistant to corrosion and good conductor of electricity.

Failure

R. W. Clyne.
Causes of Failures of Railroad Springs. Ry. Mech. Engr., v. 110, n. 11, Nov. 1936, p. 491-3. Overheating, burning, extreme surface roughing, stress corrosion, decarburization, and surface discontinuities, discussed as causes of failures; correct heat treatment method.

H. Schottky and H. Hieltenkamp.
Mitwirkung des Luffstickstoffs Beim Fressen Aufeinander Gleitender Stahlteile und Beim Daverbruch. Stahl und Eisen, v. 56, April 9, 1936, p. 444-446, pl. 1-2.

Fatigue

V. Prever and L. Locati.
Fatigue in Helical Springs Made of "Superharmonic" Steel (I fenoment di fatica nelle molle ad elica in acciaio "superharmonico"). Le Metallurgia Italiana, vol. 27, Apr. 1935, pages 255-274. The new fatigue test described in part I has been applied in testing valve springs made from several typical "superharmonic" steels. Steels having the following composition:

	C	Mn	Si	Ni	Cr	P	S
1)	0.96	0.62	0.19	0.42	trace	0.037	trace
2)	0.68	0.56	0.23	___	"	0.035	"

were given complete tests, tests on wire made using these steels being compared with tests on springs. Static tests alone are not sufficient to distinguish suitable material, so they must be supplemented by dynamic tests (vibration or torsion). Medium tensile strength and hardness are to be preferred, i.e., 36-39 kg./mm^2 tensile 44-47 R_w hardness (Rockwell hardness-cone, 150 kg load) gave the optimum results. Annealing at 320° C was found to produce better springs than when the annealing was carried out at 240° C, even though the latter gave higher tensile strength. A slight preliminary torsional set improves subsequent resistance to torsion. The characteristics required of a good spring steel are: —high C, about 0.70%; low P and S content, P plus S < 0.06%; and medium, but uniform hardness. The causes of failure of springs were found to be distributed as follows: — local graphitization 20%; variation in hardness 10%; surface defects caused during wire-drawing 10%; local defects 12%; excessive hardness 10%; low tensile and low C (0.5-0.6%) 15%; excessive strain and other defects in construction 10%.

M. L. Becker and C. E. Phillips.
Internal Stresses and Their Effect on Fatigue Resistance of Spring Steels. Iron and Steel Inst.— J v 133, n. 1, 1936, p. 427P-42P (discussion) 443P-53P, 2 supp. plates; see also Heat Treating and Forging, v. 22, n. 5, May 1936, p. 227-32 and 240; Machy. Market, n. 1856 and 1857, May 29 1936, p. 441-2 and June 5, p. 463-4; and French abstract in Génie Civil, v. 108, n. 2805, May 16, 1936, p. 473-4. Investigation made by National Physical Laboratory to determine whether internal stresses of appreciable magnitude occur near surface of heat treated steels and, if so, whether such stresses affect fatigue properties.

E. V. Walker and K. L. Beak.
An Apparatus for Determining the Commencement of Permanent Set in Material Used for Flat Springs. J. Sci. Instruments, v. 13, no. 3, 1936, p. 96. A note. A machine is described for determining whether material used for flat relay springs will take a permanent set on being deflected as a cantilever for many millions of operations at stresses below the elastic limit of the material. The springs are deflected by means of revolving cams with arrangements for counting mutiples of 5000 deflections. The instrument can be stopped at any multiple of 5000 deflections, when any permanent set is measured microscopically.

Heat Treatment

F. E. Harris.
Vertical Furnaces, for Hardening, for Tempering. Metal Progress, v. 30, n. 2, Aug. 1936, p. 52-7. Design features and use of vertical conveyor-type heat-treating furnaces of Buick Motor Car Co., Flint, Mich, for drawing coil springs and heating spring leaves.

W. C. Kernahan.
Heat Treating and Forging at Ford Motor Company. Heat Treating and Forging, v. 22, n. 6, June 1936, p. 273-81. Heat treating equipment and process for hammers, upsetters, axles, springs, wrist pins, crankshafts, gears, etc.

J. Goddet.
L'application du four électrique au traitement thermique des ressorts. Électricité, n. 17, Feb. 1936, p. 48-51. Application of electric furnaces for heat treatment of springs; description of various equipment and control system as used in France, in sizes from 8 kw to 30 kw and from 900 to 1400 C.

O. C. Trautman.
Electric Heat Treating of Wire. Iron Age, v. 138, n. 16, Oct. 15, 1936, p. 34-9. New process for heat treating spring wire by electric resistance, developed by Cleveland Wire Spring Co., Cleveland, consisting of continuous heating by direct resistance and subsequently quenching on rising temperature.

H. J. Langley.
Heat Treating Spring Leaves. Ind. Gaz., v. 14, n. 7, 1936, p. 7-8, 16. For the heat treatment of automobile springs, a special gas-fired furnace is used which maintains a reducing atmosphere and the avoidance of oxide or scale, except mill scale, and the maintenance of the required soaking temperature, prior to quenching. The steel is then removed from the furnace, automatically clamped, formed, and quenched in oil by a specially designed machine. Temperature of quenching oil is maintained below 100° F, by cooling.

G. N. Fomin and S. A. Berner.
Silicomanganese Spring Steel and its Heat Treatment. Kachestvennaia Stal, vol. 4, no. 1, 1936, pages 34-39. In Russian. Investigation was conduced to determine the influence of variation in composition from a standard on physical properties of the metal. Standard analysis was: 0.50-0.60% C, 0.45-0.80 Mn, 0.35 S, 0.45 P, 1.3-1.8 Si. Complete data on physical testing are furnished. All physical requirements are met when C content is higher than 0.60%; under 0.50% the results are unsatisfactory. With Si at the lower limit of 1.30% and Mn below it, 0.35% steel is on the margin of desired physical qualities. When Si was increased above its upper limit, 2.05%, up to 2.2% physical properties were fully met, but the material was a bit hard in the as furnished state which interfered with its cutting. 900-920° C can be recommended as quenching temperature in production.

Helical

E. W. Stewart.
Deflections and Stresses in Coiled Springs Made of Rectangular Wire. Product Eng., v. 7, n. 8, Aug. 1936, p. 286-90. Discussion of standard and basic formulas from which are developed convenient design equations and charts with constants checked and modified by actual test data.

H. W. Whiting.
Easing the Designer's Load in Selection of Springs. Machine Design, v. 8, n. 2, Feb. 1936, p. 19-23. Helical spring chart, including complete range of stresses and pitch diameters, factors for curvature correction and class of service, and ten different grades of materials.

W. R. Berry.
Graphical Helical Spring Calculations. Mech. World, v. 100, n. 2586 and 2587, July 24, 1936, p. 73-5 and July 31, p. 99-101 and 111. Spring calculating charts explained; examples of their use.

M. F. Sayre and A. V. DeForest.
New Spring Formulas and New Materials for Precision Spring Scales. Am. Soc. Mech. Engrs.- Trans., v. 58, n. 5, July 1936, p. 379-87 (RP-58-12). Development work on springs for precision measuring instruments in which various errors or deviations from desired behavior of springs were studied separately; these errors were then compensated by design of new type helical spring, combined error of which was reduced to well within 0.05%.

S. Higuchi, T. Tomita and M. Kashiwagi.
Oscillatory Motion of Loaded Helical Spring. Franklin Inst.— J v 221, n. 5, May 1936, p. 621-33. Loaded helical spring studied in hope of obtaining accurate values of internal viscosity of solid, owing mainly to fact that test piece constructed by helical spring may be assumed as being one fulfilling approximately condition of elimination of clamped effects.

J. K. Wood.
Simplifying Helical Spring Design. Product Eng. v. 7, n. 2, Feb. 1936, p. 59-61. Time saving method for designing springs when load deflection rate can be used as starting point.

R. F. Vogt.
Stress and Deflection of Helical Springs. Am. Soc. Mech. Engrs.— Trans., v. 58, n. 6, sec. 1, Aug. 1936, p. 467-75 (RP-58-14). New formulas for calculating stresses developed by author, for use in determining stress in springs of circular bar and rectangular bar

cross-section; design calculations for tension and compression springs made to show application of formulas.

Instruments

J. W. Rockefeller, Jr.
Instrument Springs. Wire and Wire Products, v. 11, n. 11, Nov. 1936, p. 631-9. Considerations important in design and manufacture discussed, together with relative merits of extension springs vs compression springs, twist of helical spring under axial load, mechanical hysteresis, creep under load, temperature effect on modulus of elasticity; Elinvar and related nickel-chromium steels, and approved methods of manufacture. Bibliography.

Laminated

S. Gross.
Blatt-Tragfedern bei schraegem Lastangriff. Technische Mitteilungen Krupp, v. 4, n. 4, Aug. 1936, p. 122-9. Laminated bearing springs under diagonal load; investigation of applicability of equation given in paper by Y. Tanaka, indexed in Engineering Index, 1922, p. 581 from Zeit fuer angewandte Mathematik u Mechanik Feb. 1922.

Manufacture

A. H. Peycke.
Hot Formed Mechanical Springs Manufacture and Life. Metal Progress, v. 29, n. 5, May 1936, p. 44-9. Large coiled springs and all leaf springs are formed from hot bar stock; subsequent heat treatment has notable effect on their static properties and endurance; tests described showing dangers of corrosion either prior to installation or during service.

J. W. Rockefeller, Jr.
Selection of Wire Spring Materials. Wire and Wire Products, v. 11, n. 10, Oct. 1936, p. 521-6 and 592-3. More important considerations in selection of materials, including music wire, annealed steel, hard wire, etc.; discussion on non-ferrous alloys, monel metal and phosphor bronze, in this connection.

A. H. Bitzer.
Variable-Speed Drives on Spring Coilers Increase and Control Production. Steel, v. 99, n. 17, Oct. 26, 1936, p. 55 and 78. Factors influencing speed of coiling machines, installation of Reeves variable speed floor controlled units by Illinois Coil Spring Co., Chicago.

J. E. Fenno.
Double-Action Cam that moves Transfer Arm in Three Planes: Spring Winding Machine, Diag., Machinery, v. 42, June 1936, p. 646-647.

Patents

Conrad L. Pfeiffer.
Apparatus for Electric Welding of Materials such as Springs and Electrical Contacts. (To Western Elec. Co.) U. S. 2,024,597, Dec. 17, 1936. Structural, mechanical and operative details.

Edward Houdremont.
Hard Alloys. Fried. Krupp, A - G. German 633,300, July 24, 1936, (Cl.40b. 16). Alloys for making cutting tools, springs, magnets, and apparatus for use at high temperatures. Contain W 10-30, Co 3-50 (preferably 25-50), C.0.1-0.55, and Va, Ti or Ta up to 10%, the remainder being Fe.

Earl S. Patch.
"Antifriction" plates for Insertion between the Leaves of Multiple-leaf Springs. (To Gen. Motors Corp.), U. S. 2,041,458, Aug. 18, 1936. One of the faces of "antifriction" metal plates has a rigid friction material such as finely powdered carborundum partially embedded in its surface to hold it in place.

Hans Gutmann.
Apparatus for Bending and Hardening Leaf Springs. Vulcanhammer-Maschinenfabrik. German 618,494, Sept. 9, 1935. (C. 18C. 2.21).

De. Hart G. Scrantom.
Processing Material, such as in Annealing Ship Metal for Springs, by Electric Heating and Treatment with a Liquid such as Water or Oil for Quenching. (To Western Elec. Co.) U. S. 2,029,037, Jan. 28, 1936. Apparatus and various operative details are described.

John F. Beam.
Apparatus for Forming and Quenching Automobile Leaf Springs etc. (To First National Bank in Massillon, Ohio). U. S. 2,022,532, Nov. 36, 1936. Structural and mechanical features.

Repair

L. Bertrand.
Up-to-date Spring Shop. Int. Ry. Congress Assn.— Bul., v. 18, n. 1, Jan. 1936, p. 25-40. Methods introduced by Belgian National Railways Co.: details pertaining to Cuesmes spring shop which has to repair whole of laminated springs on all locomotives, passenger vehicles, and freight cars of Belgian National Railways Co.

Springs (General)

H. Bock.
Das Verhalten einer rasch bewegten Ventilfeder. Schiffbau, v. 36, n. 21, Nov. 1, 1935, p. 359-61. Behavior of rapidly moving valve spring; theoretical mathematical study.

R. L. Stoughton.
How to Specify Springs. Product Eng., v. 7, n. 5, May 1936, p. 170-1. Data spring maker requires, with specifications chart and manufacturing tolerances.

G. Pielstick.
Schwingungsdaempfende Huelsenfedern. Mitteilungen aus den Forschungsanstalten--GHH-Konzern, v. 4, n. 5, Apr. 1936, p. 123-8. Vibration damping annular springs, consisting of pack of number of steel shells, cut open parallel to axis; application of such springs in elastic couplings, particularly for internal combustion engines; possibilities of their use in vibration dampers and results of tests; simultaneouus use of damper and coupling.

F. G. Altmann.
Drehfedernde Kupplungen. Il., diags. Zeit. ver Deutsch. Ing., v. 80, Feb. 29, 1936, p. 245-252.

J. A. Honneger.
Helical Spring used as Simple Flexible Coupling for Small Shafts. Diag., Machinery, v. 42, March 1936, p. 458.

L. Kasper.
Lever and Spring Arrangement for Variably Increasing Tension on Slide; Wire Forming Machine. Diags., Machinery, v. 43, Sept. 1936, p. 75.

Steel

S. Tour.
Springs of Stainless Steel. Iron Age, v. 138, n. 16, Oct. 15, 1936, p. 101-4, 106, 108, 110 and 112. Results of tests indicating that heat treated stainless steel is superior to chrome vanadium spring steel; explanation of tests and discussion of results.

Testing

R. Mossoux.
Les essais de matériaux pour ressorts envisagés comme base de calcul. Revue de Métallurgie, v. 33, n. 10, Oct. 1936, p. 609-11. Tests of

spring steels, based on which formulas are developed for calculation of design. Before Congrés Int. des Mines, de la Métallurgie et de la Géologie Appliquée, Oct. 20-6, 1935.

Anonymous.229.
Spring Testing. Automobile Engr., v. 26, n. 341, Jan. 1936, p. 16. Description of machine for rapid examination of helical springs.

Anonymous.230.
Testing Road Springs—I and II. Automobile Engr., v. 26, n. 343, and 344, Mar. 1936, p. 103-8 and Apr. p. 137-42. Current methods, apparatus, and general practice surveyed; various equipment illustrated.

Anonymous.231.
Avery Helical Spring Tester. Il., Automobile Eng., v. 26, Jan. 1936, p. 16.

Anonymous.232.
Denison and Son 3000 Kg. Spring Load Tester and Scragging Machine. Engineering, v. 140, Dec. 6, 1935, p. 617.

Anonymous.233.
Elasticometer Spring Testing Machine. Il., Automotive Ind., v. 74, Jan. 4, 1936, p. 31.

Anonymous.234.
Testing Road Springs; Current Methods, Apparatus, and General Practice. Il., diags. Automobile Eng., v. 26, March-April 1936, pp. 103-8, 137-42.

Torsion Bar

M. W. Bourdon.
Vauxhall Independent Torsion Bar Front Suspension. Il., Automotive Ind., v. 75, Sept. 26, 1936, p. 418-419.

Vibrations

J. P. Den Hartog and R. M. Heiles.
Forced Vibration in Nonlinear Systems with Various Combinations of Linear Systems with Various Combinations of Linear Springs. Am. Soc. Mech. Engrs.— Trans. (J Applied Mechanics), v. 3, n. 4, Dec. 1936, p A-127-30. Paper deals with single mass system containing combination of linear springs having force displacement characteristic; curves given.

E. Rausch.
Schwingungen von Kraftfahrzeugen. Automobiltechnische Zeit, v. 38,

n. 23, Dec. 10, 1935, p. 580-6. Vibration in automobiles; theoretical mathematical analysis pertaining to vibrations in symmetrical plane and vibrations perpendicular to symmetrical plane, and their application to design of automobile springs and suspensions; practical examples.

E. Marquard.
Zur Schwingungslehre der Kraftfahrzeugfederung. Automobiltechnische Zeit, v. 39, n. 14, July 25, 1936, p. 352-61. Theory of vibrations of automobile springs and suspension; short review of work done in Germany on basis of bibliography and theoretical mathematical analysis.

1937

Air Springs

Anonymous.235.
Cle-Air combined Air Cushion and Shock Absorber. Diag., Automotive Ind. v. 76, Jan. 2, 1937, p. 27.

Automobile Springs and Suspension

E. Lehr.
Die Berechnung der Kraftwagenfederung auf schwingungstechnischer Grundlage. Automobiltechnische Zeit, v. 40, n. 16, Aug. 25, 1937, p. 401-14. Calculation of automobile springs based on principles of vibrations; analysis of results of tests.

B. Riediger.
Federnde Lagerung des Antriebamotors in Kraftwagen und Flugzeugen. VDI Zeit v. 81, n. 25, June 19, 1937, p. 713-20. Spring suspension of automobile and airplane engines; to build automobiles and airplanes inexpensively requires engines of low number of cylinders; new type of engine has disadvantage of unbalanced masses which may be removed by spring support on engine; study of vibration processes yield equations for dimensioning of required shock absorbers. Bibliography

Anonymous.236.
Helical Springs for Automobile Front Ends. Metal Progress, v. 31, n. 2, Feb. 1937, p. 163-71. Illustrated article of operations used in plant of Buick Motor Co., Flint, Mich.

Anonymous.237.
Making Road Vehicle Springs. Passenger Transport J v 77, n. 1936, Aug. 13, 1937, p. 76-7; see also Iron and Steel Industry, v. 10, n. 14, Sept. 1937, p. 595-7; Metallurgia, v. 16, n. 94, Aug. 1937,

p. 109-12. Methods employed by Samuel Fox and Co., in manufacture of springs for commercial vehicles.

Anonymous 238.
Spring-Producing Plant at Stocksbridge. Engineer, v. 164, n. 4256, Aug. 6, 1937, p. 160-1; see also Engineering, v. 144. n. 3734, Aug. 6, 1937, p. 148-50 and 152. Illustrated description of shop of Samuel Fox and Co. entirely remodeled; springs intended for use on commercial motor vehicles; plant is fully automatic; details of furnaces, forging presses, finishing and assembly.

J. Geschelin.
Buick has New Spring Suspension for 1938. Il., diags. Automotive Ind., v. 77, Oct. 16, 1937, p. 520-525.

Anonymous 239.
Free Springing; Auto Manufacturer will put it on all Four Wheels. Business Week, June 19, 1937, p. 16.

Anonymous 240.
New English Daimlers with Independent Front Springing. Automotive Ind., v. 77, Oct. 2, 1937, p. 442.

Anonymous 241.
Tires, Wheels, Springs, Shackles and Shock Absorbers, 1938 Cars; Specifications Tabulated. Automotive Ind., v. 77, Oct. 23, 1937, p. 571.

Anonymous 242.
Tires, Wheels, Springs, Shackles; Specifications Tabulated. Automotive Ind., v. 75, Dec. 26, 1936, p. 889.

Anonymous 243.
Rocking Chair Ride; Gravity Spring Suspension. Il. Bus Transportation, v. 16, Aug. 1937, p. 379.

Clocks

P. Chevenard and others.
New Alloy of the Elinvar Type. Engineer (London), v. 163: Supp. (Metallurgist), June 27, 1937, p. 38-39.

P. Chevenard and others.
Nouveaux Alliages, du Type Élinvar, Susceptibles de Durcessement Structural. Génie Civil, v. 110, May 22, 1937, p. 470.

Deflection

S. Ikeda and N. Soda.
Deflection of Helical Springs as Affected by Pitch Angle and Ratio Between Diameters of Coil and Wire. Soc. Mech. Engrs., Japan—Trans., v. 2, n. 7, May 1936, p. 281-91. New theoretical formula presented for deflection by means of strain energy method, taking both curvature and pitch angle into consideration. (In Japanese with brief English abstract p. S-84.)

W. E. Johnson.
Load-Deflection Characteristics of Initially Curved Flexural Springs. Am. Soc. Mech. Engrs.—Trans. (J Applied Mechanics), v. 4, n. 3, Sept. 1937, p. A-119-27. Determination of relation between load and deflection of curved flexural member which is permitted to take large deflections, so that its action may be considered to be that of spring; four primary types of springs considered, in each of which line of action of load is either perpendicular or parallel to tangent to neutral axis at point of clamping; equations for initial curve of piston ring with large gap.

J. W. Rockefeller, Jr.
Load-Deflection Characteristic of Special Springs. Wire and Wire Products, v. 12, n. 2, Feb. 1937, p. 75-8. Factors entering into modification in spring design to meet special load deflection characteristics, discussed. Bibliography.

Design

S. Gross.
Zur Berechnung de gewundenen Biegungsfedern. Zeit ver Deutsch Ing., v. 81, March 20, 1937, p. 352.

Anonymous. 244.
Better Springs for Electrical Products. Elec. Mfg., v. 19, n. 1 Jan. 1937, p. 52, 54, 56, and 58. Springs can improve performance, reduce cost and increase service life of electrically operated devices if designer is careful to select most compact form for space available, if he uses best type for function desired, and then selects most suitable material; threefold problem is simplified by applying fundamentals as outlined.

V. Tatarinoff.
Spring Design Charts for Cylindrical and Conical Springs. Product Eng., v. 8, n. 9, Sept. 1937, p. 344-7. Charts for calculation of all types of round wire extension and compression wound springs are given, which

are constructed on stress deflection formulas incorporating Wahl factor.

M. F. Sayre and A. V. DeForest.
New Spring Formulas and New Materials for Precision Spring Scales. Am. Soc. Mech. Engrs.— Trans., v. 59, n. 4, May 1937, p. 339-41. Discussion of paper indexed in Engineering Index 1936, p. 1053, from issue of July 1936.

W. M. Griffith.
Standards for Spring Design. Product Eng., v. 8, n. 3, 4 and 5, Mar. 1937, p. 89-93, Apr. p. 140-3 and May p. 184-5. Mar.: Working stresses, endurance limits and standard material specifications for helical spring wires. Apr.: Selection of working stresses and formulas for calculating dimensions. May.: Drawings, tolerances and inspection standards presented.

Die Springs

Anonymous 245.
Die Springs; Stress Calculations; Reference Book Sheet. Am. Mach., v. 81, June 2, 1937, p. 461-462.

Electric Commutator Brushes

Anonymous 246.
Good Commutation Needs Right Brush Springs. Elec. Mfg. v. 20, n. 3, Sept. 1937, p. 66, 68, 70, 72 and 74. To insure low contact drop between brushes and commutators, or between brushes and slip rings, on electric machines and to minimize brush vibration calls for specification for brush springs and holders; how to correctly specify design and materials for this factor in satisfactory motor performance is discussed.

Fatigue

F. P. Zimmerli.
Effect of Longitudinal Scratches upon Endurance Limit in Torsion of Spring Wire. Wire and Wire Products, v. 12, n. 3 and 4, Mar. 1937, p. 133 and 135-8 and Apr. p. 185-9 and 191. Report, by Research Department of Associated Spring Manufacturers, on investigation to ascertain effects of scratches upon steel wire used in production of helical springs; microphotographs presented. Bibliography.

R. R. Tatnall.
Fatigue Properties of Helical Springs. Wire and Wire Products, v. 12, n. 10, Oct. 1937, p. 577-9, 582-6 and 588-91. Discussion of helical compression and to certain extent extension springs of round wire section; consideration of springs made of common types of carbon steel wires.

Anonymous. 247.
National Physical Laboratory: Tempering Stresses and Fatigue of Spring Steels. Engineering, v. 144, Aug. 13, 1937, p. 186.

Heat Treatment

Anonymous 248.
New Heat Treating Furnaces for Ford English Plant. Heat Treating and Forging, v. 23, n. 8, Aug. 1937, p. 408 and 411. Furnaces installed at Dagenham plant of Ford Motor Co., consisting of 6 hardening and one tempering furnace to be used in heat treating automobile springs.

O. N. Peterson.
Heat Treatment and Metallurgical Control. Metal Progress, v. 32, n. 4, Oct. 1937, p. 337-46. Phases of control discussed, including grain size control, regulation of annealing cycle, decarburization in gas carburizer, heat treating for machinability, treatment of manganese steels, cold drawn rods and tubing, and tests on spring steels.

Helical

C. T. Edgerton.
Abstract of Progress Report No. 3 on Heavy Helical Springs. Am. Soc. Mech. Engrs.—Trans., v. 59, n. 7, Oct. 1937, p. 609-16 (RP-50-8). Principal results of static tension and torsion tests, rotating beam endurance tests in bending, and torsion endurance tests of straight pieces of plain carbon basic open hearth, plain carbon electric furnace and silicon vanadium spring steel; these results compared with those for other steels. See also Engineering Index 1932, p. 1224.

J. Jennings.
Buckling of Compression Springs. Mech. World, v. 102, n. 2635, July 2, 1937, p. 5-6. Equations and curves given are based on analysis by author, of conditions for instability of helical spring under axial compressive loads, when angle of tilt of coils is small and when ratio of wire diameter to coil diameter is not too large.

V. Tatarinoff.
Conical Springs Made from Strip of Rectangular Section. Machy. (Lond.), v. 50, n. 1281, Apr. 29, 1937, p. 137-41. Theoretical mathematical study.

J. Jennings.
Maximum Capacity of Helical Springs. Machy., (Lond.), v. 51, n. 1307, Oct. 28, 1937, p. 109-11. Formulas and curves which facilitate designing

of helical springs for use in confined spaces.

T. Tomita and M. Kashiwagi.
Oscillatory Motion of Loaded Helical Spring. Tohoku Imperial Univ. Japan—Tech. Reports, v. 12, n. 2, 1937, p. 1-12. Spring studied by one of authors in hope of obtaining accurate values of internal viscosity of solid; in course of studies, author met some ambiguous points in regard to somewhat essential problem relating to motion of helical spring; these points are mathematically treated. (In English.)

Laminated

S. Gross.
Die Berechnung gestufter Blattfedern. Technische Mitteilungen Krupp, v. 5, n. 7, Oct. 1937, p. 214-21. Calculation of composite leaf springs for vehicles; purpose and characteristics of suspension consisting of main upper spring and supplementary lower spring, latter coming into action only when certain load is reached; two methods of calculation for such springs developed and compared.

H. Burger.
Berechnung von Blattfedern mit Ungleichen Blattdicken. Zeit. ver Deutsch Ing. v. 81, July 10, 1937, p. 844-845.

Anonymous 249.
Quality of Leaf Spring is Improved and Output Speeded by New Methods. Tuthill Spring Co., Il., Steel, v. 100, April 5, 1937, p. 70.

Locomotive Springs and Suspension

K. Pflanz.
Untersuchungen am Federungsausgleich einer elektrischen Schnellzugs-lokomotive. Organ fuer die Fortschritte des Eisenbahnwesens, v. 92, n. 6, Mar. 15, 1937, p. 106-11, supp. plate. Results of Austrian experimental studies of balancing of spring suspensions of fast electric locomotives.

Manufacture

J. W. Rockefeller, Jr.
Development of Today's Scale Spring. Wire and Wire Products, v. 12, n. 9, Sept. 1937, p. 475-7. Special treatment of wire involved in manufacture of scale and precision springs described.

J. W. Rockefeller, Jr.
Manufacture of Wire Springs. Wire and Wire Products, v. 11, n. 12, Dec. 1936, p. 705-8. Methods of manufacture, including heat treating;

choice and method of application of spring finishes; pretempered wire; annealed wire, etc.

R. Mossoux.
Quelques aspects spéciaux de la fabrication des ressorts en fil "corde à piano," Société Royale Belge des Ingénieurs et des Industriels—Bul., n. 6, 1937, p. 561-79. Some special aspects of manufacture of springs from music wire; discussion of control of material and calculation of small spiral springs.

Anonymous.250.
Modern Spring Plant in Great Britain; Samuel Fox and Co., Iron Age, v. 140, Sept. 2, 1937, p. 78.

Anonymous.251.
New Sleeper and Hartley Spring Making Machines, il, Iron Age, v. 140, Sept. 2, 1937, p. 51.

Anonymous.252.
Torrington Introduces New Line of Spring Making Machines. Il., Iron Age, v. 140, Aug, 12, 1937, p. 61; Am. Mach., v. 81, Aug. 25, 1937, p. 754.

Patents

Reinhard Straumann.
Alloy for Spiral Watch Springs. German 649,811, Sept. 3, 1937, (C. 83a. 24). Consists of Ni 30-38, W, Mo, or Cr. 5-10, Be 0.5-2.0, Ti 0.5-2.0, Si and Mn 1%, and the rest Fe.

Reinhard Straumann.
Alloys Suitable for Watch and Clock Springs. U.S. 2,072,489, March 2, 1937, Ni-Fe alloys, with an addition of Be as a hardening agent, contain Ni 25-40 and Be 0.5-2.0, at least one of the metals Mo, Cr, and W to a total of 5-12%, with the further addition of Ti 0.5-2.0% for the purpose that, in addition to the great hardness achieved and the low temperature coefficient, the dependence of the latter and its secondary error on the fixing temperature is greatly reduced, to the rate of 0.5 to 1.0 second of each degree of temperature variation of the fixing temperature.

N. V. Irma.
Intermediate Layer for Laminated Supporting Springs. Industrie en Ruwmatenalen Maatschapps: British, 457,579, Dec. 1, 1936. To retard the motion of a laminated spring, material having relatively high friction properties is added to strips of material interposed between the laminations. Such strips may comprise a metallic core, e.g., a

perforated metal sheet, a sieve or braid, into and around which is pressed or rolled a mass composed of fibrous material, e.g., asbestos, bending and hardening agents, e.g., artificial resins, and a friction agent, e.g., metal dust, glass powder, Si C, quartz sand, or colophony.

Rubber

C. F. Hirshfeld and E. H. Piron.
Necessary Qualities Found in Rubber Springs. Machine Design, v. 9, n. 6, June 1937, p. 40-4. Considerations affecting justification of rubber in place of metal as springing material; illustrations given showing various advantages of rubber and industrial applications to which it is applied.

C. F. Hirshfeld and E. H. Piron.
Rubber Cushioning Devices. Am. Soc. Mech. Engrs.—Trans., v. 59, n. 6, sec. 1, Aug. 1937, p. 471-91 (PRO-59-5); see also Wire and Wire Products, v. 12, n. 8, Aug. 1937, p. 413-4. Production of compounded rubber; properties of compounded and vulcanized rubber; rubber as springing material; comparison of steel and rubber springs; characteristics of different types of deformation; rubber springs in street car; future of rubber in mechanical engineering.

W. C. Keys.
Rubber Springs. Mech. Eng., v. 59, n. 5, May 1937, p 345-9 and 380. Physical properties of rubber and its use in tension, compression, and shear described; some representative uses. Before Am. Soc. Mech. Engrs.

C. Macbeth.
Rubber for Independent Spring Suspension Systems. India Rubber World, v. 96, n. 1, Apr. 1, 1937, p. 41-4 and 51. Description of several individually designed types of suspension involving four general methods of application; possibilities of practical application of rubber and its effects on wheel suspension in automotive engineering; illustrations given.

Springs (General)

J. W. Rockefeller, Jr.
Spring Problems of Yesterday and Tomorrow. Wire and Wire Products, v. 12, n. 5, May 1937, p. 251-3. Development of springs discussed; estimate of problems still to be solved; desirability for uniform specifications outlined; suggestions as to how to best set up such specifications.

F. Server.
Spring-Actuated Work Support for Jigs. Diags., Machinery, v. 43, April 1937, p. 549-550.

R. W. Cook.
Springs; Their Design, Materials, and Heat Treatment. Canadian Chem. and Met., v. 21, Jan. 1937, p. 19.

C. L. Seeber.
Coat System in Job Order Plant. Wallace Barnes Co., Div., of Assoc. Spring. Corp. NACA Bulletin, v. 18, June 15, 1937, p. 1139-1151.

Steel

M. Ishida and O. Ito.
Working Temperature of Silicon-manganese Steel for Bearing Spring of Railway Carriages. Japanese, Gov. Rys.—Bul., v. 25, n. 11, Apr. 25, 1937, 16 p., 2 supp. plates. In several workshops, accidents have often happened while sheets are being worked; it has been found that one of causes of accidents lies in working temperature; accordingly sheets were put to impact and tension tests at high temperature and further tested in service conditions. (In Japanese.)

Anonymous 253.
Vanadium Steels and Irons. Vanadium Corp. of America, New York, N. Y. 189 p., figs., diagrs., charts, illus. Data and descriptive matter under chapter headings; function of vanadium in steels; wrought constructional vanadium steels in light sections and in heavy sections; vanadium spring steels; cast steels, tool steels, and nitriding steels; vanadium cast irons.

Stresses

L. Locati.
Ricerche sul valore del modulo d'elasticita alla torsione di fili e tondi per molle. Industria Mecannica, v. 19, n. 7, July 1937, p. 517-25. Review of recent data and results of tests for determination of torsional modulus of elasticity of wire and round bars for springs made of steel or steel alloys.

L. I. Kukanov.
Apparatus of Siebel and Pomp for the Estimation of the Elasticity of Steel Wire Springs. Zavodskaya Laboratoria, Nov. 5, 1936, p. 1235-1237. A discussion with mathematical treatment of the performance of the Siebel and Pomp Apparatus.

Testing

R. R. Tatnall.
Development of Fatigue Testing Method for Springs and Spring Wire. Wire and Wire Products, v. 12, n. 6, June 1937, p. 297-301. Development of spring testing method; machine, developed by author, consists essentially of crankshaft carrying 12 cranks, each having connecting rod to a slide, and designed to test number of extension springs, each under different loading.

F. C. Hudson.
Tester for Driving-Box Grease-Cellar Springs. Diags., Am. Mach., v. 81, Nov. 3, 1937, p. 1045.

1938

Aluminum

E. von Burg.
Festigkeitsverhaeltnisse zwischen Stalfedern und Aluminiumfedern, etc. Aluminum, v. 19, n. 12, Dec. 1937, p. 756-8. Ratios of strength between steel springs and aluminum magnesium silicon (Anticorodal) springs; investigation of transverse conditions with equal bearing power; results show that, under certain conditions of static load; aluminum alloy springs can be used in place of steel springs.

Automobile Springs and Suspension

B. Riediger.
Federnde Lagerung von V- und Sternmotoren. VDI Zeit, v. 82, n 11, Mar. 12, 1938, p. 315-20. Spring suspension of V and radial engines; extension of theoretical mathematical design analysis covering automobile and airplane engines. Supplement to paper indexed in Engineering Index 1937, p. 99, from June 19, 1937 issue.

J. H. Shoemaker, K. K. Probst and W. F. Whiteman.
Leaf Springs for Automotive Application have been the Subject of Considerable Research. Il., diag., Automotive Ind., v. 78, June 25, 1938, p. 842-847; v. 79, July 9, 1938, p. 52-59.

T. Franzen.
Recent Developments in the Design of Passenger Car Suspension Springs and Their Application. Il., diags., Automotive Ind., v. 78, April 30, 1938, p. 607-609.

Anonymous. 254.
Tires, Wheels, Springs, 1939 cars; Specifications tabulated. Automotive Ind., v. 79, Nov. 12, 1938, p. 605.

Anonymous. 255.
Clutch Springs for Chevrolet; Illustrations. Am. Mach., v. 82, Jan. 12, 1938, p. 4-5.

J. Geschelin.
Precision follows through in Chevrolet Clutch Spring Production. Il. diag, Automotive Industry, v. 78, Jan. 8, 1938, p. 50-53.

Beryllium Copper Alloys

A. L. Riche.
Beryllium Copper Used in Electrical Switch Spring. Trans. Electrochem. Soc., vol. 69, 1936, pp. 493-494. Practical. Springs made of 2.25% Be-Cu alloy heat-treated at 260° C. have withstood many million flexures. They are mechanically superior to those made of P-bronze and, in addition, have good electrical conductivity and corrosion resistance.

Car Springs and Suspension

Anonymous. 256.
Spring-Suspended Rail Car. Il., diag., Scientific Amer., v. 158, May 1938, p. 294.

Anonymous. 257.
Type-H Railway-Truck Friction Bolster Spring., il diag. Railway Age, v. 104, June 4, 1938, p. 951.

Copper Alloys

H. Psille and W. Schulze.
A New Material for Springs—a Contribution to the Four Year Plan. (Mix u. Genest Techn. Nachr., 1938, 10, (1), 62-66).— The characteristics of suitable materials for small springs for use in radio work are reviewed. The physical, mechanical, electrical, and anti-corrosive properties of Semi-Tombak, an alloy containing only 70% copper, are tabulated in comparison with those of 6% tin-bronze and nickel-brass, and the suitability of Semi-Tombak as substitute for these two alloys in the production of small springs is discussed in detail.

Corrosion Resisting

C. H. S. Tupholme.
Corrosion-Resisting Springs. Can Metals and Met. Industries, v. 1, n. 4, Apr. 1938, p. 120. Advantages of Monel metal for making springs for use under corrosive conditions; test data.

Design

H. Martin.
Adjustable Extension Springs. Product Eng., v. 9, n. 6, June 1938, p. 224-5. Designs of coil spring ends to secure adjustability of tension and length together with methods of fastening.

V. Tatarinoff.
Cantilever Spring Design. Machy. (Lond.), v. 52, n. 1344, July 14, 1938, p. 462-4. Design of simple and compound cantilever springs facilitated by use of charts which are reproduced.

S. Gross and E. Lehr.
Die Federn, ihre Gestaltung und Berechnung. Ed. by P. Speer. Berlin, VDI-Verlag, 1938. 136 pp., ullus., diagrs., charts, tables, 25 rm. Volume, prepared under auspices of subcommittee on Spring Design of Verein deutscher Ingenieure, discusses whole field of spring design; leaf, cylindrical, helical, ring and other springs considered, covering all types used in vehicles and machinery. Eng. Soc. Lib. N.Y.

A. M. Wahl.
General Considerations in Designing Mechanical Springs. Machine Design, v. 10, n. 1, 2, 3, and 4, Jan. 1938, p. 30-5, Feb. p. 36-41, 72 and 74, Mar. p. 31-5 and Apr. p. 27-30 and 135. Jan.: Methods for determining working stresses, Feb.: Stresses in helical compression springs. Mar.: Compression and tension springs. Apr.: Torsion and spiral springs.

K. J. DeJuhasz.
Graphical Analysis of Surges in Mechanical Springs. Franklin Inst. — J v 226, n. 4 and 5, Oct. 1938, p. 505-32 and Nov. p. 631-44. Analysis of following problems: knowing design data of spring, its initial condition of equilibrium and characteristics of disturbance as function of time—to determine response of spring as expressed by velocity and of stress at any point in spring as function of time.

V. A. Nicolsky.
La calcul des ressorts curvilignes à lâmes. Génie Civil, v. 113, n. 2923, Aug. 20, 1938, p. 171. Theoretical principles of design of curved laminated springs.

G. Reynal.
Les Ressorts. Etude complète et Méthode Rapide de Calcul. 3 ed. Paris, Dunod, 1938. 222 pp., diagrs., charts, tables, 35 figs. Presentation of formulas and graphs for rapid determination of physical characteristics of main types of springs, leaf, helical, spiral, and multiples of each; discussion of effects produced by expansion of such springs under varying conditions; other special effects also considered, and nomograms with movable strips described. Eng. Soc. Lib. N. Y.

R. P. Kroon and C. C. Davenport.
Spiral Springs with Small Number of Turns. Franklin Inst.—J v 225 n. 2, Feb. 1938, p. 171-95. Practical considerations, sometimes require spring of such stiffness as can only be obtained by using comparatively thick cross section and few turns; problem is then to find best design for given limitations; theory for spiral springs with few turns is presented.

J. Jennings.
Springs of Minimum Weight. Machy., (Lond.), v. 52, n. 1352, Sept. 8, 1938, p. 707-9. Object of article is to investigate conditions which give minimum weight, and examine them with reference to length and space occupied by spring.

W. Jahr.
Zur Federberechnung. Werkstatt u Betrieb, v. 71, n. 7/8 and 11/12, Apr. 1938, p. 89-91 and June p. 150-4. Apr.: Theoretical mathematical design analysis for calculation of helical springs. June: Methods for use of slide rule in calculation of springs.

Disk

H. Stark.
Untersuchungen an Tellerfedern. Diag., Verein Deutsche Ingenieure, v. 81, Nov. 27, 1937, p. 1390-1391.

Failure

E. Takahashi and K. Shioya.
Fatigue Failure of Valve Spring. Nippon Kinzoku Gakkai-Si, vol. 1, Dec. 1937, pp. 320-334. In Japanese. Original research. Distribution of shearing stresses at various parts of valve springs subjected to compression was examined by means of a small mirror attached to the spring wire. The experimental results at each part of the spring wire agree fairly well with the value obtained from the formula, $F = 16\ WR/\pi d^3$, where F denote the shearing stress in the spring

wire, W the compressive load applied to the spring, R the radius of the spring, and d the diameter of the spring wire, provided that the spring is subjected to static loading. A coiled spring, under repeated compression, such as in the valve mechanism of high speed internal combustion engines, vibrates at its natural frequency, and begins to "surge." This is attributed to the resonance between the natural frequency of the spring and the frequency of the forced vibration as related to the revolution of the camshaft. How the surge affects spring stresses was experimentally studied by means of the deflection of the mirror; the repeated stress is especially high at the second turn from each end of the springs, the stress amounting to about 5 times the value calculated from the formula; this is in agreement with the fact that fatigue failures actually take place at this portion. The surge is an important source of failure of valve spring owing to the stress and rapidity of the stress cycle.

Fatigue

R. Marty.

Etude des déformations et de la fatigue des ressorts à boudin. Mécanique, v. 22, n. 276 and 279, Jan.-Feb. 1938, p. 33-9 and July-Aug. p. 137-44. Jan.-Feb.: Study on deformation and fatigue of wire springs of any shape submitted to forces acting from any direction; theoretical mathematical study. July-Aug.: Study on deformation and fatigue of helical springs.

F. P. Zimmerli.

Relation of Wahl Correction Factor to Fatigue Tests on Helical Compression Springs. Am. Soc. Mech. Engrs.—Trans., v. 60, n. 1 and 8, sec. 1, Jan. 1938, p. 43-4 (RP-60-2) and (discussion) Nov. p. 685-8. Supplement to article by A. M. Wahl, indexed in Engineering Index 1929, p. 1709 from Am. Soc. Mech. Engrs.—Trans (Applied Mechanics) May-June 1929; attempt made to test Wahl's factor by running fatigue tests on springs of varying indexes which were coiled from same bundle of wire; in stress calculations, Wahl factor was used throughtout.

C. T. Edgerton.

Research on Fatigue Properties of Heavy Helical Springs. Wire and Wire Products, v. 13, n. 1, 2, 3, and 4, Jan. 1938, p. 17-8, 20-6 and 41, Feb. p. 69-70, 72-3, and 97, Mar. p. 125-6, 128-31, and 155, and Apr. p. 183-5 and 204-5. Progress report No. 3 of subcommitte on heavy helical springs of Special Research Committee on Mechanical Springs, indexed in Engineering Index 1937, p. 1081, from Am. Soc. Mech. Engrs.—Trans., Oct. 1937.

F. P. Zimmerli, W. P. Wood and G. D. Wilson.
Effect of Longitudinal Scratches on Valve Spring Wire. Wire and Wire Products, v. 13, n. 5 and 6, May 1938, p. 245-6,248-9 and 258-9, June, p. 299 and 302-5. Indexed in Engineering Index 1937, p. 1273, from Am. Soc. Metals—Preprint, n. 24, mtg. Oct. 18-22, 1937.

W. Hellwig.
Verdrehdauerfestigkeit von Federdraehten, etc, Forschung auf dem Gebiete des Ingenieurwesens, v. 9, n. 4, July-Aug. 1938. p. 165-76. Torsional fatigue strength of beryllium nickel and beryllium contracid spring wire at temperatures up to 300 C; test method developed which does not damage surface of metal; results of measurements on beryllium alloys and some steels.

Heat Treatment

K. P. Kolchin.
Quenching of Flat Spring Steel. Metallurgia, v. 12, n. 12, 1937, p. 40-45. Thin spring steel containing C 0.65-0.75% Si 1.4-1.7% and Cu 0.2-0.4% is quenched from 900° C into a metallic bath at 325°C, for 1.5-6.0 min, annealed at 450°C for 1.5 minutes, and quenched in water.

M. Bonzel.
Distortion of Springs during Heat Treatment. Metal Prog. v. 33, March 1938, p. 314.

Anonymous. 258.
Speed and Temperature Uniformity Emphasized in New Furnace built by the Tuthill Spring Co., il. Iron Age, v. 141, Mar. 3, 1938, p. 56.

Helical

A. M. Wahl.
Analysis of Effect of Wire Curvature on Allowable Stresses in Helical Springs. Am. Soc. Mech. Engrs.—Advance Paper, n. 30, mtg, Dec. 5-9, 1938, 6 p. On basis of strain measurements reported in paper indexed in Engineering Index 1929, p. 1709, from Am. Soc. Mech. Engrs.—Trans., May-Aug., 1929, approximate formula was developed for calculating maximum stress in such springs.

W. E. Burdick, F. S. Chaplin and W. L. Sheppard.
Deflection of Helical Springs Under Transverse Loadings. Am. Soc. Mech. Engrs.— Advance Paper n. 6, mtg. Dec. 5-9, 1938, 8 p. Analytical approach to problem of transverse deflection of closely coiled spring under action of force perpendicular to its axis and

end moment; supporting test data included to substantiate formulas within established limits; expressions for stresses under this loading in combination with axial force derived for critical points on springs.

Anonymous 259.
Loads and Deflections of Helical Springs; Data Sheet. J. I. Hommel Co., Machinery, v. 44, Feb.-Apr. 1938, p. 360A, 424A, 542A.

Machinery Mountings

E. Rausch.
Federnde Lagerung von Maschinen. VDI Zeit, v. 82, n. 17, Apr. 23, 1938, p. 495-501. Spring mountings for machinery; theoretical mathematical design analysis for anti-vibration foundations.

Manufacture

G. H. Snyder.
Carbides for Coil Winding. Am. Mach., v. 82, n. 14, July 13, 1938, p. 647-8. Use of sintered carbides in spring making machinery and in drawing of wire assures production of springs to close tolerances; various carbide tools include dies, machine bumpers, guides, pitch tools, and arbors.

Anonymous 260.
Spring and Wire Machinery. Engineer, v. 165, n. 4298, May 27, 1938, p. 603. Brief description of machines for straightening and cutting off wire and coiling and knotting of springs, and other machines for wire industry, manufactured by Wafios Engineering Works, of Reutlingen, Germany.

J. B. Nealey.
Automatic Gas Heaters Minimize Spring Failure. Am. Gas J v 148, n. 2, Feb. 1938, p. 28-30; see also Heat Treating and Forging, v. 24, n. 2, Feb. 1938 p. 61-4; Steel, v. 102, n. 14, Apr. 4, 1938, p. 71-2. Illustrated description of methods employed by Chevrolet Forge Spring and Bumper Division of General Motors Corp., Detroit, in forming and heat treating coil springs; heating for pointing, coiling, and proper grain structure accomplished in mechanical gas furnaces.

H. Wiesecke.
Manufacture of Spring Wire from Low Carbon Steel. Wire and Wire Products, v. 13, n. 7 and 8, July 1938, p. 355-9 and Aug. p. 406-10 and 420. Study of hardening properties of low carbon steel (0.10 carbon and below) and adaptability of such steel for manufacture of spring wire and wire products. Bibliography.

C. R. Engel.
Spring-Winding Mechanism for Automobile Signalling Lights. Diag. Machinery v. 44, Aug. 1938, p. 844.

Anonymous. 261.
Electricity in Spring-Making. Il, Electrical Review (London), v. 121, Nov. 19, 1937, p. 698-699.

Anonymous 262.
Making Springs; Forming and Heat Treating Furnaces. Il., Steel, v. 103, Sept. 19, 1938, p. 66.

Anonymous. 263.
Sleeper and Hartley Torsion-Spring Winding Machine. Il., Amer. Mach., v. 81, Dec. 1, 1937, p. 1161-1162.

L. Kasper.
Switch-Operating Mechanism used on a Machine for Winding Special Springs. Diags., Machinery, v. 44, May 1938, p. 601-602.

Anonymous 264.
Wafios Spring and Wire Machinery. Il., Engineering, v. 165, May 27, 1938, p. 603.

Micrometers

W. W. Werring.
New Micrometer Ratchet. Bell Laboratories Rec v. 16, n. 5, Jan. 1938, p. 162-3. By substituting helical spring for ratchet to transmit torque of operator's fingers, Laboratories have been able to improve accuracy of machinist's micrometer calipers.

Nickel Alloys

Reinhard Straumann.
The Compensating Effect of Nivarox Springs and the Influence of the Mechanical and Ferromagnetic Properties of the Alloy on this Effect. (Ann. franc. Chronométrie, 1937, 7, (4), 311-320).—S outlines the conditions which must be fulfilled by a material acting as an autocompensating medium in precision mechanisms, and illustrates the fulfilment of these requirements by the properties of Nivarox (nickel-iron alloy containing beryllium), a material showing low and controllable magnetism, high modulus of elasticity, capacity for structural hardening, and controllable thermo-elastic properties.

N. S. Severgin.
Composition and Heat Treatment of Nickel Silver used for Flat Springs. Metallurgia, v. 12, n. 9-10, 1937, p. 92-106. The most satisfactory composition was found to be Cu 60, Ni 20 and Zn 20%. The material should be annealed at 300° C. for 45 minutes before the final cold rolling, in which the reduction should be at least 40%.

Non-Ferrous Alloys

R. W. Carson.
New Alloys for Springs. Product Eng., v. 9, n. 6, June 1938, p. 213-5. Notes on non-ferrous alloys that can be heat treated, then worked while ductile and later hardened to obtain physical properties desired.

L. L. Stott and R. W. Carson.
Stability of Some Alloys for Springs Compared. Metals and Alloys, v. 9, n. 9, Sept. 1938, p. 233-6; see also Metal Industry (Lond.), v. 53, n. 17, Oct. 21, 1938, p. 395-7. Results of tests carried out at laboratories of Instrument Specialties Co., Little Falls, N. Y.; measurements show that salt bath heat treated at 650 F for 20 min. gives minimum drift in beryllium copper cold rolled strip; effect of stress on drift or hysteresis.

Patents

Anonymous. 265.
Alloys for Springs. Heraeus Vacuumschmelze. A.-G. French 820, 517, Nov. 13, 1937. Alloys capable of being hardened by heating contain Be up to 2.5, Co 15-60, Fe 73-20, Ti or Si 0.5 to 10%, and balance Ni. An example contains Co 35.0, Fe 53.1, Mn 0.8, Si 0.1, Be 1.0, and Ti 1.0%.

Fred R. Zimmerman
Apparatus for Electrically Heating Coil Springs for Tempering. (to Nachman Spring-Filled Corp.). U.S. 2,105,105, Jan. 11, 1938. Various structural, mechanical and operative details.

Tom H. Thompson.
Lubricated Leaf Spring Liners. British 473,314, Oct. 11, 1937. These comprise a flexible porous strip of fibrous material having a lubricating material and a foliate mineral material embedded in the body thereof. The liner may be formed from a paper stock mixed with a foliate material, e.g. vermiculete, the mixture being picked up on a Four-driven belt to form a web which is then dipped into a hot lubricating material, e.g. a mixture of paraffin, cornauba wax and hydrolene,

that solidifies at ordinary temperatures. After cooling, the strip is cold calendered to its final form.

Reinhard Straumann.
Alloys Suitable for Watch and Clock Springs. British 477,729, Jan. 5, 1938, see U.S. 2,072,489.

Franz R. Hensel and Earl I. Larson.
Copper-Silver-Beryllium-Manganese Alloys, (To P.R. Mallory and Co.) U. S. 2,131,104, Sept. 27, 1938. Alloys which are suitable for Springs for Electrical apparatus contain Cu together with Be 0.5-3.0, Ag 0.05-4.0, and Mn 0.5-10%.

Edward J. Podany.
Forming and Heat Treating Sinuous Springs. (To Murray Corp. of America). U.S. 2,123,798, July 12, 1938. Various details of apparatus and operations for the formation of a substantially continuous spring fed helically around a shaft through a heating oven.

Resilience

R. R. Tatnall.
Resilience of Springs. Wire and Wire Products, v. 13, n. 10, Oct. 1938, p. 545-50 and 614. Definition and discussion of resilience; use and interpretation of formulas covering conditions of simple loading; type of loading; shape of section; use of modulus of resilience in design.

Rubber

B. Steinborn.
Die Daempfung als Qualitaetsmass fuer Gummi. Gummi-Ztg, v. 52, n. 7, Feb. 18, 1938, p. 154-5. Damping as yardstick of quality of rubber; results of experimental investigations and measurements of internal energy absorbed by rubber springs under constant deformations; accurate knowledge of internal hysteresis of different rubber compounds is important because heat generated due to variable deformations may result in premature destruction of rubber; test methods and equipment described.

C. F. Hirshfeld and E. H. Piron.
Rubber Cushioning Devices. Am. Soc. Mech. Engrs.—Trans., v. 60, n. 2, sec. 1, Feb. 1938, p. 203-5. Discussion of paper indexed in Engineering Index 1937, p. 1082, from issue of Aug. 1937.

Scales

A. C. Faberge.

Simple Spring Torsion Balance, J Sci. Instruments, v. 15, n. 1, Jan. 1938, p. 17-21. Simple and inexpensive balance described, elastic element of which is helical spring of phosphor bronze wire which is arranged to act as only support of torsion arm; relative sensitivity is about 0.002 of max. load, while absolute sensitivity attainable is at least 0.001 mg, by direct reading.

Shock Absorbers

Anonymous. 266

Spring Shock Absorber. Engineer, v. 165, n. 4300, June 10, 1938, p. 656. Illustrated description of Monarch patented device used for supporting work for 7-1/2-cwt pneumatic hammer in repair shops of Tees Conservancy Commission; these units can be applied also to coal mine cage hoists, tugs, ships' moorings, etc.

F. Michael.

Theoretische und experimentelle Grundlagen fuer die Untersuchung und Entwicklung von Flugzeugfederungen. Luftfahrtforschung, v. 14, n. 8, Aug. 20, 1937, p. 387-416. Report from German Aeronautical Experiment Station of Adlershof, near Berlin, presenting theoretical and experimental data for investigation and design of airplane springing systems; spring processes occurring in landing impact on under-carriages; numerical bases for assessment of quality of airplane springing systems; introduction of standard test methods.

Springs (General)

R. W. Carson.

What Springs Can Be Made to Do. Elec. Mfg., v. 22, n. 5, Nov. 1938, p. 26-8 and 54. Springs offer almost infinite variety of design, dimensions, materials and performance; units typical of some applications for electrically energized products, illustrated and described.

Steel

E. Wood.

Valve-Spring Wire. Aircraft Eng., v. 10, n. 110, Apr. 1938, p. 99-102. Methods of inspection and faults to which wire is subject; special attention given to cold drawn wire.

W. Bültner.

Structural Steel for Special Uses (In the Automotive Industry). Properties, Heat Treatment and Possible Uses of Spring Steels, Valve Steels, and Ball-and Roller-Bearing Steels. Automobiltech.

Z, 41, 1938, p. 307-315. Three extensive tables and four figures.

Stresses

E. Lehr and A. Weigand.
Spannungsverteilung in Federn. Forschung auf dem Gebiete des Ingenieurwesens, v. 8, n. 4, July-Aug. 1937, p. 161-9. Distribution of stresses in springs; account of dilatation on springs of different types; results compared with calculations.

L. E. Adams.
Effects of Torsional Overstrain on Physical Properties of Some Typical Spring Steels, and Its Influence on Shear Stresses in Helical Springs. Iron and Steel Inst.—Carnegie Scholarship Memoirs, v. 26, 1937, p. 1-55 supp. plate. Attention drawn to conflict between high shear stresses given by theory which includes Roever Effect, and appreciable life yielded by highly stressed helical springs in service; influence of "scragging"; investigations on torsional overstrain made on heat treated silicon manganese, chromium vanadium and mild steels and 1.0% carbon steels.

C. T. Edgerton.
Stresses in Helical Compression Springs—Present Status of Problem. Am. Soc. Mech. Engrs.— Paper mtg. Dec. 5-9, 1938, 6 p. Review of earlier investigations and theories; conclusion is that problem of design stresses in helical springs is not one for mathematician, but must be worked out in laboratories, by actual experiment.

Telephone Equipment

K. Mueller.
Trapezfoermige Blattfedern in Fernmeldegeraeten und ein Naeherungsformel. Zeit fuer Fernmeldetechnik, v. 18, n. 11, Nov. 1937, p. 180-1. Trapezoid blade springs in telephone equipment and approximate equation for their calculation.

Testing

H. Pollein.
Untersuchungen ueber Zugfederbandstahl. Mitteilungen aus dem Kaiser-Wilhelm-Institut fuer Eisenforschung zu Duesseldorf Abh 335, v. 19, n. 18, 1937, p. 247-72. Investigations of draw spring strip steel; report on investigations carried out in 1929 and 1930 on 15 plain and 4 silicon manganese steels; comparison with Swedish steels; illustrated description of testing methods and equipment employed; results.

Anonymous 267.

Chrysler's Test for Springs. Am. Mach., v. 82, n. 17, Aug. 24, 1938, p. 764-5. Description of new machine for checking suspension springs insures close tolerances; machine assures unquestionable accuracy of load readings, load indicating device is graduated in increments not greater than 1 lb., is automatic, and eliminates necessity of visual observations and adjustments of spring height.

L. Locati.

The Modulus of Elasticity in Torsion of Wires and Rounds for Springs (Ricerche sul valore del modulo d'elasticità alla torsione di fili e tondi per molle). Ind. Meccan., vol. 19, July 1937, pp. 517-525. Specimens of different spring steels were tested and showed practically the same modulus of elasticity, about 11,600,000-11,900,000 lbs./in.^{2}. Only rounds or wires which showed excessive decarburization or surface defects had lower values. Tests are described in detail. 11 references.

1939

Automobile Springs and Suspension

Anonymous 268.

Independent Front Suspension. Automobile Engr., v. 29, n. 387, Aug. 1939, p. 292. Brief illustrated description of design employing semi-elliptic springs as developed by N. Nicholas in attempt to eliminate play in joints.

F. W. Lanchester and G. H. Lanchester.

Independent Springing. Instn. Automobile Engrs.—Proc. v. 23, 1937-38, p. 412-37 (discussion) 438-69, 1 supp. plate following p. 905. Independent springing applied to rear wheels and to front wheels; diverse types of independent rear suspension; divided axle.

R. Ariano.

Molleggio di Veicoli. Strade v. 21, n. 5, May 1939, p. 239-46. Mathematical discussion of Turrinelli variable flexibility springs for automotive vehicles.

N. E. Hendrickson.

Trends in Commercial-Vehicle Spring Suspension. Soc. Automotive Engrs.— J v 44, n. 3, Mar. 1939, p. 104-8; see also Automobile Engr. v. 29, n. 380, Jan. 1939, p. 13-5. Special problems peculiar to commercial vehicle springing as compared with passenger automobile, discussed, notably difficulty of obtaining satisfactory riding qualities, long life of springs, and reasonable limitation of side sway throughout much wider range of loading.

Anonymous 269.
New Form of Clutch Spring has a varying Rate of Deflection Pressure Ratio. Il. Automotive Industry, v. 79, Dec. 10, 1938, p. 770-771.

Anonymous 270.
Variable-Rate Spring for Cars. Diags, Scientific American, v. 160, April 1939, p. 241.

Anonymous 271.
Crown Spring simplifies Buick Clutch; illustrations. Amer. Machinist, v. 83, May 3, 1939, p. 293.

Buckling

R. Mossoux.
Au sujet du flambage des ressorts hélicoidaux. Société Royale Belge des Ingénieurs et des Industriels—Bul. n. 1, 1939, p. 88-95. Theoretical mathematical discussion of buckling of helicoidal springs.

Car Springs and Suspension

W. Kaal.
Die magnetische Abfederung. Glasers Annalen v. 63, n. 17, Sept. 1, 1939, p. 227-31. Magnetic balancing of springs; author points to difficulty in finding proper balance between load and springing characteristics of passenger car, and suggests floating suspension by aid of magnetic forces on basis of similarity between spring oscillations and electric oscillation.

Anonymous 272.
Pendulum-Type Railway Passenger Car. Il., Engineering, v. 147, April 28, 1939, p. 517.

Anonymous 273.
Railway Truck Corporation Friction Type H Bolster Spring. Il. diag. Railway Mech. Eng. v. 113, Feb. 1939, p. 59-60.

Anonymous 274.
Simington-Gould Snubber for Bolster Spring Group Control. Diags., Railway Age, v. 106, June 24, 1939, p. 1088.

Clutches

C. F. Wiebusch.

Spring Clutch. Am. Soc. Mech. Engrs.—Trans. (J. Applied Mechanics), v. 6, n. 3, Sept. 1939, p. A-103-8; see also Machine Design, v. 11, n. 11, Nov. 1939, p. 46-60. Mathematical theory developed for clutch which consists of two coaxial cylinders placed end to end and coupled torsionally by coil spring fitted over them; relations derived whereby it is possible to design spring clutches in terms of requirements and constants of spring material; experimental verification of relations; theory of residual and active stresses as applied to springs is discussed.

Design

H. Martin.

Compression Spring Adjusting Methods. Product Eng., v. 10, n. 3 and 4, Mar. 1939, p. 114-5 and Apr. p. 142-3. Mar.: In many installations where compression springs are used, adjustability of spring tension is frequently required; diagrammatic presentation of methods which incorporate various designs of screw and nut adjustment with numerous types of spring centering; means to guard against buckling; some designs incorporate frictional reducing members to facilitate adjustment especially for springs of large diameter and heavy wire. Apr.: Various methods of adjustment in which thrust is taken against single or multiple steel balls.

W. R. Berry.

Practical Problems in Spring Design. Instn. Mech. Engrs.—Proc. v. 139, 1938, p. 431-79 (discussion) 479-524. Paper confined to helical tension and compression springs of round wire, with brief reference to similar springs made from square and rectangular bar; standard calculating tables; properties of patented carbon steel wire; rust prevention; chromium vanadium spring steel; curves of load carrying capacity; special formulas.

F. M. Cousins.

Torsion Springs. Product Eng., v. 10, n. 7, July 1939, p. 287-9. Stress formulas and calculations for torsion springs wound of various wire forms.

Electric Lamps

G. L. Tawney.

Zigzag and Helical Springs; Elastic Properties of Molybdenum. Rev. Sci. Instruments, v. 10, n. 5, May 1939, p. 152-9. "Zigzag" type of spring for supporting current carrying filaments is described and compared with tungsten helical type of spring; zigzag spring is particularly useful when combination of high current carrying capacity and low spring constant is desired; designs and stress analyses are deduced both for helical and zigzag spring to meet wide range of requirements.

Failure

R. Huenlick and W. Puengel.
Untersuchungen ueber die Bruchursachen von Ventilfedern. Deutsche Luftfahrtforschung—Jahrbuch 1938, p. II-134-40. Investigation of causes of fractures in valve springs; surface defects caused by rolling conditions and by corrosion frequently result in premature failure of valve springs; notches which occur after pickling of steel wire are due to local overloading.

A. Ferchaud.
La rupture des métaux par fatigue vibratoire les ressorts de soupapes. Technique Aéronautique, v. 30, n. 152, 1939, p. 79-85. Review of data and mathematical analysis on failure of valve springs due to vibrational fatigue of metals.

Fatigue

R. W. Clyne.
Some Fatigue Problems of Railroad Industry. Metals and Alloys, v. 10, n. 10, Oct. 1939, p. 316-23. Analysis of railroad spring failures, attributed mainly to progressive fracture; corrosion fatigue; failures of elliptical springs; bad effect of surface decarburization; car wheel and fatigue; fatigue failures of railway axles; description of fatigue testing machine.

Heat Treatment

H. J. Langley.
Cycle Spring Frame; Heat Treating Equipment for Auto Cycle Parts; United Spring and Bumper Co. Il., Steel, v. 105, July 24, 1939, p. 59-60.

Helical

A. M. Wahl.
Analysis of Effect of Wire Curvature on Allowable Stresses in Helical Springs. Am. Soc. Mech. Engrs.—Trans. (J. Applied Mechanics), v. 6, n. 1 and 4, Mar. 1939, p. A-25-30 and (discussion) Dec. p. A-188-91; see also Wire and Wire Products, v. 14, n. 2, Feb. 1939, p. 113-9. Method for determining effect of wire or bar curvature on allowable stresses in springs, based on endurance properties of material; charts

for determining maximum allowable stress as function of spring index, ratio of minimum to maximum stress, and ratio between yield point and endurance limit; effect of sensitivity of material to stress concentration. See also Engineering Index, 1938, p. 1124.

J. W. Rockefeller, Jr.
Better Scales Through Better Springs. Wire and Wire Products, v. 14, n. 9, Sept. 1939, p. 471-5. Method of calculating helical springs with constant mean diameter of coil and for calculation of conical or barrel shaped springs.

H. C. Keysor.
Calculation of Elastic Curve of Helical Compression Spring. Am. Soc. Mech. Engrs.—Advance Paper, n. 9, mtg. Dec. 4-8, 1939, 6 p. Equations for elastic curve developed, without making assumption of axial loading; load found to be eccentric in general, being axial only under certain conditions; elastic curves for axial and eccentric loading; effect of load eccentricity on stress; formula for estimating effect; reference made to laboratory tests by another investigator which are in good agreement with theory presented.

W. E. Burdick, F. S. Chaplin and W. L. Sheppard.
Deflection of Helical Springs Under Transverse Loadings. Am. Soc. Mech. Engrs.—Trans., v. 61, n. 7, Oct. 1939, p. 623-32; see also Wire and Wire Products, v. 14, n. 4, Apr. 1939, p. 217-25. Analytical approach to problem of transverse deflection of helical closely coiled spring under action of force perpendicular to its axis and end moment; supporting test data included to substantiate formulas within established limits; expressions for stresses under this loading in combination with axial force are derived for critical points on spring. See also Engineering Index 1938, p. 1124.

P. Klamp.
Helical Spring Tables. Product Eng., v. 10, n. 8, 9, 11 and 12, Aug. 1939, p. 361-4, Sept. p. 407-10, Nov. p. 508-10 and Dec. p. 556-8. Quick method for selecting general purpose helical compression springs, presented.

D. H. Pletta and F. J. Maher.
Helix Warping in Helical Compression Springs. Am. Soc. Mech. Engrs.—Advance Paper n. 8, mtg. Dec. 4-8, 1939, 3 p. Research reported illustrating helix warping for heavy spring, whose length was varied for series of tests; comparison of test results with theoretical behavior as outlined in paper by H. C. Keysor, to be published in Am. Soc. Mech. Engrs.—Trans., v. 62, 1940.

Instruments

H. Stabe.

Federgelenke im Messgeraetebau. VDI Zeit v. 83, n. 45, Nov. 11, 1939, p. 1189-96. Most important of numerous suspension systems discussed and illustrated; necessity for elimination of frictional defects pointed out.

Machinery Bases

J. J. Pesqueira.

Spring Balancing of Hinged Masses. Machine Design, v. 11, n. 2, Feb. 1939, p. 37-40. If mass to be balanced is not large, partial balancing may be sufficient for direct manual operation, otherwise complete balancing might be necessary; both methods discussed.

Manufacture

Anonymous 275.

Making Springs. Steel, v. 103, Sept. 19, 1938, pp. 66, 72. Practical. Describes specialized types of furnaces required in forming and heat treating coil springs. Bars are heated, prior to coiling, to 1650°-1750° F. in long, narrow furnaces. Heating time and amount of scale formed are kept at a minimum, and temperature is distributed uniformly by means of a large number of relatively small soft-flame type burners equipped with air-gas ratio control. Continuous type furnaces, equipped with automatic temperature and air-gas ratio control, heat the formed springs prior to oil quenching. Springs are drawn at 500°-1100° F. in a furnace equipped with a recirculating type of air heater.

Mechanisms

A. M. Wahl.

Utilizing Flat Spring in Accurate Mechanisms. Machine Design, v.11, n. 11, Nov. 1939, p. 40-2. Indicative of versatility of flat springs are some unusual applications to two recently designed extensometers; both utilize flat strips of spring steel to serve dual purpose of guides to obtain straight line motion and as means of exerting definite pressure on contact points.

Motor Bus Springs and Suspensions

Anonymous 276.

Springs. Bus Transportation, v. 18, n. 7, July 1939, p. 360-1. What ten companies are doing about bus spring maintenance, including cost, mileages, and other related information.

Anonymous 277.
Bus-Front Spring Breakage; Experiences of Various Companies. Transit Jour, v. 83, March 8, 1939, p. 106.

N. E. Hendrickson.
Commercial Vehicle Springs. Diags., Auto. Engineer, v. 29, Jan. 1939, p. 13-15. Same S.A.E. Jour., v. 44, March 1939, p. 104-108.

Anonymous 278.
Dr. Fageol writes a Prescription for Motor Coach Arthritis; twin Coach Gravity Spring. Il. diags., Bus Transportation, v. 18, May 1939, p. 228-229.

Anonymous 279.
Torsional Springs adapted by Twin Coach. Il. Transit Jour., v. 83, May 1939, p. 172-173.

P. Zanke.
Untersuchungen an Kraftomnibussen mit Abwälzfedern. Zeit ver Deutsche Ing., v. 83, May 6, 1939, p. 527-528.

Neoprene

F. L. Yerzley.
Neoprene as Spring Material. Am. Soc. Mech. Engrs. — Advance Paper, n. 18, mtg. Dec. 4-8, 1939, 6 p. Mechanical properties of neoprene which are important for vibration isolation and damping are evaluated and compared with analogous properties of rubber; static and dynamic moduli and damping action specifically treated.

Non-Ferrous Alloys

E. E. Halls
Tarnishing of Nickel Silver. Precautions for Avoiding Staining [in Blanking of Springs] . (Electrician, 1938, 121, (3156), 623-635). Shop procedure in the blanking of flat springs from nickel-brass sheet is discussed, with special reference to the precautions necessary to avoid tarnishing. Finger-marking during assembly is inevitable to some degree; the use of French chalk as a powder for the hands appears the best remedy.

Timōzero Tanabe and Gorō Korso.
Phosphor Bronze Suitable for Springs. Nippon Kinzoku Gakkai-Si, v. 3, 1939, p. 153-162. The influence of the addition of Al, Si, Fe, Mn, Zn, etc. upon the mechanical properties of phosphor bronze was investigated. The phosphor bronzes containing 0.5% Si and 0.5%

Al were superior in strength to plain phosphor bronze, and the addition of Fe or Mn gave rise to good hot-working properties. The compositions of modified alloys are Sn 3%, P less than 0.2%, Al less than 1.0%, Si less than 1.0%, and the tensile strength is 67 Kg. per mm^2, yield point 63 Kg. per mm^2, and elongation 4%.

Patents

John Chatillon and Sons.

Alloy for Springs. British, 495,502, Nov. 14, 1938. An alloy having a low elastic limit, and a low temperature coefficient of elastic modulus, especially for helical, hair, and other springs, bourdon tubes, metallic bellows, tuning forks etc. comprises Ni 34.5-37.0% Cr 5-10%, C not more than 0.2%, and one or more hardening agents from the group Mo, W, Ti, Va, Co, U, and Ta, a total of 0.35-0.65%, the balance being Fe with, or without Mn 0.45-0.75%, and Si 0.3-0.6%. The alloys may be annealed, cold worked to reduce the cross sectional area by over 85%, and hardened by heating at 400-1300°F.

Frederick P. Flagg.

Compensating-Hair Springs for Time Pieces, (to Waltham Watch Co.) U.S. 2,151,197, March 21, 1939. An alloy is used containing Fe together with Ni 35, Mn 3.35 and Si 5.39%.

Marcus A. Grossman.

Alloy Steels. (To U.S. Steel Corp.), U. S. 2,155,347, April 18, 1939. Alloy steels having a high degree of resilience, and resistance to shock and fatigue, and suitable for springs, contains Fe with C 0.45-1.00%, Mn 0.4-1.25%, Cr up to 0.75% and Ti 0.01-0.1%, proportioned to produce a shallow hardening steel. U.S. 2,155,348 relates to generally similar steels with omission of the Cr. U.S. 2,155,349-50 (Grossman and Walther Mathesius, joint inventors; to same assignee) relates to steels generally similar to those of U.S. 2,155,347-8, except for a content of Va 0.75-0.2% instead of the Ti.

Anonymous 280.

Springs. Société des Fabriques de Spiraux réunis and Soc. anon. de Commentry-Fourchambault et Decazeville . British, 504,864. May 2, 1939. In the manufacture of compensating springs for Chronometers etc. from an austenitic Fe-Ni alloy containing C, Cr, Mn, Si and one or more added elements capable of entering into solid solution in the austenite so as to modify its thermoelastic properties and so as to form carbides that are more soluble hot than cold in the austenitic matrix, the alloy is subjected to a wire drawing operation with reheating between the passes, then to overhardening of the wire, followed by further drawing without intermediate annealing, and to a rolling operation that forms the wire into a ribbon which is straightened, wound into spiral form, and fixed by heating.

Anonymous 281.
Automatic Machine for Electrically Heating Coiled Springs Previous to Hardening. Nachmon-Spring-Filled Corp. British 489,137, July 20, 1938.

Anonymous 282.
Molding Flexible Fluid-Pressure Containers of Rubber for Use; e.g. as Springs for Motor Vehicles. Firestone Tire and Rubber Co. LTD. British 493,921, Oct. 17, 1938.

Howard W. Russell.
Alloy Suitable for Watch Hairsprings. (To Elgin National Watch Co.) U.S. 2,146,231, Feb. 7, 1939. An alloy having substantially stable elastic properties over a temperature range of from -18° to 70° F, high tensile strength, very weak magnetic properties, and a high resistance to corrosion, contains Ni about 35%, Cr 5%, Mn 5.5%, Si 0.5% and C 0.6-0.75%, the balance being Fe with the usual impurities.

Resilience

R. R. Tatnall.
Resilience of Spring Materials. Wire and Wire Products v. 14, n. 1, Jan 1939, p. 29, and 31-3. Discussion of paper before Wire Assn., indexed in Engineering Index 1938, p. 1124, from issue of Oct. 1938.

Rubber

J. F. D. Smith.
Rubber Springs— Shear Loading. Am. Soc. Mech. Engrs.— Trans. (J Applied Mechanics), v. 6, n. 4, Dec. 1939, p. A-159-67. Information supplied for calculation of size and hardness of rubber springs; agreement of theory and experiment shown in all cases where data are available; chart given for determining immediately shear angle expected from plane shear mounting of any size and rubber hardness within limits ordinarily used for springs.

F. L. Houshalter.
Rubber as a Load-Carrying Material. Diags. S.A.E. Jour., v. 44, Jan. 1939, p. 15-22.

A. S. Krotz.
Rubber suspension. Soc. Automotive Engrs.— J v. 45, n. 5, Nov. 1939, p. 471-7; see also

Rubber Age (N.Y.), v. 45, n. 3 and 4, June 1939, p. 149-52 and July, p. 217-8 and 221-2; India Rubber World, v. 100, n. 5, Aug. 1, 1939, p. 46-7. Advantages and limitations of "Torsilastic," torsion type spring having inner shaft, surrounded by annular layer of rubber, and metal sheet around outside.

Springs (General)

W. C. Conrad.
How to Get Springs that Satisfy. Elec. Mfg., v. 24, n. 1, July 1939, p. 31-5 and 78. Practical suggestions for application of springs in machine and equipment design; some preferred specifications.

F. J. Linsenmeyer..
University of Detroit Studies Volute Conical Helper Springs, Manufactured by Zink-Bordick Products. Automotive Ind., v. 80, Jan. 7, 1939, p. 22.

Anonymous. 283.
Resilient Bushes; New Scheme Incorporating Embedded Coil Spring. Diags., Automobile Eng., v. 29, March 1939, p. 93-94.

Spring Washers

Anonymous. 284.
Spring Washers. Steel, vol. 103, Oct. 17, 1938, pp. 58-9. Describes heat-treating practice of Philadelphia Steel and Wire Corp., Philadelphia, Pa. Fine-grained spring steel, with 0.60-0.70% C, in hot-rolled rounds and shapes is used. It is cold drawn to the various sizes required. Some of the smaller sections require 8-10 passes through wire-drawing plates. Wire is given a spheroidizing treatment at about 1300° F. between each pass. Washers are fabricated on specially designed machines that coil and automatically sever each convolution. Hardening is done in automatically controlled closely muffled rotary-retort type gas-fired furnaces. At the discharge end, work passes through an oil-sealed chute into a rotary quench drum without coming into contact with atmosphere, thus holding decarburization and scaling to a minimum. After fracture and hardness tests are made, washers are washed to remove quenching oil, and drawn at 500°-700° F in an automatically controlled electric dense-load forced-convection air-tempering furnace. Hardness of 48-53 Rockwell C is produced.

Steel

A. Oreffice.
Specification for Valve Spring Wire. Metal Prog., v. 35, March 1939, p. 273.

Anonymous 285.
Report of Committee A-1 on Steel. Am. Soc. Testing Matls.—Preprint, n. 6, mtg. June 26-30 1939, 86 p. Committee activities; proposed revisions in standards for steel; specifications for alloy steel boiler tubes, electric welded steel tubes, castings for fusion welding, carbon steel and alloy steel castings, steel for bridges and buildings, carbon steel forgings, carbon silicon steel plates, steel and heat treated helical springs, heat treated elliptical springs, steel elliptical springs, and steel tires.

Y. V. Tesler and G. P. Pyankov.
Manufacture of Polished Chrome-Vanadium Spring Wire. Kachestvennaya Stal, v. 5, n. 8 (1937), p. 38-40; Chem. Zentr, 1938, I, p. 1442.

Y. V. Tesler and G. P. Pyankov.
The use of a steel containing C 0.45-0.55, Mn 0.25-0.6, Si 0.4, Cr 0.75-1.1, and V 0.15-0.3% for the manufacture of valve springs is reported. The most satisfactory conditions for cold drawing with intermediate annealing are given. In the cold drawing of polished wire, care must be taken to prevent injury to the surface by small cracks and scratches.

Stresses

C. T. Edgerton.
Stresses in Helical Compression Springs—Present Status of Problem. Am. Soc. Mech. Engrs.—Trans., v. 61, n. 7, Oct. 1939, p. 643-9; see also Wire and Wire Products, v. 14, n. 3, Mar. 1939, p. 165-70 and 177. Indexed in Engineering Index 1938, p. 1124, from Paper mtg. Dec. 5-9, 1938.

Testing

G. Richter.
Modern Spring Testing Machines. Eng. Progress, v. 20, n. 1, Jan. 1939, p. 31-2. Static and endurance spring testing machines illustrated and described.

Valve Springs

M. Bonzel.
Le ressort de soupape, problème de métallurgie. Société des Ingénieurs de l'Automobile—J v 81, n. 4, Mar. 15, 1939 p. 116-29 see also English abstract in Automotive Industries, v. 81, n. 4, Aug. 15, 1939, p. 150-5. Valve springs as metallurgical problem; modern methods of testing; heat treatment and qualities of materials as factors in design and construction of automobile valve spring.

H. E. Blank, Jr.
Valve Spring Materials. Automotive Industries, v. 80, n. 3, Jan. 21, 1939, p. 72-6. Review of developments in materials since 1922, as occasioned by introduction of higher automobile speeds; while carbon steel wire preferred today is of same analysis that it was 10 yr. ago, substantial progress has been achieved by improvement in technique of fabrication.

P. Koetzschke.
Neuere Erkenntnisse ueber Herstellung und Pruefung von hochwertigen Draehten. Deutsche Luftfahrtforschung— Jahrbuch 1938, p. II-310-25. Recent progress in manufacture and testing of high test wires, with special reference to valve spring wire such as is used in automobile and airplane engines; influence of steel manufacture, grinding, etc., on quality of spring wires; increasing fatigue resistance of springs by spraying with steel balls.

Vibrations

K. J. De Juhasz.
Graphical Analysis of Free Vibrations of Helical Springs. Franklin Inst.— J v 227, n. 5, May 1939, p. 647-72. Theoretical mathematical and graphical study. Bibliography.

R. M. Davies.
Vibrations of Helical Springs. Engineering, v. 148, n. 3837 and 3839 July 28, 1939, p. 113-5 and Aug. 11, p. 174-5. Method of calculation of periods of vibration of unloaded and loaded springs.

A. Hussmann.
Schwingungen in schraubenfoermigen Ventilfedern. Deutsche Luftfahrt-forschung— Jahrbuch 1938, p. II-119-33. Vibrations in spiral valve springs; theoretical principles discussed, based on which formulas for calculating resonance load are derived; as result of analysis of valve lift curves, cam designs with low vibrations frequency are developed, in which resonance oscillations can be avoided to large extent; tests confirm results of calculation. Bibliography.

1940

Automobile Springs and Suspension

Anonymous 286.
Buick Rear Suspension on Coil Springs. Automotive Industries, v. 82, n. 6, Mar. 15,1940, p. 285-6. Drawings show plan view and side elevation of coil spring rear suspension of Buick passenger cars; assembly drawings

and numerous details of independent front suspension (or knee action) also given.

Anonymous 287.
Coil Springs for Buicks. Steel, v. 107, n. 3, July 15, 1940, p. 46-7. Facilities maintained at Buick plant in Flint, Mich., for production of 10,000 springs per day; illustrations show various steps in forming and heat treating these springs from original centerless ground silicomanganese steel rods.

Anonymous 288.
New Spring Suspension System Developed. Steel, v. 107, n. 2, July 8, 1940, p. 65. Design of new type of wheel suspension, adapted to both front and rear wheels, and embodying sets of four transverse leaf springs supported at center of car frame and attached to wheels through rubber bushings and special forged steel bracket.

E. Richter.
Ring Sprung Undercarriage Legs. Engrs.' Digest, v. 1, n. 2, July 1940, p. 61. Kronprinz undercarriage legs are springs with system of ring springs; claimed to be 3 to 4 times lighter, as compared with helical spring of equal strength; brief illustrated description. From Deutsche Motor-Zeitschrift, n. 6, v. 16.

Anonymous 289.
Front and Rear Suspension on Coiled Springs of Nash Ambassador 600; Diagrams. Automotive Ind., v. 83, Oct. 1, 1940, p. 402.

Anonymous 290.
Springs and Shock Absorbers, 1941 Cars; Specifications Tabulated. Automotive Ind., v. 83, Oct. 15, 1940, p. 449.

Belleville

W. W. Boyd.
Belleville Springs for Spring Thrust Loaded Spindles. Product Eng., v. 11, n. 2, Feb. 1940, p. 66. Comparison of space required for Belleville and helical springs.

Car Springs and Suspension

W. Kaal.
Die Guete der Abfederung von Schienenfahrzeugen. Glasers Annalen, v. 64, n. 9, May 1, 1940, p. 85-90. Efficiency of car springs and suspension and improvement of running quality, especially for light weight cars; it is shown that too heavy spring mounting is not expedient, especially for light weight cars.

Anonymous 291.
Freight Car Trucks for Speed. Ry. Age, v. 108, n. 21, May 25, 1940,

p. 920-3. Spring snubbers play important role; new truck designs will incorporate improvements based on Association of American Railroads truck tests soon to be released; function of spring snubbers; illustrations given.

P. K. Beemer, F. C. Lindvall, E. F. Stoner and W. E. Van Dorn.
Fundamental Devleopment in Suspension and Construction for Railroad Cars. Mech. Eng., v. 62, n. 11, Nov. 1940, p. 779-84. Conventional types of spring suspension; advantages of above-gravity suspension, which ideally hangs car above its center of gravity on imaginary longitudinal axis which is allowed all necessary vertical and lateral movement against soft spring restraints; wheels follow rail irregularities while body floats about central position; results of road tests.

W. S. Spieth.
Truck-Spring Snubbers. Ry. Mech. Engrs., v. 114, n. 5, May 1940, p. 175-9 and 189. Snubber as applied to railroad freight cars, often referred to as spring; development of snubber; test data included to show characteristics of coil springs and snubbers acting independently and in combination.

C. Cleveland.
Forging Practice at Sedalia Shop of Missouri Pacific Railroad. Heat Treating and Forging, v. 26, n. 12, Dec. 1940, p. 581-6. Few examples of variety of forgings produced in railroad shops with specific reference to shops of Missouri Pacific; discussion of composition and preheating, normalizing and tempering, forging link cheeks, hardening furnace, and manufacture and repair of springs.

Anonymous 292.
Reconditioning Carbon-Steel Springs; Point St. Charles Locomotive Shops. Il., Railway Mech. Eng. v. 114, May 1940, p. 201-202.

Motomu Ishida.
The Working Temperature of Si-Mn Steel for Bearing Springs of Railway Vehicles. Bull. Research Office, Japan. Govt. Railways, v. 25, no. 11, 1937, p. 1-16. Japan Jour. Eng. Abstracts, v. 17, 1939, p. 5. An investigation into the cause of cracks that appeared in Si-Mn steel eyes of the main leaves of railway vehicle bearing springs in the course of their manufacture, showed that in many cases the cracks were caused by improper working temperatures. Tensile and impact tests were carried out with the material at high temperatures. The best working temperature was found to be 750-850°C. At temperatures above 900°C, the steel had great elongation and toughness, but heating for a long time at such temperatures caused decarburization and oxidation. Between 850 and 950°C, Si-Mn steel showed minimum elongation and became

brittle -- a matter that has been confirmed by tests under service conditions.

Clutches

C. F. Wiebusch.
Spring Clutch. Am. Soc. Mech. Engrs.--Trans. (J. Applied Mechanics), v. 7, n. 2, June 1940, p. A-89--91. Discussion of paper indexed in Engineering Index 1939, p. 222, from issue of Sept. 1939.

Design

A. M. Wahl.
Designing Flat Springs to Fit Job. Machine Design, v. 12, n. 1 and 2, Jan. 1940, p. 44-6 and Feb. p. 40-2. Some of fundamental principles involved in design of flat springs including plate springs and simple leaf springs; formulas and charts presented to facilitate accurate calculations of stress and deflections in variety of typical cases.

A. M. Wahl.
How Holes and Notches Affect Flat Springs. Machine Design, v. 12, n. 5, May 1940, p. 40-3 and 108. Endurance diagrams for spring materials showing reduction in fatigue strength due to surface effects, are discussed; curves given for evaluating stress concentration factors in typical cases.

R. Saxton.
Instrument Unit-Springs. Metallurgia, v. 21, n. 125, Mar. 1940, p. 139. Design of instrument springs; various forms used; attention directed to some aspects of their production, particularly need of confining hysteresis.

M. Tessarotto.
Moderni Organi e Sistemi di Organi Elastici a Parametro Di Rigidita Variabile. Criteri Teorici e Costruzione. Ingegnere, v. 18, n. 4, Apr. 15, 1940, p. 254-62. Theory of design and construction of modern elastic organs and systems of organs of variable rigidity; with special reference to laminated and helical springs.

F. M. Cousins.
Theory and Design of Springs. Edwards Brothers, Ann Arbor, Mich., 1940. 99 p, diagrs, charts, tables, $2.50. More general types of springs, helical, spiral, conical, leaf, ring and disk, analyzed for purpose of establishing mathematical basis for spring design; problems connected with surging characteristics of valve springs and other types subject to dynamic action investigated. Bibliography. Eng. Soc. Lib., N.Y.

Fatigue

R. R. Tatnall.

Factors in Fatigue of Helical Springs. Mech. Eng., v. 62, n. 4 and 10, Apr. 1940, p. 289-92 and (discussion), Oct. p. 752-5; see also Engineering v. 150, n. 3887, July 12, 1940, p. 36-7 and Mech. World, v. 108, n. 2812, Nov. 22, 1940, p. 373-5. Analysis of typical spring failure from fatigue; induced vibration of helical springs; effect of physical properties of materials; comparison of fatigue properties of material with fatigue requirements of spring. Before Am. Soc. Mech. Engrs.

Émile Ravilly.

Contribution to the Study of the Rupture of Metallic Wires subjected to Alternating Torsion. Publ. Sci. Tech. Ministere Air, 1938 (120), p. 187. Bull. B.N.F.M.R.A. 1938 (126). After a general discussion of fatigue and the machines used for testing it, Ravilly describes his own machine for applying alternating torsional stress to wires. The "scatter" in the results for steel wires, and the effect on it of annealing, were studied, and an electromagnetic method of selecting specimens (including nickel) is described. The results of torsional fatigue tests on ferrous materials, Nickel, Copper, Aluminum, Silver, and Zinc are reported, and related to the fatigue strengths of helical springs. Ravilly also studied the damping capacity of Iron, Nickel, Copper, Aluminum, Silver and Tungsten at various temperatures, and attempted to correlate the results with those of fatigue tests.

Glass

T. J. Thompson.

Glass for Mechanical Parts. Product Eng., v. 11, n. 5, May 1940, p. 196-8. Physical properties and product design possibilities of glass as material for mechanical parts, described and illustrated, including machine blowing of lamp bulb blanks, manufacture of glass springs, centrifugal pumps, and glass tubing for various applications.

Helical

H. C. Keysor.

Calculation of Elastic Curve of Helical Compression Spring. Am. Soc. Mech. Engrs.— Trans., v. 62, n. 4, May 1940, p. 319-24 (discussion) 324-6; see also (discussion) in Mech. Eng. v. 63, n. 10, Oct. 1940, p. 755. Indexed in Engineering Index 1939, p. 1105, from Advance Paper, n. 9, mtg Dec. 4-8, 1939.

A. C. Rasmussen.

Helical Spring Selection Chart. Product Eng., v. 11, n. 9, Sept. 1940,

p. 433-4. Simplified graphical method for selection of helical compression and tension springs with round wire.

D. H. Pletta and F. J. Maher.
Helix Warping in Helical Compression Springs. Am. Soc. Mech. Engrs.—Trans., v. 62, n. 4, May 1940, p. 327-9; see also Wire and Wire Products, v. 15, n. 9, Sept. 1940, p. 469-71. Indexed in Engineering Index 1939, p. 1105, from Advance Paper, n. 8, mtg. Dec. 4-8 1939.

M. Yamamuro.
Variable Pitch Helical Springs at High Speeds. Soc. Mech. Engrs., Japan—Trans., v. 5, n. 21, Nov. 1939, p. II-15-8. Results of testing some six different varieties of springs on 14-cyl radial engine show that at very high speeds, the more gradual the rate of change of pitch the better the result and high critical speed produces better results in general. (In Japanese with English abstract p. S-101-2.)

Instruments

Anonymous 293.
Measures Torque of Instrument Springs. Diag., Elec. World, v. 114, Aug. 10, 1940, p. 422.

Laminated

Anonymous 294.
Laminated Springs. Automobile Engr., v. 30, n. 393, Jan. 1940, p. 3-7. Production methods and equipment employed by Jonas Woodhead and Sons, described and illustrated.

Manufacture

Anonymous 295.
Woodhead Power Presses. Il., diag., Automobile Eng., v. 30, April, 1940, p. 102-3.

L. Kasper.
Spring Tension varied Automatically on a Wire-Forming Machine. Diags., Amer. Mach., v. 84, July 10, 1940, p. 509-510.

James E. Lose.
Problems in the Manufacture and Use of Steel Products in the U.S. Blast Fur. and Steel Plant., v. 27, 1939, p. 577-581, 586, 680-685, 705-706. Many products are discussed. Wire and Wire products are required to meet closer size tolerances which requires more frequent replacement and reconditioning of wire dies. Surface smoothness and

decarburization have definite influence upon the life of springs. Springs of unusual combination of strength and hardness are now produced by austempering.

T. V. Sergievskaya.
Choice of the Quality of the Steel and Heat Treatments of Heavy-Duty Springs. Kachestvennaya Stal., v. 6, n. 2, 1938, p. 29-33; Chem. Zentr., 1938, 3451. Investigations are reported on three spring steels; (1) a Cr-Si steel containing C 0.6, Cr 1.54 and Si 1.15%; (2) also a Cr-Si steel containing C 0.47, Cr 1.54 and Si 1.15%; and (3) a Ni-Si steel containing C 0.6, Si 1.37, and Ni 1.4%. The most satisfactory treatment for the first was hardening in oil at 830°C and annealing in lead at 400-420°C with subsequent cooling in air. For the second steel, hardening at 925°C, and lead annealing at 400-430°C are recommended, and for the third steel hardening at 870°C, followed by annealing at 380-420°C. After tempering, this last steel possesses a tensile strength of 130 Kg per mm^2 with a reduction of area of 40%.

Motor Bus Springs and Suspension

N. E. Hendrickson.
Springing Modern Motor Coach. Bus Transportation, v. 19, n. 6, 7 and 8, June 1940, p. 261-3, July p. 331-3 and Aug. p. 375-7. Road shocks discussed with reference to wear and efficiency of springs; current design types described.

Non-Ferrous Alloys

B. Barr.
Phosphor-Bronze for Springs and Pressings. Metal Treatment, v. 5 (19), 1939, p. 125-126, 130. Properties and applications of the three grades of phosphor-bronze covered by British Standard Specification No. 407 are briefly outlined, and reference is made to the uses of a harder bronze containing tin 7-9%, and of a free-machining leaded phosphor-bronze. The bad effects of surface defects on a strip used for spring manufacture are emphasized.

Neoprene

F. L. Yerzley.
Neoprene as Spring Material. Am. Soc. Mech. Engrs.— Trans., v. 62, n. 5, July 1940, p. 469-74, (discussion), 474-8. Indexed in Engineering Index 1939, p. 1105, from Advance Paper n. 18, mtg. Dec. 4-8, 1939.

Patents

Robert B. Wasson and Alfred V. DeForest.
Resilient Articles such as Springs from Alloys containing Nickel, Iron, etc. (To John Chatillon and Sons). U.S. 2,174,171. Sept. 26, 1940. An annealed alloy which may contain Ni about 35-37, Fe 50-60, Cr 7-8, Mn 0.45-0.75, Mo 0.35-0.65, Si 0.3-0.6 and C not over 0.2%, is cold worked to reduce its cross section by over about 85%, and is hardened by heat treatment.

Shot-Blasting

F. P. Zimmerli.
Shot Blasting and Its Effect on Fatigue Life. Am. Soc. Metals.— Preprint, n. 51, mtg. Oct. 21-25, 1940, 14 p.; see also Machine Design, v. 12, n. 11, Nov. 1940, p. 62-3; Heat Treating and Forging, v. 26, n. 11, Nov. 1940, p. 534-6. Description of method of surface finishing called "shot blasting"; fatigue machine for small springs described; by using valve spring wire, increases in fatigue values exceeding 40% have been obtained; results on other materials presented; various commercial factors, as size of shot, velocity of impact, methods of applying shot to work, etc., discussed; reference to work of E. G. Herbert on Cloudburst method of hardening and hardness testing, described in papers indexed in Engineering Index 1929, p. 916 and 1773.

Springs (General)

A. M. Wahl.
Spring Materials. Machine Design, v. 12, n. 10, Oct. 1940, p. 46-9, 94 and 96. Summary of available data on endurance ranges of helical and leaf springs and spring materials to aid designer in making intelligent selection of proper spring for particular application.

Anonymous 296.
Springing of Colliery Tubs; Buffer Springing and Spring Draw Bar Gear. Diags. Mech. Handling, v. 27, July 1940, p. 163-164.

Steel

Anonymous. 297.
Ferrous Metals. Am. Soc. Testing. Matls.— Standards, pt. I, 1939, p. 1-437, 456-9, 471-4, 781-950, and 1225-9. Specifications for structural and rivet steel, boiler steel plates and rivets, strip

steel, filler metal, concrete reinforcement steel, commercial bar steels, steel rails and accessories, spring steel and springs, steel spring wire, steel blooms, forgings and axles, steel wheels and tires, steel castings, and electrodeposited coatings.

A. A. Drushkov.
The Production of Heat-Treated, Cold Drawn Spring Steel. Kachestvennaya Stal, v. 6, n. 2 (1938), p. 47, Chem. Zentr, 1938, II, p. 3734. Two different processes of heat treatment are used in the production of spring-steel wire from steel containing 0.42-0.5 C, 0.4-0.7 Mn, 0.17-0.37 Si, .04 S (max), 0.04 P (max) 0.2 Cr (max) and 0.3 (max) % Ni. The first process consists in heating the spring steel to 830-40°C in a salt bath composed of 50% NaCl, 25% Na_2CO_3 and 25% K_2CO_3. The steel remains in the bath 25-40 minutes depending on the diameter of the wire. It is then quenched in oil at 20-50°C. Since this treatment is unsatisfactory in several respects, large furnaces are more recently used. Such furnaces have 10 muffles of Dinas brick in which the wire is heated 20-45 minutes at a furnace temperature of 920-40°C and a muffle temperature of 840-60°C. Quenching is likewise done in oil. The spring steel wire is drawn in a salt bath at 640-650°C.

I. I. Reav.
The Production of Spring Steel and the Manufacture of Springs. Ural. Met., 1937, n. 9, p. 21-29. Chem. Zentr., 1939, I, 781. A review of the composition of the more common spring steels, thin melting, heat treatment, and shaping (cold), the manufacture of spiral springs, their heat treatment, and the appearance of fractures in faulty springs.

Testing

F. P. Zimmerli.
Effect of Temperature on Coiled Steel Springs Under Various Loadings. Am. Soc. Mech. Engrs.— Advance Paper, n. 27, mtg. Dec. 2-6, 1940, 5 p. Results of tests conducted in laboratories of author's company on effect of various stress temperature combinations on steel springs; particular attention drawn to value of various strain relief heatings after coiling.

M. Hempel.
Magnetpulverbild und Dauerhaltbarkeit von Schraubenfedern. Archiv fuer das Eisenhuettenwesen, v. 13, n. 11, May 1940, p. 479-87. Magnet powder testing and fatigue strength of spiral springs; report on fatigue tests made on cylindrical spiral springs of plain steel, employing special test machine with eccentric drive and magnetic powder tests; 384 springs tested; no relation found between irregularities revealed by magnetic test and fatigue fractures.

C. T. Edgerton.
Recommended Code of Procedure for Fatigue Testing of Hot-Wound Helical Compression Springs. Am. Soc. Mech. Engrs.—Advance Paper, n. 15, mtg. Dec. 2-6, 1940, 6 p. Test procedure planned to develop complete S-N diagram for each group of variables; in actual plotting of S-N diagrams, Special Research Committee on Mechanical Springs developed technique based on probability theory, included in code recommendations; type of formula used is assumed; precision measurements and test methods prescribed permit computation of relative stress in test springs to high order of accuracy.

A. Pomp and M. Hempel.
Ueber die Dauerhaltbarkeit von Schraubenfedern mit und ohne Oberflaechenverletzungen. Mitteilungen aus dem Kaiser-Wilhelm-Institut fuer Eisenforschung zu Duesseldorf—Abh 394, v. 22, n. 4, 1940, p. 35-56. Endurance of spiral spring with and without surface defects; review of research; results of fatigue tests carried out with spring testing machine; macroscopic study of cracked surfaces and corners; results of magnetic tests.

Anonymous 298.
Emmericher Spring-Testing Machine, il., Automobile Eng., v. 30, May 1940, p. 152.

M. Jacker.
Simple Method of Timing the Recoil Action of Springs. Diags. Machinery, v. 47, Oct. 1940, p. 139.

H. Stabe.
Federgelenke im Messgerätebau. Biblio., diags. Zeit. ver Deutsche Ing. v. 83, Nov. 11, 1939, p. 1189-1196.

H. Moore.
Micrometer Attachment for Measuring Coil Springs. Diag. Machinery, v. 46, Aug. 1940, p. 112.

Valve Springs

C. E. Squire.
Springs for Large Diesel Engines. Diesel Engine Users Assn.—Publ. n. S.155, Nov. 9, 1939, p. 1-8 (discussion) 9-23; see also abstract in Gas and Oil Power (Annual Tech Rev. No) 1940, p. 227-8. Condensed survey of recent knowledge of helical springs of circular section wire, indicating where gaps still exist, and contribution towards filling them.

L. H. Dawfrey.
Valve Spring Design Data; Abstract. Automotive Ind., v. 83, Sept. 15, 1940, p. 266.

A. Oreffice.
Austempering Improves Valve Springs. Metal Prog., v. 38, July 1940, p 71.

A. Oreffice.
Endurance of Valve Springs. Metal Prog., v. 36, Dec. 1939, p. 759.

A. F. Federov.
The Choice of Steel, the Manufacture, and Conditions of Testing of Valve Springs for the Motor Vehicle. "S1SS101". Kachestvennaya Stal., v. 5, n. 10, 1937, p. 37-40, Chem. Zentr, 1938, p. 584. Studies are reported on the manufacture, heat treatment, and testing of the following three steels; (1) 0.8-0.9% C, 0.25-0.6% Mn, 0.2-0.3% Si; (2) 0.6-0.7% C, 0.9-1.2% Mn, 0.2-0.3% Si; and (3) 0.45-0.55% C, 0.5-0.8% Mn, not more than 0.3% Si, 0.8-1.1% Cr and 0.15-0.18% V. The different kinds of flaws in springs and their causes are discussed. The second kind of steel (Mn steel) is most satisfactory for the manufacture of springs, since no plant in Russia has been able to produce high quality steel springs from the oil hardened Mn-Cr-V steel which were free from cracks and other flaws.

Vibrations

Anonymous 299.
New Generator Design Isolates Double Frequency Vibration. Power Plant Eng., v. 44, n. 12, Dec. 1940, p. 59. Spring mounted design of 25,000-kw turbo-generator isolates vibration at its source and confines it to laminated core which is flexibly mounted.

Anonymous 300.
Up, Down and Sideways; Use of Cork, Felt, and Springs for Isolation of Vibratory Air Conditioning Machinery. Il. diags. Domestic Eng., v. 155, June 1940, p. 44-45.

1941

Automobile Springs and Suspension

P. H. Pretz.
Combining Spring Efficiency and Good Ride. Automotive Industries, v. 84, n. 8, Apr. 15, 1941, p. 430-3 and 459. Discussion of spring development with special reference to development by Cadillac Motor Car Division.

Anonymous 301.
Grooved Section Springs. Automobile Engr., v. 31, n. 408, Mar. 1941, p. 93-4. Description of improved form of spring which given lighter component for equal strength; grooved section is satisfactory for luxury cars and is sufficiently economical to be employed on mass production car as well as heavy vehicle; comparison made in table between two springs showing saving in weight per inch., and stress for given thickness.

A. Wiegand.
Zur Theorie der Fahrzeugfederung. Forschung auf dem Gebiete des Ingenieurwesens, v. 11, n. 6, Nov.-Dec., 1940, p. 309-23. Theory of automobile springing, especially progressive springing; problem often treated as oscillatory problem, using substitute of oscillating system; further investigations concerned with damped coupled oscillations of car body and metrological aids for determining oscillatory characteristics of body were developed; author extends these investigations to oscillating systems with curved characteristic.

Beryllium Copper Alloys

Anonymous 302.
Beryllium-Copper Brush Springs. Automotive Ind., v. 85, Aug. 15, 1941, p. 50.

Car Springs and Suspension

F. Lutteroth.
Neuzeitliche Tragfederbearbeitung bei der Deutschen Reichsbahn und ihre Voraussetzungen. Glasers Annalen, v. 64, n. 19, Oct. 1, 1940, p. 198-205. Factors governing modern design and manufacture of laminated springs of German railroad rolling stock and specifications for maintenance of springs discussed; use of standard material; proper heat treatment and dimensions; testing and testing machines.

P. K. Beemer, F. C. Lindvail, E. F. Stoner and W. E. Van Dorn.
Railroad-Car Suspension. Mech. Eng., v. 63, n. 8, Aug. 1941, p. 608-9. Discussion of paper indexed in Engineering Index 1940, p. 175, from issue of Nov. 1940.

C. J. Holland.
Why Freight Car Snubber Springs? Ry. Age, v. 110, n. 12, Mar. 22, 1941, p. 526-8. Explanation, in layman's language, of how spring snubbers operate to reduce car bounce; stiffness and periodicity vary with load deflection; flexibility for high speeds vs. damping for critical speeds; how vibration can be controlled; snubbers on open top cars.

Anonymous 303.
Duryea Selective Spring Arrangement. Il., Railway Age, v. 110, June 14, 1941, p. 1075-1076.

Corrosion Resisting Alloys

H. Carlson.
What Alloys Have to Do With Springs. Elec. Mfg., v. 28, n. 2 and 3, Aug. 1941, p. 53-7, 90, 92 and 94 and Sept. p. 110, 112 and 114. Corrosion

resistant spring materials are considered in five primary classifications; stainless steel alloys, nickel copper alloys, nickel chromium iron alloy, phosphor bronze and beryllium copper; summary of chemical and physical properties given in tabulations.

Design

A. M. Wahl.
Calculating Springs for Static Loading. Machine Design, v. 13, n. 6, June 1941, p. 66-71. Allowable loads on springs under static or infrequently repeated loading may be determined readily by method of analysis based on assumption that stress concentration effects due to bar curvature may be neglected; method is discussed along with factors which designer should consider in selecting springs.

J. Jennings.
Calculation of Springs for Cams. Machy., (Lond.), v. 57, n. 1475, Jan. 14, 1941, p. 433-6. Main function of cam spring is to maintain contact between follower and cam during second and third stages of motion, that is, over nose of cam; spring may also have pressure on follower during idle arc; various steps necessary in determination of dimensions of appropriate spring considered, i.e., determination of effective mass, acceleration of follower, estimating spring data, and surging in cam springs.

C. E. Ives.
Coil Springs for Special Machines. Tool Engr., v. 10, n. 6, June 1941, p. 46-8. In design of special machines, jigs and fixtures as well as products, designer is often called upon to select specific springs; time saving method for selecting coil springs; with aid of special charts and standard formulas which are given, process is comparatively easy.

H. G. W. Taylor.
Wave Action in Gun Run-Up Springs. Instn. Mech. Engrs.—J. and Proc., v. 145, n. 4, Sept. 1941, p. 150-9. Theoretical mathematical analysis with reference to springs employed to run gun up after firing.

Disk

A. M. Wahl.
Designing Constant-Load Disk Springs. Machine Design, v. 13, n. 10, Oct. 1941, p. 59-60. Discussion presented which will facilitate calculations on disk spring design for applications where constant load is desired over considerable range of deflection as in gasket applications; original design calculations given in article by author published in Machine Design Mar. 1939.

Hammers, Mountings for

W. Zeller.
Bedeutung der Daempfung fuer die Erschuetterungsdaemmung bei Hammeranlagen. VDI Zeit, v. 85, n. 6, Feb. 8, 1941, p. 152-4. Theoretical mathematical discussion of economic design of spring foundations for heavy duty power hammers, by including fluid damping devices in parallel to usual steel springs, thus minimizing vibrations and saving in weight of foundations; theory of damping hammer foundation vibrations; transmission of dynamic stress in foundation sites; determination of weight of foundation and of springing.

Heat Treatment

N. P. Kuznetsov.
Heat-Treatment of Springs and the Prevention of Cracking. Vestnik Inzhenerov Tekh, 1939, n. 1, p. 55-56; Chem. Zentr., 1939, II, p. 2149. The chief cause of crack formation in the coils of steel springs was found to be the crazing of the steel surface. Hardening and drawing imparted the best mechanical properties to spiral springs wound while hot. For a spring diameter of 18.3 mm, a wire diam. of 3 mm and a steel composition of C 0.48, Si 0.33, Mn 0.58, Si 0.038 and P 0.037%, the most satisfactory hardening temperature was 800-850°C, and the best drawing temp. 300°C.

Helical

A. H. Church.
Altering Wound Springs to Modify Their Deflection Rates. Product Eng., v. 12, n. 9, Sept. 1941, p. 474-5. Method for calculating how much material should be ground off of helical springs to adjust their spring scale.

A. M. Wahl.
Designing Open-Coiled Helical Springs. Machine Design, v. 13, n. 2, Feb. 1941, p. 62-5, 126 and 132. Simple but accurate formulas and reference charts are given to aid designers in applying helical springs with large pitch angle; calculation of stress and deflection with ends free to rotate; angular twist of spring under load; calculation of deflection with ends fixed.

J. W. Lee.
Helical Compression Springs. Tool Engr., v. 10, n. 7, July 1941, p. 45-50. Object of article is to present simple solution of ordinary spring problem, in such a manner that none of essential phases of problem will be overlooked, and one requiring minimum amount of time and effort; spring data sheets given.

H. A. Illing.
Helical Spring Selection Chart. Product Eng., v. 12, n. 10, Oct. 1941, p. 573-4. Spring selection is simplified by inclusion of spring length as factor in spring design; definitions applying to round steel wire; applications of helical spring chart.

P. Klamp.
Helical Tension Spring Tables. Product Eng., v. 12, n. 11 and 12, Nov. 1941, p. 631-2 and Dec., p. 689-92. Method for selecting tension springs which does away with usual cut-and-try process; tables given and their application described.

S. Gross.
Die Elastische Linie druckbeanspruchter schraubenfedern. Diag., VDI Zeit, v. 85, Jan. 11, 1941, p. 524.

C. P. Nachod.
Graphical Calculations of Helical Springs; Data Sheet, chart. Mach. Design, v. 13, Sept. 1941, p. 77-78.

Instruments

J. W. Rockefeller, Jr.
Self-Compensating Instrument Springs. Wire and Wire Products, v. 16, n. 2, Feb.1941, p. 116-9. Commentary on hysteresis, physical dimensions, temperature effect, and bimetallic self compensating scale spring; closer tolerances possible in self compensating springs.

Laminated

Anonymous 304.
Laminated Springs; Production Processes Employed by Toledo-Woodhead Springs, Ltd., il, Automobile Eng., v. 31, Sept. 1941, p. 295-298.

Emil Grieb.
Smooth-surfaced or Ribbed Steel for Leaf Springs. Stahl und Eisen, v. 60, n. 12, 1940, p. 252-253. Although the ribbed surface reduces lateral disalignment, the smooth-surfaced material is preferred because of longer life and economy.

Manufacture

J. F. Cavanagh.
Methods for Forming Eye on Close-Wound Springs. Diag., Am. Mach., v. 85, Aug. 6, 1941, p. 755-756.

J. F. Cavanagh.
Simplified Forming of Small Flat Springs. Diags. Am. Mach., v. 85, May 14, 1941, p. 431-432.

M. O. Haas.
Spring Winding Tool controls Lead and Tension. Diags., Am. Mach., v. 84, Nov. 27, 1940, p. 967.

Nickel Alloys

B. B. Betty, E. C. MacQueen and C. Rolle.
Relaxation Resistance of Nickel-Alloy Springs. Am. Soc. Mech. Engrs.— Advance Paper, n. 16, mtg., Dec. 1-5, 1941, 9 p. As result of series of tests reported stresses required to produce 2, 4 and 6% load loss, or relaxation in coil springs, held at constant height and constant temperature, have been determined for several alloys, namely, Monel, "K" Monel, "Z" nickel and Inconel; successive test temperatures from 300 to 700°F were used; range of temperature over which these alloys can be used successfully, when load loss is criterion, determined.

Neoprene

F. L. Yerzley.
Notes on Creep of Neoprene in Shear. Rubber Age, (N. Y.), v. 48, n. 3, Dec. 1940, p. 165-8. Preliminary information given; data obtained from tests of laboratory samples in survey now in progress to classify different candidate compositions for spring service; tests described

were conducted at constant temperature of 82°F ± 2° under static load of 47.7 lb. psi. Before Am. Soc. Mech. Engrs. Reference made to paper indexed in Engineering Index 1940, p. 1135, from Am. Soc. Mech. Engrs.—Trans., July 1940.

Patents

Yackiti Sekiguti and Ryonosuke Yamada.
Steel for Gases, Springs or Gears. Japan 130,093, May 11, 1939. Low carbon steel containing suitable amounts of hard elements, such as W, Cr, Ni, or Mn, is carbon treated and cooled slowly above the transition point to produce a martensitic surface layer.

Wm. H. Wood and Oscar C. Trautman.
Heat-Conditioning Carbon Steel Wire, etc. U.S. 2,224,998, Dec. 17, 1941. An Arrangement of apparatus is described, and a method suitable for preparing spring material from carbon steel which involves rapidly quenching it from a temp. at which it has assumed the so-called austenitic form to a temp. below the temp. range of pearlitic transformation and above the temp. range of rapid Martensitic transformation, the quenching being in a metal bath having a rate of temp. reduction which will inhibit substantial pearlite transformation; and further quenching from such temp. at a rate of temp. reduction at which transformation is to a structure predominantly martensitic.

Carlo Adamoli.
Copper Alloys Containing Beryllium. (To Perosa Corp.), U.S. 2,250,850, July 29, 1941. Alloys for Springs, needles, etc., containing Cu together with Be about 1.3-2.6% and, as a solubilizing agent for the Be, Va about 0.2-0.5% or Ti 0.1-0.5%.

James E. Harris.
Alloy for Vibratory Devices such as Springs and Tuning Forks. (To Bell Telephone Laboratories Inc.) U.S. 2,251, 356, Aug. 5, 1941. An alloy is used such as one containing Fe 45.8, Ni 34.8, Mo, 15.7, Mn 2.2, Co 1.2 and C 0.3%; such an alloy having a substantially consistent frequency of vibration at different Temps.

Luciano G. Selnič and Clarence L. Altenburger.
Alloy Steels Suitable for Automobile axles, gears, springs, etc., (to Great Lakes Steel Corp.) U.S. 2,250,505, July 29, 1941. A steel having inherently fine grain and a hardenability variable through wide ranges by relatively small changes in the proportions of its alloy elements and capable of being welded by commercial processes, contains Fe together with C 0.25-0.7, Mn 0.5-0.75, Cr 0.5-0.75, Si 0.7-0.9, Zr 0.05-0.35, and Mo 0.05-0.35%.

Resilience

J. Jennings.
Springs for Maximum Resilience. Engineering, v. 152, n. 3944, Aug. 15, 1941, p. 134-5. Theoretical mathematical study; number of empirical formulas proposed by various authorities for maximum shear stress induced in spring have been compared in paper by W. R. Berry indexed in Engineering

Index 1939, p. 1104, from Instn. Mech. Engrs.—Proc., v. 139, 1938; it is concluded that very convenient rule emerges, that wire diameter should be same for each spring, subject to coil wire diameter ratio of about 4:2 for inner spring.

Rubber

C. Macbeth.
Rubber Road Springs. Automobile Engr.,v. 31, n. 411, 412 and 413, June 1941, p. 195-9, July, p. 221-6 and Aug. p. 263-6. June: Development of conical torsion disk type rubber springs; form of stress most likely to furnish best results in vehicle suspension discussed; methods of attaching rubber to its component parts or housing. July: Schemes of front and rear independent suspension embodying rubber springs; road tests results from viewpoint of riding quality and drivability given. Aug.: Behavior or suspensions in service; track variation, shimmying and tire wear.

Springs (General)

W. E. Abbott.
Compression Spring Improves Bearing Puller. Diags., Am. Mach., v. 85, July 23, 1941, p. 700.

R. W. Cook.
Gets Data Every Hour; Wallace Barnes Co. Division, of Asso. Spring Corp. Bristol, Conn. Il. Factory Management, v. 99, Aug. 1941, p. 99-101.

C. J. Bechstedt.
Modern Trends in Spring Making. S.A.E. Jour., v. 48, May 1941, p. 204.

Steel

B. L. McCarthy.
Steel Wire. Can Metals and Met. Industries, v. 4, n. 2, Feb. 1941, p. 42. Metallography of steel and steel wire in color; recent trends in manufacture of spring wires. Extracts from paper before Am. Soc. Metals.

C. N. Dawe.
How Vanadium Influences Design Materials. Machine Design, v. 13, n. 10, Oct. 1941, p. 49-53. Summary of principal vanadium steels now in use; tables presented which classify forging steels in heavy sections, forging steels in light sections, spring steels, and cast vanadium steels; chemistry, heat treatment, uses, and some of special characteristics listed; particular application to gears, springs and various forgings and castings.

I. I. Baranov and V. V. Propastina.
The Substitution of Mn Steel for Cr-Va Wire for Springs. Avrapromyshlennast, v. 56, 1938, Chem. Zentr, 1939, II 1365. Spring wire from Mn steel containing 0.6-0.7% C, and 0.9-1.2% Mn, when quenched in oil and annealed 8-10 minutes in a salt petre bath at 375°C, possessed greater durability than wire from the Cr Va steel 50 Ch Fa.

Stresses

A. Thompson.
Elastic Limit of Flat Spring Material. Prod. Eng., v. 12, May 1941, p. 262.

Testing

F. P. Zimmerli.
Effect of Temperature on Coiled Steel Springs Under Various Loadings. Am. Soc. Mech. Engrs.—Trans., v. 63, n. 4, May 1941, p. 363-7 (discussion) 367-8. Indexed in Engineering Index 1940, p. 1135, from Am. Soc. Mech. Engrs.—Advance Paper n. 27, mtg. Dec. 2-6, 1940.

A. Pomp and M. Hempel.
Einfluss der Oberflaechenverletzungen auf die Dauerhaltbarkeit von Ventilfedern. VDI Zeit, v. 85, n. 7, Feb. 15, 1941, p. 174-5. Endurance of spiral spring with and without surface defects. Abstract of paper indexed in Engineering Index 1940, p. 1135, from Eisenforschung zu Duesseldorf—Abh 394, n. 4, 1940.

J. W. Rockefeller, Jr.
Instrument Applications of Thermally Compensated Springs. Wire and Wire Products, v. 16, n. 9, Sept. 1941, p. 491-5. Importance of eliminating errors due to temperature changes, in parts used in connection with indicating of recording instruments; such errors may be due to differential expansion of parts making up instrument, or to change in stiffness of elastic elements; test data, dealing with helical wire spring made of various alloys, for use in some specific types of instruments.

C. T. Edgerton.
Recommended Code of Procedure for Fatigue Testing of Hot-Wound Helical Compression Springs. Am. Soc. Mech. Engrs.— Trans., v. 63, n. 6, Aug. 1941, p. 553-8 (discussion) 558-60. Indexed in Engineering Index 1940, p. 1135, from Am. Soc. Mech. Engrs.—Advance Paper n. 15, mtg. Dec. 2-6 1940.

Torsion

R. L. Adams.
Mechanics of Torsion Spring. Wire and Wire Products, v. 16, n. 3 and 4, Mar. 1941, p. 165-70 and Apr. p. 223 and 225-30. Mar.: Investigation made to develop deflection and stress equation based upon correct theory and so simplified that designers unfamiliar with spring calculation could use it safely and without confusion; extensive testing of springs made to observe and explain effects of curvature to establish whether or not theory holds for both winding up and unwinding springs, and to compare properties of springs used as coiled with those of springs heat treated after coiling; results. Apr.: Basic theoretical mechanics of stress and deflection in torsion spring investigated; test results given. Bibliography.

Torsion Bar

O. Foeppl.
Oberflaechendruecken von Verdrehungsstabfedern (Porschefederung) zum Zwecke der Steigerung der Dauerhaltbarkeit. Werkzeugmaschine, v. 45, n. 2, 2nd, Jan. 1941 issue p. 27-9. Compression of outer surface of torsion rod springs as means for increasing of fatigue resistance; results of experiments conducted in Woehler Institute, Germany, on torsion rod automobile springs; influence of each of three zones, formed by compression of rod, on fatigue resistance.

Valve Springs

M. W. Bourdon.
Valve Spring Surge. Bus and Coach, v. 12, n. 143, Nov. 1940, p. 240-3. Review of causes and effects of spring surge and methods of overcoming it.

L. H. Dawtrey.
Valve Springs. Automobile Engrs., v. 31, n. 408, 1941, p. 73-8. After surveying problem of normal valve spring stress, Wahl theory is outlined; alternative design possibilities considered, more particularly in relation to surge; formulas based on results given.

A. H. Allen.
New Steels for Valve Spring Service. Steel, v. 108, Feb. 10, 1941, p. 35-36.

1942

Automobile Springs and Suspension

Anonymous 305.
Front Axle Suspension, All Cars from 1939-1942. Can Automotive Trade, v. 24, n. 3, Mar. 1942, p. 36, 38 and 43. Due to shortage of crude rubber and existing or impending restriction on use of tires, front end alignment takes on added importance as means of tire conservation; summary of front end specifications for cars produced in period of 1939 to 1942 inclusive; condensed instructions for adjustments in cases of misalignment.

Anonymous 306.
Suspension. Automobile Engr., v. 32, n. 427, Sept. 1942, p. 357-8. Notes on current schemes of automobile suspension.

P. E. Mercier.
Vehicle Suspensions. Automobile Engr., v. 32, n. 428, Oct. 1942, p. 405-10. Theoretical mathematical analysis of motion of vehicle body and wheels caused by traversing uneven ground; all conclusions drawn from this analysis are in agreement with experimental evidence.

P. E. Mercier.
Theory of Vehicle Suspensions. J. Applied Physics, v. 13, n. 8, Aug. 1942, p. 484-95. Analysis of motion of vehicle body and wheels caused by translation over uneven ground; relative magnitude of seven vibrations corresponding to bobbing, rolling, and pitching motions of body, and to four specific vibrations of wheels, are discussed in view of their combined effects on displacements of body of car.

Beryllium Copper Alloys

Anonymous 307.
High-Conductivity Beryllium-Cobalt-Copper Alloy. Engineering, v. 153, n. 3978, Apr. 10, 1942, p. 287. Brief note on ternary alloy developed by Mallory Metallurgical Products, Ltd., known as Mallory 73 beryllium copper, used for current carrying springs or other parts of complicated shape for electric equipment, instruments, diaphragms, etc.

R. W. Carson.
Springs of Beryllium Copper. Aero Digest, v. 41, n. 1, July 1942, p. 150, 153 and 272-3; see also Metal Industry (Lond.), v. 61, n. 18, Oct. 30, 1942, p. 278. Growing shortage of tin, hardening element in phosphor bronze, is emphasizing place of beryllium copper as spring material in airplane construction, instruments and accessories; properties are discussed.

Anonymous 308.
Alloys for Springs; Development of Beryllium-bronze. Chem. Age, (Lond.) v. 46, Jan. 3, 1942, p. 7-8.

Car Springs and Suspension

P. K. Beemer and F. C. Lindvall.
Dynamically Stable Spring Suspension for Railway Cars and Motorcoaches. Soc. Automotive Engrs.—J v, 50, n. 13, Dec. 1942, (Trans.), p. 521-7. Description of "above-gravity,dynamically stable" spring suspension in which car or coach is elastically supported at each end on virtual, universal center bearing on longitudinal centerline above center of gravity of car or coach body.

Anonymous 309.
Springs and Spring Steel: Railway Rolling Stock Material. Brit. Standards Instn.— Brit. Standard, n. 24— Pt 3—1942, 40 p. Specifications for carbon steel laminated springs, silico manganese steel laminated springs, carbon steel volute and helical springs, silico manganese steel volute and helical springs, and carbon spring steel and silico manganese spring steel for volute and helical springs.

Anonymous 310.
Packing Retainer Springs. Il., Railway Age, v. 113, July 4, 1942, p. 8. Same, Railway Mechanical Eng., v. 116, July 1942, p. 313.

Conical

A. Bodenschatz.
Conical Springs. Product Eng., v. 13, Feb. 1942, p. 109-110,

Design

A. M. Wahl.
Combining Maximum Spring Deflection with Minimum Space. Machine Design, v. 14, n. 1, Jan. 1942, p. 57-9 and 102. Mathematical discussion of problem of designing springs to store maximum amount of potential energy per unit volume of space occupied; advantages of spring nest (telescoped springs) equations for potential energy for two and three spring nest. Bibliogrphy.

H. G. W. Taylor.
Communications on Wave Action in Gun Run-up Springs. Instn. Mech. Engrs.-J and Proc., v. 146, n. 4, Feb. 1942, p. 183-7. Discussion of paper indexed in Engineering Index 1941, p. 1135, from issue of Sept. 1941.

C. Thumin.
Procedure Blanks and Charts Simplify Spring Design Jobs. Product Eng., v. 13, n. 11, Nov. 1942, p. 662-4, 1 supp. sheet. Work proven method of spring calculation, in which known important factors are automatically included, can be used by average drafting room employee; method requires filling in of forms with help of special charts; results of calculations are then summarized in specification sheet which gives all information manufacturer needs.

A. M. Wahl.
When Springs Are Statically Loaded. Machine Design, v. 14, n. 7, July 1942, p. 67-71. Tables and charts given which have been developed to facilitate design of statically loaded helical springs; they are based on assumption that stress concentration effects due to bar or wire curvature may be neglected in calculating stress for springs subject to such loading conditions.

Electrical Instruments

P. M. G. Thorpe.
Materials for Springs. Elec. Rev., v. 130, n. 3359, Apr. 10, 1942, p. 465-7. High carbon spring steel possesses high tensile and elastic strength, but is very little used for electrical springs on account of

its low conductivity, its magnetic properties and its poor resistance to corrosion; for these reasons use of phosphor bronze or nickel silver has become common; other spring alloys are now available which do not depend upon cold working for their properties; beryllium copper is one of outstanding examples.

Handbooks and Reference Books

Anonymous 311.
Manual of Spring Engineering. Am. Steel and Wire Co., Cleveland, Chicago and New York, 1941. 132 p., illus., diagrs., charts, tables, $1.00. Manual presents recent developments in technique of spring design; it provides unique graphical representation of basic spring formulas and typical designs illustrating mechanics of calculating spring data; valuable information having to do with general spring characteristics and physical properties of materials from which springs are made is also included.

G. F. Nordenholt, J. Kerr and J. Sasso.
Handbook of Mechanical Design. McGraw-Hill Book Co., New York and London, 1942, 277 p., diagrs., charts, tables, $4.00. Comprises material which has appeared previously in "Product Engineering"; chapters cover: charts and tables for general arithmetical calculations; properties of materials; beams and structures; latches, locks and fastenings; springs; power transmission elements and mechanisms; drives and controls; and design data on production methods. Eng. Soc. Lib., N.Y.

Heat Treatment

P. M. Fisk and E. F. Pellowe.
Method for Tempering Spring Steel Prior to Rustproofing. Machy. (Lond.), v. 60, n. 1534, Mar. 5, 1942, p. 156-8. Traditional method of hardening and tempering of spring steel suffers from several disadvantages, especially when material has subsequently to be rustproofed by wet method; article describes new method developed by authors which uses minimum of labor and produces undistorted parts; preheater, two salt tanks and hot water tank used are arranged in circle, with operator in center.

Helical

P. Klamp.
Helical Tension Spring Tables—III. Product Eng., v. 13, n. 1, Jan, 1942, p. 59-60. Method for selecting tension springs which does away with usual cut-and-try process. See also Engineering Index, 1941, p. 1136.

R. A. Collacott.
Helical Valve-Springs, Power and Works Engr., v. 37, n. 433, July 1942, p. 190-2. Brief consideration of characteristics of helical valve springs; how practical conditions of use influence choice of materials and forms, is shown.

Anonymous 312.
Symposium on Formulation of Code for Design of Helical Springs. Am. Soc. Mech. Engrs.—Trans., v. 64, n. 5, July 1942, p. 475-88. Papers presented cover scope of problem of formulating practical working code: What Does Practical Spring Designer Need? J. K. Wood; Helical Spring Design Stresses for Standard Code, A. M. Wahl; Helical Spring Tables—Scope and Arrangement, H. C. Keysor; Future Research Work Needed in Mechanical Spring Problems, M. F. Sayre; Monographic Charts, L. C. Peskin.

L. Kasper.
That Occasional Spring. Modern Machine Shop, v. 15, n. 3, Aug. 1942, 11 p. between 140 and 158. Fundamental considerations in design and manufacture of helical spring presented in practical manner.

J. I. Hommel.Comp.
Load and Deflection of Phosphor-bronze Round-wire Helical Springs; Data Sheets. Machinery, v. 49, Oct. p. 155 and Nov. p. 213, 1942.

J. I. Hommel.
Loads and Deflections of Stainless-steel Round-wire Helical Springs; Data Sheets. Machinery, v. 48, April 1942, p. 197, May, p. 135 and June, p.133.

Instruments

J. W. Rockefeller, Jr.
Aeronautical Applications of Instrument Springs. Wire and Wire Products, v. 17, n. 3, Mar. 1942, p. 139-41 and 166. Information pertaining to effect of temperature on action of instrument springs.

O. F. Hudson.
Alloys for Instruments. J. Sci. Inst., v. 18, 1941, p. 211-216. Many different alloys for instruments are given. For springs, heat treatment is necessary, alone or after cold working. Beryllium-bronze, phosphor bronze and Ni-Ag are used. Nickel steel known as Invar or Elinvar, a Cr-Ni-Fe alloy has a practically constant modulus over the temperature range 80-100°C. Additions of NiO and V have made Metelinvar and Al and Ti (Durinvar); after heat treatment they are superior to Elinvar.

Laminated

Anonymous 313.
Laminated Springs. Automobile Engr., v. 31, n. 414, Sept. 1941, p. 295-8. Production processes employed by Toledo-Woodhead Springs, Ltd., described; American practices in mass production have been successfully adapted to comparatively small quantities involved in English practice.

Locomotive Springs and Suspension

Anonymous 314.

Application of Bearing Springs to Locomotives and Other Rail Units. Ry. Gaz., v. 76, n. 8, Feb. 20, 1942, p. 263-6. Design, maintenance and characteristics of suspension systems commonly applied to locomotives and rolling stock.

Manufacture

C. W. Bartlett.

Spring Making. Steel, v.110, n. 7 and 8, Feb. 16, 1942, p. 85, 88 and 101 and Feb. 23, p. 66, 68 and 71. Manufacture of spring steel products is greatly facilitated by mechanized handling set-ups incorporated into production equipment in plant of Spring Perch Co., Lackawanna, N. Y., devoted to producing special spring suspensions for heavy motorized equipment; operations in production of heavy volute springs for caterpillar and other heavy track laying vehicles are detailed; leaf spring procedure also described.

Patents

Louis L. Stott.

Treatment of Copper-Beryllium Alloys. (To Beryllium Corp.), U.S. 2,257,708. Sept. 30, 1942. A method employed for producing a spring wire from an age-hardenable and cold-workable alloy of Cu with 0.3 to 3.0% Be, involves mechanically deforming the alloy to wire form of a size materially larger than the desired final size, heating to an age-hardening temp. within the range 482-588°C for a time at least sufficient to over-age the alloy to a degree producing a hardness materially less than the max. hardness obtained at the temp. of heating, and then strain hardening the material by mechanically deforming the wire at a cold working temp. to the desired final size, the extent of the strain hardening being approximately that required to increase the hardness of the over aged alloy to a value approx. the max. hardness value obtainable on heating to the age hardening temp.

C.W. Wulff.

Volute Steel Springs. (To Holland Co.), U.S. 2,271,111, Jan. 27, 1942. A mfg. method is employed which involves heating a steel bar from which the spring is to be made to a predetermined temp. suitable for coiling, and above its critical temp., then coiling the bar about a mandrel, immediately thereafter removing the coiled bar from the mandrel and before any portion of the bar cools below its critical temp.; reheating it to a predetermined quenching temp. and then immediately thereafter quenching the coiled bar in a medium of low viscosity and high volitilization until the temp. of the bar is lowered to around 400°F, and then tempering the coiled bar.

Carlo Adamali.
Aluminum-Beryllium Alloys suitable for Bearings, Springs, needles etc. (To Perosa Corp.), U.S. 2,275,070, Mar. 3, 1942. For improving the machinability and electrical properties of alloys of Al with Be, about 1-3%, Mn is introduced in a proportion of from a trace up to 2%, and the alloy is heated to about 470-475°C, then rapidly cooled and subjected to an annealing treatment producing reprecipitation of the hardening constituent.

George L. Talbot.
Apparatus for Heat Treating Small Articles. British 541,117, Nov. 13, 1941. An apparatus for quenching or otherwise thermally treating springs, small gears, carbon steel taps or rock drills is described.

Hubert B. Hathaway.
Coil Springs from Steel Wire. (To L. A. Young Spring and Wire Corp.) U.S. 2,261,878, Nov. 4, 1942. Steel wire having a carbon content below 1% is bent to spring shape, the bent pieces cut off, and immediately flexed and subjected to heating at 450-525°F for less than 3 seconds and then cooled in air. Apparatus is described.

Rubber

E. Latshaw.
Designing Mountings for Rubber Under Shear. Machine Design, v. 14, n. 4 and 5, Apr. 1942, p. 173-4 and May p. 85-6. Simplified formulas presented for designing rubber springs; nine characteristic types of mounting covered.

C. W. Kosten and C. Zwikker.
Simplifying Design of Rubber Mountings. Machine Design, v. 14, n. 1, Jan. 1942, p. 66-71. Equations for solution of rubber spring problems; stress formulas for plane shear and when torque is applied; solution of practical examples; tabulated data for compression of rubber cylinders, initial stiffness and static and dynamic changes in stiffness. Bibliography.

W. C. Keys.
Vibration and Rubber Springs. Mech. Eng., v. 64, n. 3, Mar. 1942, p. 175-80 and (discussion), n. 11, Nov. 1942, p. 808; see also Machine Design, v. 14, n. 2, Feb. 1942, p. 77-81 and 150-4. In presented discussion of rectilinear vibration, data are included as to resonance frequencies of vibratory movement of mountings made of typical rubber compounds; few practical applications of rubber are shown and typical quantitative results are given. Before Am. Soc. Mech. Engrs.

C. Macbeth.
Rubber Suspension. Automobile Engr., v. 32, n. 422 and 423, Apr. 1942, p. 151-5 and May p.195-8. Attention confined to adaptation of conical torsion disk units to cycles and motor cycles; evolution of such suspensions is described; problem of arranging suitable braking system also dealt with; rubber suspension for rear wheels considered.

F. Göebel.
Studies of Rubber Springs for Airplane Motor Installation. Kautschuk, v. 17, 1941, p. 104-107. The function and behavior of rubber in airplane engine mounting are discussed, with reference to the measurement of its elastic properties, the strength of rubber-to-metal bonds, and the loss of elastic properties at elevated temperatures.

Springs (General)

A.V. deForest.
Precision Springs. Wire and Wire Products, v. 17, n. 2, Feb. 1942, p. 97-9 and 122-3. Springs represent most universal and precise method of measurement of force— with widely extending field of use; investigation into behavior of springs is reported.

K. D. Montgomery.
Springs given New Significance in Hunter Campaign. Il., Indust. Marketing, v. 27, Feb. 1942, p. 26-27.

Steel

H, Carlson.
Spring Steels. Product Eng., v. 13, n. 1, 2 and 3, Jan. 1942, p. 2-5, Feb. p. 89-92, Mar. p. 139-41 and Oct. p. 602. Data required for selection of proper spring steel for specific application; basic and acid steel manufacture; wire manufacture; high strength springs; safe working stress; hard drawn steel spring wire; data required for selection of proper spring steel for specific application. Feb.: Design data for music wire spring steel and oil tempered spring steel wire. Mar.: Design data for chromium vanadium and silicon manganese spring steel wires.

A. M. Wahl.
Which Spring Material? Machine Design, v. 14, n. 11, Nov. 1942, p. 87-9. In view of present restrictions, plain carbon steels such as music wire, oil tempered wire or hot rolled high carbon steels should be used instead of alloy steels, stainless steel, and nonferrous materials; composition, tensile and physical properties of each material discussed.

Ernst Meier.
Selecting, Testing, and Properties of Spring Steels in Fine Mechanics. Feinnech V. Praxis, v. 48, 1940, p. 131-132. Chem. Zentr., 1940, II, p. 1996. Strength and Elasticity tests furnish reliable data for the production of uniform spring leaves from carbon steel with 0.8-1% C. In addition, the load limit and the modulus of elasticity should be determined. The two latter are not strictly proportional to the tensile strength. The acceptable strength for steels with 0.8, 0.9 and 1.0% C respectively is 140-160, 160-190, and 210 Kg per sq. mm:

the elongation is 8-6, 6-4 and 3% resp.; the load limit is 90, 100, 110 Kg per sq mm; and the acceptable modulus of elasticity is 19,000-20,000 Kg per sq mm. For highly loaded springs, the load limit should be carefully determined. The conversion factor from brinell hardness to tensile strength is 0.42 for steels with .8 and .9% C and 0.46 for steels with 1%. To attain the highest load limits the steels are: oil hardened at approximately 800°C, annealed at 300-400°C, quenched in H_2O, treated in an oil bath at 150-200°C (to relieve tension) and cooled in the air.

Stirrup

Anonymous 315.
Dies for Stirrup Springs. Am. Mach., v. 86, n. 26, Dec. 24, 1942, p. 1522-4. Phosphor bronze stirrup springs for 40-mm percussion fuse are being turned out in three press operations; pieces are blanked from roll of 9/32-in. wide, 0.010 in thick strip stock in progressive die which also bends six lower projections at 90° angle with strip; blank and finish forming described.

Stresses

H. O. Fuchs.
Notes on Secondary Stresses in Volute Springs. Am. Soc. Mech. Engrs.—Advance Paper, n. 13, for meeting Nov. 30-Dec. 4, 1942, 7 p. Besides torsion stress which can be calculated from twisting moment and cross section, other secondary stresses appear in volute springs; these are caused chiefly by variation of twist from section to section or by bending of spring; they may reach high values in small diameter coils; approximation theory is given for their calculation; strain gage measurements and distortions of springs are shown.

Testing

B. B. Betty, E. C. MacQueen and C. Rolle.
Relaxation Resistance of Nickel-Alloy Springs. Am. Soc. Mech. Engrs.—Trans., v. 64, n. 5, July 1942, p. 465-73 (discussion) 473-4; see also Wire and Wire Products, v. 17, n. 11, Nov. 1942, p. 653-61; Metallurgia, v. 27, n. 157, Nov. 1942, p. 30. Indexed in Engineering Index 1941, p. 1136, from Am. Soc. Mech. Engrs.—Advance Paper n. 16, mtg. Dec. 1-5 1941.

J. F. Cavanagh.
Testing Small Springs. Product Eng., v. 13, n. 9, Sept. 1942, p. 520. Illustrated description of set-up for simultaneously testing two small mechanisms which have hairpin type spring; for test, block of maple is adjustably mounted upon reciprocating bar of old filling machine; for

springs designed to carry loads in excess of approximately 5 lb., stronger mechanisms should be provided.

Torsion Bar

H. E. Simi.
Torsional Rod Springs and How They Are Designed. Product Eng., v. 13, n. 12, Dec. 1942, p. 710-12. Torsional rod springs with properly designed suspensions have several important advantages over leaf springs; though less compact than helical coiled springs, which also depend on twist and torsion, design of torsional rod springs has proved to be comparatively simple, as shown by examples of design and selection from small number of standard sizes.

Anonymous 316.
Torsion Bar Suspension. Diags., Auto. Eng., v. 31, Dec. 1941, p. 433.

Valve Springs

W. Marti.
Valve Springs; Investigations into the Problems of Surge and Vibration. Diags., Auto. Eng., v. 32, Mar. 1942, p. 95-100.

Vibrations

A. M. Wahl.
Eliminating Surging in Helical Springs. Machine Design, v. 14, n. 4, Apr. 1942, p. 47-51 and 216-218. Relation between frequency of alternating motion of spring end and natural vibrations of spring; equations of vibrating spring; natural frequency of spring, equation of vibrations and boundary conditions. Bibliography.

J. Dick.
Transverse Vibrations of Helical Spring With Pinned Ends and No Axial Load. Lond., Edinburgh and Dublin Philosophical Mag. and J. Science, v. 33, n. 222, July 1942, p. 513-9. Approximate calculation for frequencies of transverse vibration of uniform helical spring, obtained by applying mathematical analysis for transverse vibrations of long, thin uniform rod.

Volute Springs

B. Sterne.
Characteristics of Volute Spring. Soc. Automotive Engrs.—J v 50, n. 6, June 1942 (Trans.) p. 221-40. Paper attempts to clarify functioning of volute spring and to eliminate confusion which is at present connected with volute-spring computations.

C. J. Holland.
Volute-Spring Formulas. Am. Soc. Mech. Engrs.— Advance Paper, n. 12 for meeting Nov. 30-Dec. 4, 1942, 7 p. It is shown by geometry that line, drawn through mean diameters of turns of volute spring, is parabola, but that line differs very little from straight line forming side of triangle; using triangle as base for derivation of formulas does not introduce any appreciable error and does permit of extreme simplification; formulas should be based on diameters, because turns of volute spring are not circles and, therefore, using radius will not give accurate results.

Wood Springs

Anonymous 317.
Wooden Springs for Chairs, Divans, Studio Couches, Box Springs, and Inner Spring Mattresses. Il. Business Week, Oct. 31, 1942, p. 35-36.

1943

Airplane Springs and Suspension

R. H. Carter.
Space Limitations and Optimum Conditions in Aircraft Spring Design. J. Aeronautical Sciences, v. 10, n. 2, Feb. 1943, p. 51-7. Effect of space limitations on spring performance is analyzed and leads to optimum design formulas for three most common types of aircraft springs, i.e., tension, compression, and torsion springs; using formulas thus derived, for given allowable stress relationship between space limitations, maximum load obtainable and corresponding wire size can be found immediately.

Automobile Springs and Suspension

Anonymous 318.
Absorbing Bounce. Can Automotive Trade, v. 24,n. 11, Nov. 1942, p. 22, 38 and 40. Placed between axles and frame chassis, leaf springs carry weight, absorb shock and transmit drive; illustrations given.

Beryllium Copper Alloys

R. W. Carson.
Making Beryllium-Copper Behave. Metals and Alloys, v. 18, n. 6, Dec. 1943, p. 1314-9. Historical outline; early work on beryllium; heat treatment; properties of beryllium copper suitable for springs in precision instruments; data on investigation for drift; hysteresis or aging characteristics; heat treating for minimum drift; problem of distortion or warping during heat treatment solved by using lower temperature. Bibliography.

H. G. Williams.
Predicting Spring Performance of Beryllium Copper Wire and Strip. Iron Age, v. 152, n. 2, July 8, 1943, p. 62-7; see also Metal Industry (Lond.), v. 63, n. 11, Sept. 10, 1943, p. 165-8. Details of laboratory routine that not only predetermines spring performance or beryllium copper wire and strip but also shows how to heat treat for peak properties.

Car Springs and Suspension

P. K. Beemer and F. C. Lindvall.
Suspension. Automobile Engr., v. 33, n. 438, July 1943, p. 283-7. Consideration of dynamically stable springs for motor coaches and railroad cars. Indexed in Engineering Index 1942, p. 168, from Soc. Automotive Engrs.—J Dec. 1942.

Anonymous 319
Suspension Springs for Axle-Hung Transmission. Diesel Ry. Traction (Supp. to Ry. Gaz.), n. 131, Apr. 1943, p. 26-7. Dynamic stress involved in spring design considered.

Cranes

K. Idel.
Gummi als Federungselement fuer Kranlaufraeder mit grossen Raddruecken. Stahl u Eisen, v. 37, n. 63, Sept. 16, 1943, p. 685-6. Rubber as spring element for crane wheels with heavy wheel pressure; use of embedded synthetic rubber (Perbunan) disks.

Design

A. M. Wahl.
Calculating Spiral Springs. Machine Design, v. 15, n. 11, Nov. 1943, p. 128-32, 208, 210, 212, 214. Discussion of fundamentals underlying special spring performance; examples of spring analysis given.

H. O. Fuchs.
Design Method for Volute Springs. Soc. Automotive Engrs.—J v 51, n. 9, Sept. 1943 (Trans.), p. 317-28. Gradually increasing spring rate (stiffness) and unequal stress distribution along blade are chief features of volute springs; apart from scale factors, rate increase and stress distribution depend only on ratio of smallest to largest free coil radii and on variation of free helix angles from coil to coil; use of non-dimensional charts simplifies design.

A. M. Wahl.
Simplifying Design of Volute Springs. Machine Design, v. 15, n. 2, Feb. 1943, p. 103-7. Equations and curves presented which provide for quick and simple calculations.

R. L. Adams.
Some Effects of War on Mechanical Spring Design and Inspection. Wire and Wire Products, v. 18, n. 5, 6 May 1943, p. 273-7, 301, June, p. 331-4, 350-3. General survey of spring design as it affects inspection; spring production has been affected by government specifications and inspection methods.

R. Sonntag.
Theory of Closed Circular Spring. Roy. Aeronautical Soc.—J v 47, n. 390, June 1943, (Abstract Sec.), p. 294. Author applies non-linear elastic theory to case when ring is formed from originally plain strip by application of two end moments; spring characteristics are not in general affected by inherent stress associated with constant bending moment, and law of superposition can also be applied in case of large deformations. Brief English abstract from Ingenieur-Archiv, v. 13, n. 6, 1943, p. 380-97.

C. J. Holland.
Volute-Spring Formulas. Am. Soc. Mech. Engrs.—Trans., v. 65, n. 5, July 1943, p. 533-9 (discussion) 539-41. Indexed in Engineering Index 1942, p 1027, from Am. Soc. Mech. Engrs.—Advance Paper, n. 12, for meeting Nov. 30-Dec. 4, 1942.

Electrical Measuring Instruments

A. F. Love.
Control Springs Applied to Electrical Measuring Instruments. Elec. Engr. and Merchandiser, v. 20, n. 4, July 15, 1943, p. 64-8. Control springs of electric instruments have to meet requirements and must possess characteristics not essential in other types of instrument springs; means for meeting these requirements discussed.

Heat Treatment

E. M. Zamanskii and G. O. Baron.
Heat Treatment of Springs. Vestnik Metalloprom, n. 20, 1940, p. 11-12, 73-75. Chem. Zentr., 1942, p. 920. Spiral springs (over 6 mm wire diameter) containing carbon 0.45, Si 1.65, Mn 0.86, P 0.024, S 0.03, Cr, 0.08, and Ni 0.05% were hardened at 860-880°C and annealed at 400-450°C. Spiral springs having the same wire diameter and made of U10A steel and containing 1.02%C were hardened at 830°C and also annealed at 400-450°C. These wires should be coiled hot. Wires of up to 6 mm diameter

and made from BC, OBC and P steel should be annealed at 180-290°C and coiled cold. Mechanical properties of various heat treated springs are given.

Helical

C. P. Nachod.
Calculating Buckling Load of Helical Compression Springs. Machine Design, v. 15, n. 9, Sept. 1943, p. 133-4; see also Product Eng., v. 14, n. 10, Oct. 1943, p. 681. Nomogram presented to facilitate calculation of buckling load of spring; chart is based on information included in article by A. M. Wahl, indexed from issue of May 1943.

Anonymous 320.
Loads and Deflections of Stainless-Steel Round-Wire Helical Springs. Machy. (Lond.), v. 63, n. 1617, Oct. 7, 1943, p. 399. Table gives maximum safe load in pounds and deflection, in inches per coil.

J. S. Swearingen.
Nomograph for Helical Springs. Product Eng., v. 14, n. 10, Oct. 1943, p. 682. Nomograph for obtaining dimensions of helical spring is presented.

A. M. Wahl.
When Helical Springs Buckle! Machine Design, v. 15, n. 5, May 1943, p. 96-9. Discussion of buckling of springs together with related problem of combined lateral and axial loading.

C. P. Nachod and J. F. Swearingen.
Helical Compression Springs; Radial Chart and Nomograph. Prod. Eng., v. 14, Oct. 1943 , p. 681-682.

Monel Metal

Anonymous 321.
Heavy-Duty Springs Provide High Properties for Corrosion-Resistant Service. Inco., v. 18, n. 3, 1942, p. 11. Experimental spring made of K Monel was subjected to various tests to determine its suitability for heavy duty service; spring weighs 50 lbs. and tests indicate that it can support load of 5-1/2 tons before reaching its elastic limit.

Motor Bus Springs and Suspension

J. Pickles.
Independent Springing. Bus and Coach, v.15, n. 174, June 1943, p. 154-5. Possibilities of individual wheel suspension for passenger vehicles.

Motor Truck Springs and Suspension

E. Ingham.
Care of Leaf Springs of Transport Vehicles. Mech. Handling, v. 30, n. 8, Aug. 1943, p. 347-9. Suggestions for proper care of leaf or laminated springs which are used for supporting chassis nad obviating shocks; damage due to shock; inspection and lubrication.

Non-Ferrous Alloys

L. P. Dudley.
Comparative Resilience of Duralumin and Steel. Light Metals, v. 5, n. 59, Dec. 1942, p. 497-500 and v. 6, n. 61, Feb. 1943, p. 80-6. Dec. 1942: Comparison between duralumin and typical grade of mild steel; treatment restricted to brief consideration of cases of pure axial and torsional loading. Feb. 1943: Further cases of resilience are considered, i.e., resilience of transversely loaded members (or beams) and that of helical and laminated springs.

R. Wood and G. H. Wyatt.
Instance of Corrosion in Electric Relays. Soc. Chem. Industry—J (Trans. and Communications), v. 62, n. 7, July 1943, p. 110-1. Corrosion of phosphor bronze springs in relays has been shown, analytically and synthetically to be due to oxidation by ozone followed by conversion of copper constituent into basic carbonate, tin component of alloy being preferentially attacked.

Patents

Heraeus Vacuumschmelze.
Beryllium Alloys for Watch Springs. A-G, German, 726,270, Aug. 27, 1942 (Cl. 40b 14). Addition to German 725,586.

Pivots

W. E. Young.
Investigation of Cross-Spring Pivot. Am. Soc. Mech. Engrs.— Advance Paper, n. 33 for meeting Nov. 29-Dec. 3, 1943 8 p. Characteristics of cross spring pivot, or elastic hinge, for large deflection angles; design formulas established for certain standard forms of two-spring pivot on basis of experimental results; formulas developed for spring constant, bending stress, and motion of pivot point; their application is illustrated by example.

Ring

A. M. Wahl.
Designing Ring Springs. Il. diags. Machine Design, v. 15, Aug. 1943, p. 124-127.

Rubber

C. W. Kosten.
Calculation for Rubber Springs. Engrs.' Digest, v. 6, n. 4, Apr. 1943, p. 123-6. Principles of design; spring equations; numerical examples; cylindrical rubber springs of general cross section. English translation from VDI Zeit v. 86, n. 35/36, Sept. 1942, p. 535-8.

J. Geschelin.
Lord Plant Organized Efficiently to Make Wide Variety of Rubber Mountings for Vibration Control. Automotive and Aviation Industries, v. 89, n. 7, Oct. 1, 1943, p. 20-4, 94. Illustrated description of methods and equipment employed in manufacture of bonded rubber shear-type mountings for automotive, aircraft and industrial applications; recent development is "Dynafocal" suspension for radial aircraft engines; details of metal cutting and rubber department, located separately.

Springs (General)

W. W. Boyd.
Spring Material Substitutes Have Unconsidered Qualities. Product Eng., v. 14, n. 2, Feb. 1943, p. 112-3. Substitution of other materials for standard spring steels calls for re-examination of spring materials that served in past, consideration of new resilient materials, and evaluation of other basic qualities in spring materials in addition to resilience; means for producing ferrous spring materials and ways for using wood, plastic, and even glass are suggested for least temporary substitutes.

J. W. Rockefeller, Jr.
Some Things to Have in Mind in Specifying Springs. Elec. Mfg., v. 31, n. 4, Apr. 1943, p. 87-90, 174 and 176. Consideration of metal springs, such as are likely to be specified for integration within electrically energized products of various kinds; factors which must be considered in design; selecting spring materials; established spring metals and their properties listed; endurance strength of spring materials; what temperatures do to springs.

Anonymous 322.
War Products Consultation: Temporary Set in Heavy Springs. Metal Progress, v. 43, n. 1, Jan. 1943, p. 54-5. Problem posed by ordnance inspector; volute spring is being assembled into heavy gun mounts; as

furnished by manufacturer, spring passes all acceptance tests; trouble is due to variable amount of set after being pressed nearly closed and kept that way for 24 hr.; suggested answers to three questions; final conclusion is that "set," after long loading, is only temporary.

Anonymous 323.
Calibrating Springs. Electronic Industries, v. 2, n. 11, Nov. 1943, p. 120-1, 220. Description and complete wiring diagram of electronic mechanical device for separating and sorting small instrument springs according to their stiffness or spring constant, developed by Sperry Gyroscope Co. in cooperation with Aerotronics Products Corp., Great Neck, N. Y.

Anonymous 324.
Spring removes Slack from Equipment Leads. Diag., Elec. World, v. 118, Dec. 12, 1942, p. 1968.

A. M. Wahl.
Which Spring Material Il., Mach. Design, v. 14, Nov. 1942, p. 87-89.

Steel

R. R. Tatnall.
Hydrogen Brittleness in Spring Steels. Wire and Wire Products, v. 18, n. 10, Oct. 1943, p. 607-11, 614. Steps to be taken to counteract "acid" brittleness which occurs in wire manufacture; occurrence; measurement; recovery of ductility.

G. P. Sobol.
A Rapid Method for the Determination of the Grain Size of Axle and Spring Steel. Zavod. Lab., n. 8, 1939, p. 586-588. Chem. Zentr. 1941, p. 2171. The following procedure is recommended as a rapid method: the samples are heated to 940°C in the electric furnace, held at this temperature for 60-70 minutes, then transferred to a Ni - Cr furnace at 750°C and held at this temperature for 2 - 3 minutes. The axle steel is then quenched in water at 40 - 50°C and the spring steel in oil at 20 - 25°C. Sections are then etched with a mixture of 2 parts cond. HNO_3, 25 parts 4% Picric acid and 73 parts alcohol. The results agree with those obtained by the method of McQuaid and Ehn, but only 1/15 to 1/12 as much time is required.

Stirrup

Anonymous 325.
Dies for Stirrup Springs for 14 mm Percussion Fuze. Il., diags., Amer. Mach., v. 86, Dec. 24, 1942, p. 1522-1524.

Stresses

H. O. Fuchs.

Notes on Secondary Stresses in Volute Springs. Am. Soc. Mech. Engrs.— Trans., v. 65, n. 5, July 1943, p. 543-9 (discussion) 550-1. Indexed in Engineering Index 1942, p. 1027, from Am. Soc. Mech. Engrs.— Advance Paper, n. 13, for meeting Nov. 30 - Dec. 4, 1942.

Testing

B. B. Betty, E. C. MacQueen and C. Rolle.

Relaxation Resistance of Nickel-Alloy Springs. Metal Industry, (Lond.), v. 62, n. 7, Feb. 12, 1943, p. 98-100. Indexed in Engineering Index, 1942, p. 1027, from Am. Soc. Mech. Engrs. —Trans., July 1942.

B. Sterne.

Testing of Volute Springs. Am. Soc. Mech. Engrs.— Trans., v. 65, n. 5, July 1943, p. 523-30 (discussion) 530-2. Tests conducted both on suspension springs, which are under continuous static load, and on bumper springs which are normally unloaded; paper gives some instances of test results; it also deals with static loading tests, both axial and radial, and with differences in results caused by different manufacturing methods.

Anonymous 326.

Testing Springs for Endurance. Mech. World, v. 114, n. 2953, Aug. 6, 1943, p. 162-3, 166-7. Arrangements incorporated into production plant to deal with whole output: endurance tests of valve springs; testing laminated springs; improved auxiliaries used.

Tolerances

H. Carlson.

Commercial Tolerances for Springs. Product Eng., v. 14, n. 3, Mar. 1943, p. 156-7. Easily readable commercial tolerances presented in tabular form, based upon inherent variations caused by automatic spring coiling machines and manufacturing methods; most of tolerances are similar to those originally agreed upon, but have been enlarged to cover more conditions; more specific explanations and interpretations than were shown in original tolerances included; etc.

Vibrations

C. R. Wylie, Jr.

On Forced Vibrations of Non-Linear Springs. Franklin Inst.— J v 236, n. 3, Sept. 1943, p. 273-84. Determination of amplitude of undamped vibrations of a mass, excited by a periodic force and restrained by a spring; present note is quantitative study of problem, and consists of comparison of several methods of approximate solution in relation to accurate solutions obtained by numerical integration. Bibliography.

Wood Springs

L. Moholy-Nagy.
Modern Designs from Chicago; Wooden Furniture Springs. Il., Modern Plastics, v. 20, Dec. 1942, p. 62-65.

Anonymous 327.
Wood Springs Pinch Hit for Steel. Il., Sales Management, v. 52, June 1, 1943, p. 35-36.

1944

Automobile Springs and Suspension

C. Lupton.
Spring Suspension. Can. Automotive Trade, v. 26, n. 7, July 1944, p. 42-3. Discussion of properties that make springs function under various conditions and how to use properly for best results.

Beryllium Copper Alloys

H. G. Williams.
Beryllium Copper for Wire and Strips. Metallurgia, v. 29, n. 171, Jan. 1944, p. 166-7. Abstract from paper indexed in Engineering Index 1943 p. 999, from Iron Age, July 8, 1943.

S. C. Klock.
Beryllium-Copper Springs. Electronic Industries, v. 3, n. 5, May 1944, p. 108-9, 282, 284. Production control methods necessary in applications of beryllium copper in electric equipment.

L. B. Hunt.
Beryllium Copper in Instrument Design. (J. Sci. Instruments, 1944, 21, (6), 97-105).— The physical properties of Mallory 73 beryllium-copper are tabulated. This alloy contains beryllium 2.0, cobalt 0.5, and silicon 0.1%, and in the heat-treated condition it is characterized by a combination of high elastic limit with relatively low elastic modulus. This combination makes it particularly suitable for the manufacture of springs, and a number of applications to the manufacture of instrument springs are described. These include flat or cantilever springs, helical springs, hair springs, corrugated diaphragms, flexible bellows, and Bourdon tubes. Some of the theory of the deflection process

is indicated. The alloy has the advantage that it can be worked while soft, and then heat-treated to produce the desired properties, and the resulting material is free from the internal strains present in some spring materials which have to be used in the cold-worked state.

Car Springs and Suspension

M. Forestier and M. Leheune.
Shock Absorbing Suspension and Shock Absorbers. Engrs.' Digest (British Edition), v. 5, n. 10, Oct. 1944, p. 303-5; see also Engrs.' Digest (American Edition), v. 1, n. 12, Nov. 1944, p. 663-5. Discussion of springs showing progressively diminishing resilience when load is increased or decreased relative to specified equilibrium value; and springs of constant resilience with mechanism producing non-proportional deflection; hydraulic shock absorbers. English abstract from Revue Generale des Chemins de Fer, v. 63, n. 1 Jan./Feb. 1944, p. 1-10.

Design

H. Carlson.
Deflection of Coiled Springs Wound With Initial Tension. Product Eng., v. 15, n. 9, Sept. 1944, p. 619-21. Physical factors and manufacturing considerations that affect design of coiled springs wound with initial tension; formulas for computing deflection and torsional stress; curves derived from test data which indicate range of initial tension obtainable in springs of different coil and wire diameters.

A. M. Wahl.
Frequently Overlooked Factors in Design of Springs. Machine Design, v. 16, n. 3, Mar. 1944, p. 107-11. Some of pertinent factors involved in design of helical compression springs; these factors, which frequently are overlooked, include allowance for end turns, effect of eccentricity of loading, variations in modulus of rigidity, effects of cold setting, and stress at solid compression.

A. M. Wahl.
How End-Coil Design Affects Tension Springs. Machine Design, v. 16, n. 7, July 1944, p. 107-12; see also Engrs.' Digest (British Edition), v. 5, n. 9, Sept. 1944, p. 253-6. It is customary practice in spring design to use somewhat lower working stresses for helical tension springs than those permissible for compression springs of same material and wire size; analysis indicates, however, that practice is justified when all factors are considered; article discusses these from standpoint of fundamentals of strength of materials. Bibliography.

A. M. Wahl.
Recent Developments in Mechanical Spring Design and Testing. Wire and Wire Products, v. 18, n. 11, 12, Nov. 1943, p. 717-20, 735, Dec. p. 778-80. Use of curvature correction factors in helical spring calculations; calculation of springs for static loading, working stresses used in practice, fatigue and relaxation test results, shot blasting, and calculation of Belleville and disk spring. Bibliography. Presented at Summer Section for Mech. Eng. Teachers Sponsored by SPEE and ASME, Purdue Univ.

H. O. Fuchs.
Springs Need Working Space Too. Elec. Mfg., v. 33, n. 1, Jan. 1944, p. 114-6, 188, 190, 192. Often spring maker is called upon to produce literally impossible component with reference to space and weight limitations; what nature of design problem is, and suggestions that will enable closer approaches to realities.

H. O. Fuchs.
Volute Spring Design Data. Product Eng., v. 15, n. 2, Feb. 1944, p. 143-4. Volute springs, roughly described as conical helical springs, are sometimes made of round wire, but more often of rectangular blades, with coils nesting in each other so that solid height of spring equals height or width of blade; three reasons for using volute springs are given; drawbacks which in part offset advantages are difficulties of manufacturing, tendency to tilt during deflection, and tedious calculations; curves presented help to overcome calculations.

Electric Measuring Instruments

J. W. Whittaker.
Instrument Hairspring Manufacture. Metropolitan Vickers-Gaz., v. 20, n. 345, July 1944, p. 324-8; see also Metal Treatment—Quarterly Autumn 1944, p. 193-8; Engineering, v. 158, n. 4105, Sept. 15, 1944, p. 217. Description of various processes involved in manufacture of hairsprings, used in small size instruments.

Failure

R. R. Tatnall.
Hydrogen Brittleness in Spring Steels. Wire and Wire Products, v. 19, n. 1, Jan. 1944, p. 51-2. Discussion of paper before Wire Assn., indexed in Engineering Index 1943, p. 1020, from issue of Oct. 1943.

G. H. Jackson.
Some Causes of Failure of Medium and High Duty Helical Compression Springs. Junior Instn. Engrs.— J v 55, pt I Oct. 1944, p. 9-19. Steel wire faults are divided into 6 categories and discussed as to causes and control.

Helical

G. Ashworth.
Approximate Calculations for Helical Springs of Round Section. Machy. (Lond.), v. 65, n. 1666, Sept. 14, 1944, p. 299-300. In preliminary spring design standard formulas and Wahl correction factor give rise to much trial and error work before satisfactory solution is reached; author presents formulas which will give immediate and close approximation to final design when ratio of diameter of spring rod to diameter of spring is within normal limits.

A. M. Wahl.
Design Considerations for Square or Rectangular Wire Helical Springs. Wire and Wire Products, v. 19, n. 12, Dec. 1944, p. 842-4, 866-8. Considerations involved in design of helical tension or compression springs made of square or rectangular wire are discussed, with particular reference to effect of curvature on stress and deflection; use of square or rectangular bar springs appears to be advantage where space limitations are of prime importance. Bibliography. Based on Chapter 12 of author's book "Mechanical Springs" published by Penton Publishing Co.

R. G. Minarik.
Engineering Data Sheet—Direct Method Facilitates Helical Spring Design. Machine Design, v. 16, n. 8, Aug. 1944, p. 145-8. It is frequently found that procedures, tables and charts for use in design of helical springs are inadequate for obtaining answers to many spring problems without much cut-and-try calculation; design procedure presented in this data sheet is effective and proved routine for rapid solution of such problems.

C. P. Nachod.
Engineering Data Sheet—Single Line Nomogram Aids Spring Design. Machine Design, v. 16, n. 1, Jan 1944, p. 149-51. In arriving at best proportions of helical spring for particular job, several preliminary approximations usually must be made; single line nomographic chart greatly facilitates such calculations and offers distinct advantages over other methods, particularly in speed with which results may be obtained.

Anonymous 328.
Helical Spring Calculations. Machy. (Lond.), v. 64, n. 1650, May 25, 1944, p. 567-73. Tables and worked examples presented.

Leaf

J. Geschelin.
Tuthill Important Producer of Leaf Springs. Automotive and Aviation Industries, v. 91, n. 4, Aug. 15, 1944, p. 28-9, 82. Description of equipment and operations at plant of Tuthill Spring Co., Chicago.

J. Ade.
Leaf Spring Production. Steel, v. 115, n. 13, Sept. 25, 1944, p. 80-1, 136, 138. Manufacture of leaf springs requires close control over heat treatment; forces designer to stay close to physical limits of material used; procedure followed by Standard Steel Spring Co. is described and illustrated.

Locomotive Springs and Suspension

J. Noethen.
Die Anpassung von Lokomotiven mit groesseren Federund Ausgleichhebel-systemen an windschiefes Gleis. Organ fuer die Fortschritte des Eisenbahnwesens, v. 97, n. 1, Jan. 1, 1942, p. 10-6. Adaptation of locomotive with large spring and equalizer beam systems to sloping track; values of springs are calculated for case where bearing consists of several springs of different degrees of hardness connected by means of equalizers with unequal arms.

Manufacture

R. G. Sartorius.
Cold Working and Forming of Si-Mn Spring Steel. Iron Age, v. 154, Dec. 14, 1944, p. 50-51. The full annealing without graphitization of Si-Mn spring steels has resulted in definite advantages in the cold working and forming of this grade of steel.

Anonymous 329.
Metallurgy of Spring Manufacture. Canadian Met. and Met. Ind., v. 7, July 1944, p. 43. Metals used; failures result from application of stresses beyond the limit of the springs' proper design; two methods of manufacture.

Military Vehicles

Anonymous 330.
Steel for Hardened and Tempered Coil Springs (for Guns and Fighting Armored Vehicles). British Standard Specification, BS /STA, 2, 1942.

Motor Bus Springs and Suspension

C. A. Martin.
Spring Costs Cut 300%. Bus Transportation, v. 23, n. 10, Oct. 1944, p. 50-1. Author Explains how he has been able to reduce spring cost from 3.33 to 0.8 mills per bus mile through adoption of "engineered spring" program.

Patents

Francis Buckingham.

Apparatus for the Fatigue Testing of Specimens such as Coil Springs. (To Baldwin Locomotive Works), U.S. 2,350,722, June 6, 1944. Various structural, mechanical, electrical, optical and operative details.

Wm. O. Bennet Jr.

Furnace for Heat Treating Watch Springs. (To Hamilton Watch Co.), U.S. 2,339,136, Jan. 11, 1944. Various details of a furnace with a fused silica vacuum chamber housing, and a spring container of material such as nickel, within the vacuum chamber.

Geo. M. Black.

Coating Metal Surfaces such as Ferrous Metal Springs. U.S. 2,326,120, Aug. 10, 1943. A composition is used, capable of adhering to a metal surface coated with a lubricant, and of producing a hard durable film where applied to such surfaces, and heated to 300-600°F. and containing 8-60% of a chromium soap and a solvent for such soap including a mixture of resin acids and higher fatty acids in sufficient proportion to dissolve the soap, the fatty acids being of the type present in, or derived from fats, vegetable oils or wood, and the composition being free from inflammable ingredients which are volatile at normal temperatures, and from ingredients which cause a film formed from the composition as described, to chip or crack when subjected to expansion, contraction or percussion.

Pivots

W. E. Young.

Investigation of Cross-Spring Pivot. Am. Soc. Mech. Engrs.— Trans. (J. Applied Mechanics), v. 11, n. 2, June 1944, p. A-113-120. Indexed in Engineering Index 1943, p. 809, from Am. Soc. Mech. Engrs.—Advance Paper, n. 33 for meeting Nov. 29-Dec. 3, 1943.

Reference Books

S. Gross and Ernst Lehr.

Die Federn, ihre Gestaltung und Berechnung. 136 pages, published by J. W. Edwards, Ann Arbor, Michigan.

A. M. Wahl.

Mechanical Springs. Penton Publishing Co., Cleveland, Ohio. 1944, 435 p., illus., diagrs., charts, tables, $6.00. Fundamental principles that underlie design of mechanical springs are presented, together with more important developments in spring theory and testing that have occured in recent years; special attention is given to helical springs, to calculation of their stresses and to their fatigue properties; other springs discussed include disk, flat, leaf, torsion, spiral, volute and ring springs, and rubber springs and mountings. Eng. Soc. Lib., N.Y.

Shot Blasting

H. H. Clark.
Shot Blasting. Steel, v. 114, n. 9, Feb. 28, 1944, p. 100, 102, 137. Methods and equipment employed by Eaton Mfg. Co., Detroit in shot blasting of springs as means to promote increased fatigue life; coil springs are conveyed through blast stream by conveyor chain carrying pins, which push springs axially as they rotate on 2 revolving pipes; controls to regulate degree of blasting are discussed.

Springs (General)

Anonymous 331.
Calibrating Springs. Electronic Industries, v. 2, n. 12, Dec. 1943, p. 99, 170, 172. Descriptive analysis of functions of electro-mechanical equipments for automatically checking and sorting components.

Anonymous 332.
Plant Suspension on Torsion Springs. Oil Engine, v. 12, n. 139, Nov. 1944, p. 174-5. Designs evolved and applied to many types of stationary and portable plantswithin recent years by Torbar Anti-vibration Suspension Co.

Spring Motors

Anonymous 333.
Spring Motors and Typical Associated Mechanisms. Diags., Prod. Eng., v. 15, June 1944, p. 384-385.

Steel

A. M. Borzdika.
Springs of Case-Hardened Mild Steel. Iron Age, v. 154, n. 4, July 27, 1944, p. 49-51; see also Engineer, v. 178, n. 4627, Sept. 15, 1944, p. 209-10; Mech. World, v. 116, n. 3011, Sept. 15, 1944, p. 285. Experiments conducted for substituting carburized mild steel for spring steel wire and strip; method consists of deep penetration carburization at low temperatures; use of fish scales proved to be soft carburizing agent of great power of penetration. From Stal., n. 1-2, p. 42-4.

Anonymous 334.
Special First Quality Hard-drawn Spring Wire. British Standard Specifications, BS/STA 1 (1942).

Anonymous 335.
High Quality Hard-drawn Spring Wire. British Standard Specifications, BS/STA 4, 1942.

Anonymous 336.
Standard Quality, Hard-drawn Spring Wire. British Standard Specifications, BS/STA 4 1942.

Subways

W. Zeller.
Beitraege zur Erschuetterungs- und Schalidaemmung bei der Eisenbahn. Organ fuer die Fortschritte des Eisenbahnwesens, v. 97, n. 4, Feb. 15, 1942, p. 53-9. Vibration and noise suppression on railways, particularly subways; vibration damping by supporting track on springs; conclusions based on measurements of vibrations on track and in vicinity; recommendation for spring supported track; calculation of springs; damping and adsorption of horizontal forces; noise suppression in subways. See also Engineering Index, 1930, p. 1475-6, under Railroad Tracks- Spring Supports.

Testing

W. H. Lee.
Engine Valve Springs Mech. World, v. 116, n. 3005, Aug. 4, 1944, p. 115-20. Surging of springs, harmonic analysis of cam lift cycle, and methods of detuning are discussed.

Ya. Abramson, A. Bibergal and R. Bragilerskaya.
X-Ray Investigation of the Quality of Heat Treatment of Steel Springs. Zavodskaya Lab., 9, 1280-1283 (1940), Chem. Zentr., 1942, II, 2412. The determination of internal stress in steel springs is discussed as a function of annealing condition, from the ratio of width and intensity of the X-Ray lines. The optimum working conditions for tempering motor valve springs of steel 65-G are 400°C for 5 minutes, used springs can be investigated by the same method, because the tensions of second order are independant of fatigue.

Torsion Bar

A. H. Allen.
84-inch Torsion Bars. Steel, v. 115, n. 3, July 17, 1944, p. 130, 186. Hardening, quenching and drawing of 3-in. steel torsion bars installed on new type of combat vehicle is accomplished with special heat treatment setup in Michigan plant, no scale or decarburization being permissible since, heat treating is carried out after machining and grinding.

Vibrations

W. A. Tuplin.
Vibration In Springs with Non-Linear Characteristics. Engineering, v. 158, n. 4100, 4101, Aug. 11, 1944, p. 103, Aug. 18, p. 124-5. Examination of suggestion that excessive stresses in vibrating system might be avoided by arranging it to have non-linear relation between load and deformation of its elastic element; conclusions given.

1945

Aeronautical Instruments

J. W. Rockefeller, Jr.
Manufacture of Air-Craft Instrument Springs. Wire and Wire Products, v. 20, n. 3, Mar. 1945, p. 189-91, 210. Details pertaining to manufacture of springs for aircraft instruments; thermally self-compensating springs; hysteresis and creep in instrument springs.

Automobile Springs and Suspension

Anonymous 337.
Kirkstall Heavy 4-Wheel Bogie Drive. Passenger Transport, J v 91, n. 2314, Nov. 10, 1944, p. 263-5; see also Transport World, v. 97, n. 3094, Jan. 11, 1945, p. 50. Description of truck built by Kirkstall Forge, Ltd., Leeds; specially designed for use on industrial and passenger vehicles operating big yearly mileages; Kirkstall patented suspension system comprises single spring on each side of truck, top leaves being extended to form additional anchorages for axles; all driving and braking reactions are taken through springs; maintenance simplified by reduction in number of wearing parts.

A. Blum.
Laminated Springs. Automobile Engr., v. 35, n. 469, Nov. 1945, p. 497-501. Summary of principles underlying private car systems of laminated springs.

R. N. Austen.
Maintenance Engineering of Chassis Leaf Springs. Soc. Automotive Engrs.,-J v 53, n. 10, Oct. 1945, (Trans.), p. 603-6. Author lists various places on spring where breakage is most likely to occur and reasons for each type of breakage; these types depend on where spring fails, and are listed as follows: at center bolt hole, just away from axle and outside of U-bolt anchorage, midway between axle and eye, at base of eye, and just throughout spring generally.

Anonymous 338.
"Torsilastic" Springing. Automobile Engr., v. 35, n. 465, Aug. 1945, p. 327-8. Illustrated description of rubber suspension system for passenger transport vehicles.

Anonymous 339.
Wartime Discoveries Stress Spring Maintenance. Can. Automotive Trade, v. 27, n. 8, Aug. 1945, p. 44-5, 96. Description of developments in construction of springs and practical solutions to care and servicing based on experience with use of military motor vehicles; maintenance tips concerning U-bolt nuts, rebound clips and spring eyes; correct use of lubricants on springs.

G. Zinser.
Wartime Care of Automobile Springs. Il., Consumers Res. Bull., v. 15, June 1945, p. 17-18.

Beryllium Copper Alloys

L. Sanderson.
Beryllium Copper. Aircraft Production, v. 7, n. 80, June 1945, p. 287-8. Survey of treatment and properties of useful spring materials; need for correct treatment; electric conductivity; drift; quenching; resistance to corrosion.

Car Springs and Suspension

Anonymous 340.
Car Springs Studied through Window in the Car Floor. Sci. Am. v. 173, July 1945, p. 34.

Design

Anonymous 341.
Manual on Design and Application of Helical and Spiral Springs for Ordnance, S.A.E. War Engineering Board, New York, N. Y., Feb. 1943, 37 p., price $1.00. Manual presents characteristics of available spring materials and design features peculiar to ordnance springs; consideration of energy, static vs. dynamic loading and temperature; buckling, diameter changes, flat spiral and torsion springs; spring materials and maximum design stresses; general spring tolerances; spring design formulas.

Anonymous 342.
Manual on Design and Manufacture of Volute Springs, Soc. Automotive Engrs., War Engineering Board, New York, N. Y., May 1945, 27 p., supp. 248 p.; diagrs., tables, charts. Manual proper is confined to concise description

of major features of volute spring, of manufacturing requirements, and of design considerations; supplementary volume is intended for those who wish to become more thoroughly acquainted with design and manufacturing problems and deals with design methods for springs of different characteristics, various research problems and laboratory tests, and with two specific manufacturing operations.

Electrical Contacts

L. B. Hunt and H. G. Taylor.
Electrical Contact Springs. Instn. Elec. Engrs.— J v 92, pt III (Radio and Communication Eng.), n. 17, Mar. 1945, p. 38-44; see also abstracts in Engineering, v. 159, n. 4145, June 22, 1945, p. 495-6; Wireless World, v. 51, n. 7, July 1945, p. 196. High thermal conductivity is necessary, together with low contact resistance and appreciable hardness; sometimes conditions can be met by use of plain spring in which contact is formed by spring material itself; in other cases it is necessary to employ special contact material, attached to body of spring; both classes of contact are dealt with.

Helical

J. Dick.
Tapered Helical Springs. Automobile Engr., v. 35, n. 459, Feb. 1945, p. 57-9. Mathematical analysis of longitudinal vibrations.

A. M. Wahl.
Utilizing Effects of Cold Setting in Springs. Machine Design, v. 17, n. 1, Jan. 1945, p. 107-12. Discussion of methods for estimating residual stresses set up in helical springs and determination of reduction in operating stress made possible by cold setting operation; analysis of actual springs shows that reduction of peak stresses may be substantial and indicates why high working stresses may be used in design. Bibliography.

A. M. Wahl.
Working Stresses for Helical Springs. Machine Design, v. 17, n. 7, July 1945, p. 129-34. Discussion of fundamentals underlying choice of working stresses in steel round-wire springs in cases where normal temperature and no corrosion are involved; reasons for wide variation in work stresses used in practical design; significance of various stresses calculated by methods in common use; illustrated examples of actual spring designs used in industrial and railway work. Bibliography.

C. P. Nachod.
Helical Steel Springs. Prod. Eng., v. 16, Dec. 1945, p. 892. Chart used in designing springs made from wire sizes ranging from 0.2 to 0.75 inches diameter.

N. B. Archer.
Deflections and Capacities of Helical-Round Bar Springs; Chart; Reference Book Sheet. Am. Mach., v. 89, Aug. 2, 1945, p. 137.

Instruments

P. MacGahan.
Instrument Springs Control Performance. Elec. Mfg., v. 34, n. 4, Oct. 1944, p. 99-102, 174, 176. Compared to springs in other mechanisms or even in watches, springs used in instruments may be very weak; their strength is measured in "mili-metergrams" of force required to produce certain angular deflection; measuring strength of springs; proper mounting of springs.

Laminated

Anonymous 343.
Manual on Design and Application of Leaf Springs, S.A.E. War Engineering Board, New York, N.Y., Nov. 1944, 89 p., price $1.00. Manual written as guide for designer of leaf spring installations contains information which will enable him to calculate space required for leaf spring, to provide suitable attachments, and to determine elastic and geometric properties of assembly; detail design of spring itself also is described.

Military Vehicles

J. E. Canning.
Faster Combat Vehicles. Army Ordnance, v. 29, n. 151, July-Aug. 1945, p. 94-5. Illustrated description of new torsion-bar suspension and its advantages.

C. O. Herb.
Making Torsion-Bar Springs. Machy. (N.Y.), v. 51, n. 12, Aug. 1945, p. 141-9. Description of machining operations and machinery involved in manufacture of torsion bar springs, for Hellcat tank destroyers, at Spencer Mfg. Co., Spencer, Ohio.

Anonymous 344.
Torsion Bar Suspension Developed by Buick, is Major Feature of Famous Hellcat. Steel Processing, v. 31, n. 7, July 1945, p. 430-3; see also Product Eng., v. 16, n. 6, June 1945, p. 390-2. Description of operation and effectiveness of torsion bar suspension system, installed on Buick

M 18 Hellcat; complete sequence of operations in manufacture of torsion bars given.

J. Geschelin.
Torsion Bar Suspension Systems. Automotive and Aviation Industries, v. 93, n. 4, Aug. 15, 1945, p. 30-2, 80, 82. Description of steel torsion bar developed by Buick, and Torsilastic system by Goodrich; torsion taken through rubber instead of steel member.

Anonymous 345.
Design of Torsion Rod Springs used in M-18 Tank Destroyer. Prod. Eng., v. 16, June 1945, p. 390-392. Design of a torsion rod spring discussed as to its application, stress range, creep, and fatigue life. Points out many steps in manufacture which are critical, to obtain a satisfactory design. Methods used in cold working and shot peening described.

Motor Bus Springs and Suspension

Anonymous 346.
High Speed Spring Change: Harmony Short Lines Develops Replacement System. Il., diags. Bus Trans., v. 24, March 1945, p. 62-63.

Anonymous 347.
No Sprain, No Pain; Spring Rack; Eastern Massachusetts Street Railway Co., il. Bus Trans., v. 24, Sept. 1945, p. 101.

H. P. Smith and S. Greymont.
Thrust Plates for Gravity Spring; Solution to a Critical Maintenance Problem; Milwaukee Railway and Transport Co. Il., diags. Bus Trans., v. 24, July 1945, p. 58-59.

Anonymous 348.
Torsilastic Springing; Rubber Suspension System for Passenger Transport Vehicles. Il., Automobile Eng., v. 35, Aug. 1945, p. 327-328.

Motor Cycle Springs and Suspension

P. E. Irving.
Rear Suspension of Motor-Cycles. Instn. Automobile Engrs.,—J v 13, n. 6, Mar. 1945, p. 115-28. Desirability of springing rear wheel as well as front wheel; it is concluded that development of new or existing designs of spring frame would be greatly facilitated if there were available a bump rig, with provision for simulating effects of road conditions, cornering forces and winds, and also motion picture cameras for obtaining pictorial records which could be run off in slow motion; this would be greatly superior to relying solely upon road tests.

Nickel Alloys

W. J. Kroll.

Heat-Treatable Nickel Alloys. Metals and Alloys, v. 20, n. 6, Dec. 1944, p. 1604-6. Report on development work in use of heat-treatable alloys for springs and similar applications; preparation and properties of alloys; heat treatment and structure; causes of age hardening; magnesium carbon monel metal nickel can be age hardened to considerable extent by simultaneous additions of carbon and magnesium; no substitute for either magnesium or carbon could be found; hardness values as function of carbon and magnesium contents. Bibliography.

Patents

Donald K. Crampton and Henry C. Burghoff.

A Copper base Alloy Spring. (To Chase Brass and Copper Co.), U. S. 2,375,285, May 8, 1945. An age-hardening Cu alloy characterized by high endurance limit, high resistance to creep, relaxation, stress corrosion, cracking and to softening by heat, contains Ni 0.7-1.7, P 0.11-0.36, Cd 0.5-0.8 and Cu 88% minimum. Ni and P are the main age-hardening elements. Cold working up to 98% can be superimposed on age-hardening to produce spring materials having a miximum endurance limit of 40,000 psi. Maximum for Al, Cr and Si are 0.1%, for Zn 10%.

Pivots

V. V. Sokolovsky.

Uravneniya Plasticheskovo Ravnovesiya Pri Ploskom Napryazhennom Sostoyaniyi. Prikladnaya Matematika in Mekhanika (Applied Mathematics and Mechanics), v. 9, n. 1, 1945, p. 111-28. Equations of plastic equilibrium in plane stressed state; method for solving problems of plastic equilibrium analagous to that used in theory of plastic deformed state or in theory of loose media. (In Russian with brief English abstract.)

Reference Books

Anonymous 349.

Copper and Copper Alloy Springs. Copper Development Association, (C.D.A.) Publication n. 39, Demy 8 Vo, 61 pages, 21 illustrations, 1944. London; The Association, Grand Buildings, Trafalgar Square, W.C.2. (Gratis).

Rubber

M. W. Bourdon.

Rubber-To-Metal. Bus and Coach, v. 17, n. 198, June 1945, p. 204-10. Illustrated descriptions of applications of rubber in place of, or supplementing bearings and mountings in motor vehicle design and construction; discussion of rubber-to-metal bonding process; anti-vibration properties and factors limiting application.

C. W. Kosten.
Calculation of Rubber Spring Element. Diag., Prod. Eng., v. 16, Nov. 1945, p. 777-780.

Scales

Schlee.
Feder-Waagen und hydraulische Waagen. Archiv fuer Technisches Messen, n. 125, Nov. 1941, p. 1148-9, (4 p.) (J131-9). Illustrated description of various types of spring and hydraulic scales. Bibliography.

Seismographs

G. Grenet.
L'influence de ressort de suspension sur le fonctionnement des seismographes verticaux. Académie des Sciences—Comptes Rendus, v. 213, n. 6, Aug. 11, 1941, p. 246-8. Influence of suspension spring on operation of vertical seismographs; theoretical mathematical study.

Shot Peening

O. J. Horger.
Mechanical and Metallurgical Advantages of Shot Peening. Iron Age, v. 155, n. 13, 14, Mar. 29, 1945, p. 40-9, 100, Apr. 5, p. 66-76, 146, 148-9; see also Iron and Coal Trades Rev., v. 151, n. 4040, Aug. 3, 1945, p. 171. Engineering appraisal of technical and economic utility of compressing surface layers of design members as means of greatly improving their fatigue resistance. Mar. 29: History; treatment of coil and leaf springs; sandblasting effect on fatigue; tempering after peening; peening of torsion springs and drive shafts. Apr. 5: Control of shot peening, treatment of light alloys; shot size and time; liquid blast; etc.

Anonymous 350.
Shot-Blasting or Shot-Peening Springs, and the Effect on Fatigue Life. Mainspring, n. 11, Aug. 1945, p. 1-6. Shot-peening markedly increases the fatigue life of metal parts. It is a surface phenomenon which can be removed by heating. Use of alloy steel from a fatigue point of view is not necessary in fabricating many parts. Properly applied, it should save weight by allowing the use of higher stresses. Perfectly smooth surface is not necessarily the best surface to resist fatigue. Fatigue testing is the best way to evaluate shot-peening.

Springs (General)

M. H. Sabine.
Springs of Variable Rate. Mech. World, v. 118, n. 3063, 3064, 3065, Sept. 14, 1945, p. 285-90, Sept. 21, p. 332-7, Sept. 28, p. 361-6. Sept. 14: Examination of characteristics of springs of various shapes and methods of calculation. Sept. 21: Loads and stresses encountered in conical and diamond shaped springs and effect of variable coil spacing. Sept. 28: Characteristics of barrel, hour glass, and conical spiral types. From author's forthcoming book on springs.

Anonymous 351.
You Must Know Your Materials When Designing Springs. Elec. Mfg., v. 35, n. 5, May 1945, p. 120-2, 204, 206, 208, 210, 212. Elasticity, ultimate strength, resistance to corrosion and ability to withstand elevated temperatures, all vary greatly in available spring materials; oil tempered carbon steel; hard drawn carbon steel; hot rolled steel; flat spring materials; clock spring steel; non-ferrous materials.

Steel

R. G. Sartorius.
Cold Working and Forming of Silicon-Manganese Spring Steel. Iron Age, v. 154, n. 24, Dec. 14, 1944, p. 50-1. Experience of National Lock Washer Co. with silicon manganese steel for spring washers for industrial and railway use; full annealing without graphitization of silicon manganese spring steels has resulted in definite advantages in cold working and forming of this grade of steel.

Stresses

N. C. Talmadge.
Elastic Properties of Steel Wire Intended for Springs and Formed Parts. Wire and Wire Prod., v. 20, Nov. 1945, p. 859-861, 884. Results of tests indicate that cold drawn wire with a yield point between 55 and 75% of its tensile strength could be formed or coiled into springs or other parts uniform in shape and size. Wire with higher yield strengths, from 80-90% of their tensiles, resulted in non-uniform products or required frequent adjustment of the forming tools in order to maintain possible uniformity of the product.

Testing

Anonymous 352.
Adjustable-Range Force-Measuring Spring. Iron Age, v. 156, n. 12, Sept. 20, 1945, p. 63, 163; see also Steel, v.117, n. 25, Dec. 17, 1945, p. 102,

148. Construction details and operating principles of new type force measuring beam explained; beam provides comparable defections under widely divergent load ranges and secures same degree of accuracy in measuring stress involved in dissimilar materials such as steel, copper porcelain and plastics.

Anonymous 353.
Gun-Spring Tester. Can. Machy., v. 56, n. 8, Aug. 1945, p. 81. Design details and features of testing machine developed for measuring pressure strength of springs for recoil mechanisms of military ordnance; load is applied by platen, and platen movement is effected by motor driven gear and hydraulic mechanism.

A. C. Vivian, Harold G. Williams.
The "Set-Test" Elastic Limit. Metallurgia, 1945, 32, 1(90); (152). Willaims describes the "set-test" method using the electron micrometer for evaluating the material and heat treatments for beryllium-copper precision springs, and states that, no matter how low the stress, there is some set, although for very low stresses it may be beyond the sensitivity of the measuring instrument. For such stresses tests are carried out at a load below the "set-test" elastic limit and a logarithm drift or room temperature creep curve is obtained over a period of 100 hours. The rate of drift obtained is used to evaluate the stability of the spring material in relation to the retention of calibration in instruments, as when springs are deflected within the usual elastic limits there are three elements in the subsequent strain; an elastic deflection, a permanent set not recoverable, and a drift or creep with time under load that is recoverable.

Vibrations

R. G. Manley.
Response of Elastically-Mounted Bodies to Rapid Accelerations. Engineering, v. 159, n. 4137, Apr. 27, 1945, p. 321-3. General method of analysis of behavior of elastically mounted bodies, such as delicate instruments, when supporting structure is subjected for very short periods to rapid accelerations; design problem involved is determination of optimum characteristics for mounting, in order that accelerations of mounted mass may be restricted to small fraction of imposed accelerations.

M. F. Spotts.
Isolation of Combined Torsional and Translational Vibrations. Product Eng., v. 16, n. 11, Nov. 1945, p. 790-4. Derivation of equations for determining frequency of free vibration for combined torsion and translation for each of three coordinate planes of machine supported at four corners by springs; curves are given that eliminate considerable work in calculating correct spring constants for system.

1946

Aluminum

A. Gelb.
Aluminum Spring May Be Answer! Machine Design, v. 18, n. 5, May 1946, p. 137-40, 178. Evaluation of suitability of one of new war developed high strength aluminum alloys for spring applications, including experimental data to aid designer in determining its applicability; alloy considered is zinc magnesium type known as R303; characteristics are summarized in tables and charts.

Automobile Springs and Suspension

A. S. Krotz.
Design of Rubber Torsion Springs for Passenger Cars. Automotive and Aviation Industries, v. 94, n. 8, Apr. 15, 1946, p. 24-7, 69-70. Characteristics and operating principles of torsilastic spring explained; various designs for application considered with emphasis on rubber life and protection, chassis limitations, functions of rubber thickness and spring rate, resistance to tilting and to axial displacement, spring shaft design, and mounting.

R. Schilling.
Flexible or Spring Medium of Suspensions. Soc. Automotive Engrs.,— J v. 54, n. 7, July 1946, (Trans.), p. 366-72 (discussion) 372-4; see also Automobile Engr., v. 36, n. 479, Sept. 1946, p. 396-400. Problems of suspension spring design that have been of major interest in recent years, such as spring life and reliability, hardness and settling, fatigue, shot peening, and presetting, are presented; various types of springs are discussed and it is concluded that no one type is superior in all respects, hence commercial applications of different types have remained competitive.

Anonymous 354.
Hot-Coiling Automotive Suspension Springs. Machy. (N.Y.), v. 53, n. 3, Nov. 1946, p. 190-4. Forging, hot coiling, heat treating, shot peening and enameling methods employed by Eaton Mfg. Co., Detroit, in production of springs made from SAE 9260 bar stock.

J. E. Hale.
Rubber Springs. Automotive and Aviation Industries, v. 95, n. 8, Oct. 15, 1946, p. 18-23, 44. Elastic deformation and recovery properties of rubber properly designed and engineered to function as elastic element in providing proper functional characteristics such as load deflection,

periodicity, and rate, applied specifically to automotive suspension; basic forms of elastic element illustrated; detailed examples of various European automotive applications.

A. S. Krotz and W. B. Fageol, Jr.
Torsion Rubber Spring Design with Automotive Applications. Product Eng., v. 17, n. 7, July 1946, p. 112-6. Fundamentals of spring design and relation of spring medium to specialized problems of applying spring to chassis; flexibility of Torsilastic rubber spring, its advantages and analytical and graphical methods of design; discussion deals specifically with design of spring for use in buses and automobiles.

A. Blum.
Laminated Springs; Private Car Systems. Diags., Auto. Eng., v. 35, Nov. 1945, p. 497-501.

Anonymous 355.
1946 Passenger Cars, Springs and Shock Absorbers; Specifications Tabulated. Auto. and Aviation Ind., v. 94, March 15, 1946, p. 111.

Anonymous 356.
Hot-Coiling Automotive Suspension Springs; Eaton Manufacturing Co., Il., Machy., v. 53, Nov. 1946, p. 190-194.

Beryllium Copper Alloys

R. W. Carson.
Designing with Beryllium Copper for Spring Components. Elec. Mfg., v. 37, n. 2, Feb. 1946, p. 129-31, 216. Stress relief hardening thechnique for beryllium copper offers important cost reduction opportunity in making variety of useful forms in production quantities; special advantages of stress relief hardening or microprocessing; plating, brazing and soldering.

H. G. Williams.
Heat Treating Beryllium Copper for Peak Performance. Bibliog. Il., Iron Age, v. 156, Dec. 6, 1945, p. 58-64.

Car Springs and Suspension

H. C. Keysor.
Carbon and Alloy Steel Materials for Hot-Formed Springs. Product Eng., v. 17, n. 11, Nov. 1946, p. 86-9. Physical and chemical properties of various steels used in fabrication of hot coiled springs for railway car suspension; proper methods of heat treatment; importance of presetting, effects of surface conditions of hot coiled springs, and conditions of service under which alloy steel is superior to plain carbon steel.

Anonymous 357.
Air Springs Proposed for Railroad Cars. Il., Comp. Air Mag., v. 51, Oct. 1946, p. 278.

Anonymous 358.
Long-Travel Springs on Great Northern Box Cars. Il., Rail. Mech. Eng., v. 120, April 1946, p. 192.

Anonymous 359.
Passenger-Car Air Springs Tested. Il., Rail. Age, v. 121, Aug. 3, 1946, p. 183.

Anonymous 360.
Spring-Rigging Design and Maintenance; Locomotive Maintenance Officers Assn. Report. Diags., Rail. Mech. Eng., v. 120, Oct. 1946, p. 533-38.

Copper and Copper Alloys

Anonymous 361.
Copper and Copper Alloy Springs. Wire and Wire Products, v. 21, n. 4, 5, 6, 7, Apr. 1945, p. 299-306, 326-7, May p. 382-6, 395-400, June, p. 456-60, 476-7, July, p. 527, 530, 532-3, 559. Use of copper alloys for spring making; details pertaining to design and manufacture of springs, characteristics of spring materials, and behavior of springs; mechanical and physical properties; fatigue; maximum operating temperature; corrosion resistance; behavior of springs discussed. Bibliography. From Copper Development Assn., Publ. n. 39.

Design

F. Hymans.
Flat Spring with Large Deflections. Am. Soc. Mech. Engrs.— Trans., (J Applied Mechanics) v. 13, n. 3, Sept. 1946, p. A223-A230. Analysis of flat spring initially curved and inserted in apparatus of which it is element in buckled condition; unstressed spring is shaped in arc of circle, and it is shown that problem may be reduced to initially straight bar by adding to impressed force, couple, which acting alone, produces initial curved shape; possible shapes of buckled spring and forces associated with them.

L. Richter.
Uueber zylindrische Schraubenfedern und Federsaetze, VDI Zeit, v. 88, n. 31/32 Aug. 5, 1944, p. 415-20. Cylindrical springs; with aid of precise fundamental equations for spring forces and natural vibrations and based on properties of material employed, main dimensions and weights of separate spiral springs and whole spring aggregates, with circular and

rectangular cross section of wires, are calculated and compared; it is shown that circular cross section is in many ways superior to rectangular.

M. A. Sadowsky.
Non-Linear Springs. Frank. Inst. Jour., v. 240, Dec. 1945, p. 469-476.

K. Walz.
Plate Springs. Diags., Prod. Eng., v. 17, Oct. 1946, p. 114-117.

Disk

K. Walz.
Die Tellerfeder. VDI-Zeit, v. 88, n. 47/48, Nov. 25, 1944, p. 643-6; see also English abstract in Engrs.' Digest (Brit. Edition), v. 7, n. 4, Apr. 1946, p. 113-4; Engrs' Digest (Am. Edition), v. 3, n. 4, Apr. 1946, p. 181-2. Most important principles for design and manufacture of disk springs are discussed; disk springs are claimed to show definite advantages even under alternating and repeated stresses; recommendations for selection of material and finish.

G. Ashworth.
Disk Spring or Belleville Washer. Instn. Mech. Engrs.—Proc., v. 155, 1946 (War Emergency Issue, n. 16), p. 93-100. Spring comprising circular conical disk of constant thickness, with concentric hole and under central loading, is analyzed as to theory and design; load deflection curves; stress distribution relationships; design of nests of disk springs; data facilitating rapid design. Bibliography.

Electrical Contact

Anonymous 362.
Electrical Contact Spring. Instn. Elec. Engrs.— J v. 93, n. 24, pt. III (Radio and Communication Eng.) July 1946, p. 242. Précis of discussion at Radio Section meeting May 22, 1945.

Electric Equipment

A. L. Clark.
Copper-Base Alloys for Special Electrical Applications. Elec. Mfg. v. 37, n. 3, Mar. 1946, p. 112-4, 228. Phosphor, aluminum and silicon bronzes, have properties peculiarly fitting them for specification in contact springs, other current carrying and corrosion and fatigue resisting applications; tabular data on copper alloys suitable for springs; properties of phosphor and aluminum bronze.

Failure

C. T. Eakin and H. W. Lownie, Jr.
Reducing Embrittlement In Electroplating. Iron Age, v. 158, n. 21, Nov. 21, 1946, p. 69-72. Outline of procedure for minimizing embrittlement during plating operations, and for removal by heat treatment following plating; procedures substantiated by production applications concerning relief of embrittlement in electroplated steel springs, caused by hydrogen released from electrolyte; non-acid method for deplating also presented. Bibliography.

R. W. Parsons.
Failure of Spring Loops by Stress-Corrosion. Met. Prog., v. 48, Dec. 1945, p. 1310.

Heat Treatment

H. H. Schneider.
Salt Baths in Wire Industry. Wire and Wire Products, v. 21, n. 8, Aug. 1946, p. 593-6, 615-20, 635. Study of salt bath heat treating for wire and wire products; furnace equipment; salts used and some of their properties; descaling with molten salt baths; double salt patenting of process spring wire; spring rod patenting and descaling; subcritical annealing and descaling; annealing stainless steels and nonferrous alloys; bolt rods.

Helical

H. F. Ross.
Application of Tables for Helical Compression and Extention Spring Design. Am. Soc. Mech. Engrs.—Advance Paper, n. 46-SA-27 for meeting June 17-20 1946, 10 p, supp. sheets. Tables presented eliminate tedious calculations, and offer visual comparison for arriving at optimum design; include all standard steel wire gages between .025 and .394 in., music wire gages between .010 and .118 in., and most even fractions; use of tables and examples of spring designs. Bibliography.

J. Dick.
Helical Springs. Automobile Engr., v. 36, n. 477, July 1946, p. 284. Theoretical mathematical consideration of buckling under static loads.

E. I. Shobert.
Maximum Performance of Helical Springs. Am. Soc. mech. Engrs.— Advance Paper, n. 46—A-6 for meeting Dec. 2-6, 1946, 2 p. Report of method for determining way spring material influences volume of space required for helical spring of type used in connection with carbon brush in small

electric motors or generators; equation is developed indicating proportionality of spring volume in terms of torsional modulus of elasticity and maximum stress limit of spring material.

C. P. Nachod.
Nomogram Facilitates Helical Spring Design. Machine Design, v. 18, n. 2, Feb. 1946, p. 149-50. Formulas, examples, and nomogram chart given for determining relations between load, deflection, stress, and wire diameter of helical steel springs.

H. H. Clark.
Stranded Wire Helical Springs for Machine Guns. Product Eng., v. 17, n. 7, July 1946, p. 154-8. Comparison of spring characteristics and life expectancy with corresponding properties of conventional helical springs; effect of number of strands on spring design, deflection, damping and resonance; methods of testing, interpretation of test data and observations during manufacture of satisfactory springs are considered.

Laminated

W. F. Whiteman.
Shortcuts in Spring Manufacture. Steel, v. 119, n. 22, Nov. 25, 1946, p. 72-4. Manufacturing techniques, practice and equipment at plant of W and H Rowland, Inc., Philadelphia; step by step operations, with particular reference to improved shearing, heat treating, and simultaneous quenching and cambering in semi-automatic furnaces and machines which have increased plant's output 15%.

Liquid

Anonymous 363.
Liquid Spring. Engineer, v. 181, n. 4699, Feb. 1, 1946, p. 101; see also Automobile Engr., v. 36, n. 427, Feb. 1946, p. 79-80; Aircraft Production, v. 8, n. 89, Mar. 1946, p. 148; Flight, v. 49, n. 1935, Jan 24, 1946, p. 95; Aeroplane, v. 70, n. 1809, Jan. 25, 1946, p. 104; Engrs' Digest, v. 3, n. 3, Mar. 1946, p. 154; Indus. Power and Mass. Production, v. 22, n. 2, Feb. 1946, p. 61-3; Mech. Handling, v. 33, n. 3, Mar. 1946, p. 156-8; Passenger Transport, J v 94, n. 2379, Feb. 8, 1946, p. 94-8; Bus and Coach, v. 18, n. 206, Feb. 1946, p. 55-6. Illustrated description of new method of suspension, developed during war by Dowty Equipment Ltd., based upon compressibility of liquids; it has been used on large numbers of aircraft for past few years; it comprises pressure sealed cylinder of high tensile steel, filled with oil and has one end formed as suspension link; spring made possible by development of efficient high pressure sealing gland.

Machinery Mounting

J. N. Macduff.
Isolation of Vibration In Spring Mounted Apparatus. Product Eng., v. 17, n. 7, 8, July 1946, p. 106-9, 159, 161, 163, Aug. p. 154-6. Simple classical theory of vibration reviewed for system having one degree of freedom with no damping; energy equations derived; procedure described for calculating linear and angular displacements, natural frequencies, and rocking and torsional modes of apparatus supported symmetrically on bottom mounts; exact and approximate equations derived for spring mounts.

Manufacture

Anonymous 364.
Spring Forming Attachment for Lathes. Il., Oil and Gas Jour., v. 44, April 27, 1946, p. 143-144.

L. Kasper.
Die for Forming Irregular-Shaped Spring. Diags., Machy., v. 52, Jan. 1946, p. 185-186.

Mechanisms

D. B. Nichinson.
Torsional Oscillating Motion with Self-Synchronized Impulse. Product Eng., v. 17, n.8, Aug. 1946, p. 110-2. Details of spring torsional oscillating system for airborne radar scanner; machine maintains oscillation at specified frequency and variable amplitude in resonant system; principles and method discussed can be applied advantageously to obtain smooth rapid oscillation with minimum of power and power transmitting parts.

Military Vehicles

Anonymous 365.
Signal Corps Trailer Chassis has Torsion Bar Suspension. Il., diag. Prod. Eng., v. 17, Sept. 1946, p. 142.

Motor Bus Springs and Suspension

Anonymous 366.
Duo-Flex Spring. Bus Transportation, v. 25, n. 4, Apr. 1946, p. 66-9. Illustrated description of new ACF-Brill Duo-Flex leaf spring suspension with considerable information on steps leading to its development and adoption; advantages and performance details evaluated.

Motor Truck Springs and Suspension

Anonymous 367.
Light Weight Suspension for Tandem Axles on Trailers; Developed by Feather Ride Corp., il. Mach. Design, v. 18, July 1946, p. 106-107.

Anonymous 368.
New Spring Developed for Fruehauf Trailer Line. Il., Auto and Aviation Ind., v. 95, July 1, 1946, p. 48.

Anonymous 369.
Torsion Bar Suspension System of Fruehauf Tandem Axle Trailers. Il., diags. Auto and Aviation Ind., v. 94, Jan. 15, 1946, p. 22-23.

Non-Ferrous Alloys

F. P. Zimmerli.
Nonferrous Alloy Materials for Mechanical Springs. Product Eng., v. 17, n. 12, Dec. 1946, p. 85-7. Physical and chemical properties of commonly used nonferrous alloy spring materials; phosphor bronze; brass; beryllium copper; silicon bronze; nickel silver; nickel alloys; proper application and limitations of materials under conditions requiring electrical conductivity, corrosion resistance or resistance to loss of load at elevated temperatures are discussed.

Patents

Franz R. Hensel, Earl I. Larsen and Alfred M. Suggs.
Annealing of Electroplated Springs to prevent Drift. (To P. R. Mallory and Co.) U.S. 2,406,683, Aug. 27, 1946. The electroplating process sets up stresses in springs which cause excessive drifts. An annealing treatment, for most metals at a temperature of 200-300°C, removes these stresses. In the case of cold worked metals, the annealing temp. should be kept below the recrystallization temp. In the case of steels the annealing temp. should be below the drawing temp.

Rubber

A. S. Krotz.
How to Design Rubber Torsion Springs. Machine Design, v. 18, n. 9, Sept. 1946, p. 147-9, 182. Description of Torsilastic or torsion type spring having inner shaft surrounded by annular layer of rubber bonded to it and to metal shell around outside; discussion covers applications of rubber torsion springs and their torque and stress characteristics; calculations and analysis involved in spring design are indicated.

J. F. Downie Smith.
Rubber Springs—Shear Loading—II. Am. Soc. Mech. Engrs.— Advance Paper n. 46-AA-20 for meeting June 17-20, 1946, 12 p. Theoretical stress-strain relationships for rubber of various shapes loaded in shear; analysis covers shear slab, double shear sandwich, cylindrical disk sandwich, coaxial tube, and coaxial torsion bushing. Continued from article indexed in Engineering Index 1939, p. 1105 from Am. Soc. Mech. Engrs.— Trans. (J Applied Mechanics) Dec. 1939.

A. S. Krotz.
Torsilastic Rubber Springing; Abstract. Mech. Eng., v. 68, May 1946, p. 468-469.

Shot Peening

L. J. Wieschhaus.
Shot Peening and its Importance in Spring Industry. Wire and Wire Products, v. 21, n. 9, Sept. 1946, p. 665-7, 701-3. Advantages of shot peening in increasing life of springs; various types of Wheelabrator installations for shot peening work are illustrated; types of equipment recommended for shot peening coil and leaf springs.

Springs (General)

R. D. Mindlin.
Dynamics of Package Cushioning. Bell Sys. Tech. Jour., v. 24, July 1945 il. diags. p. 353-461.

Anonymous 370.
Home Made Stretcher reclaims $1.80 valve Springs for Further Use. Diag. Petro. Process, v. 1, Oct. 1946, p. 100.

Anonymous 371.
Standard Springs for Pipe Hangers; Table; Data Sheet. Power, v. 19, May 1946, p. 343.

Anonymous 372.
Standarized Bouncing-Pin Contact Springs Speed Adjustments for Knock-Test Engine. Nat. Pet. News, 38 pt. v. 2, April 3, 1946, p. R257.

Steel

F. P. Zimmerli.
Carbon and Alloy Steel Materials For Cold-Formed Springs. Product Eng., v. 17, n. 10, Oct. 1946, p. 119-22. Properties of types of steel commonly used for manufacture of cold formed springs; special emphasis on

proper choice of material to meet various service conditions such as impact loading, elevated temperatures or corrosive atmospheres.

A. Oreffice.
Scratches on Spring Wire. Met. Prog., v. 50, Aug. 1946, p. 309.

N. C. Talmadge.
Elastic Properties of Steel Wire Intended for Springs and Formed Parts. Wire and Wire Products, v. 20, n. 11, Nov. 1945, p. 859-61, 884, (discussion) v. 21, n, 1, Jan. 1946, p. 49-51, 94. For several years, author's company has kept records of physical properties of hard drawn wire, both X1055 and music wire, that did not behave as expected when formed or coiled, in attempt to determine ideal physicals resulting in uniform product with expenditure of least amount of labor, tool adjustment and inspection; result of tests. Before Wire Assn.

Stresses

F. Baldauff.
Spiralfedern unter radialer Last. Schweiz Bauzeitung, v. 127, n. 2, Jan. 12, 1946, p. 17-20. Spiral springs subjected to radial loads; computation of deformation and stresses compared with results of tests; application to practical examples; illustrations.

W. C. Troy.
Utilizing Residual Forming Stresses in Flat Steel Springs. Machy. (N.Y.) v. 52, n. 10, June 1946, p. 152-7. Effect of residual stresses induced by forming operations on flat spring design is explained; formation of residual bending stresses and their marked effect on spring performance discussed; actual case of pressure spring bend forming reviewed in detail, illustrating significance of stresses set up, in respect to spring performance; combinations of applied and residual stresses, and their utilization to improve spring strength.

H. Carlson.
Spring Material; Moduli of Elasticity and Allowable Stresses; Eng. File Facts. Mat. and Methods, v. 23, Jan. 1946, p. 185.

Torsion Bar

Anonymous 373.
The Production of Torsion Bar Springs. Machy., (Lond.) v. 67, Dec. 27, 1945, p. 721-727. Torsion Bars are 73 inches long and in 2 diameters along the body, 1.900 in. and 1.690 in. These diameters must be held within +0.022 in. minus 0.003 in. At the ends, the diameter is increased to 2.5 in. on both sizes. The weight of the finished larger size is 65 lbs. Out of approximately 35,000 torsion bar springs only one has failed during

fatigue tests in which loads from 30,000 to 140,000 psi are applied for 80,000 cycles.

Trailer Springs and Suspension

Anonymous 374.
Torsion Bar Suspension System. Automotive and Aviation Industries, v. 94, n. 2, Jan. 15, 1946, p. 22-3, 48. Installation, operation and constructional details of newly developed torsion bar system adopted by Fruehalf Trailer Co., as standard equipment for their tandem axle units.

1947

Automobile Springs and Suspension

M. Fahnestock.
Broad-Beam Springs with Fewer and Wider Leaves. Automotive Industries, v. 97, n. 10, Nov. 15, 1947, p. 36, 64. Report on trend toward use of fewer and wider spring leaves for passenger car springs; application based on idea of reducing interleaf friction and making springs more quickly responsive to slight road irregularities; advantages set forth.

A. M. Wolf.
Experimental Suspension System. Automotive Industries, v. 97, n. 2, July 15, 1947, p. 42-3, 84. System, developed by Opel in Germany, has individual front wheel suspension, while rear suspension consists of coil spring at each side, transferring its load to radius rod, improving riding qualities, roadability, and steering of current designs through elimination of undesirable torsional moments on car and its roll center. Extract from Report 412, "Passenger Car and Truck Chassis," Field information Agency, Technical.

Anonymous 375.
New Wheel Suspension Design. Automotive and Aviation Industries, v. 96, n. 8, Apr. 15, 1947, p. 43. Details of novel arrangement of torsion bars, hydraulic dampers, and independent wheel suspension for both front and rear wheels, incorporated in 1947 model of British Invicta passenger car; front and rear suspension design illustrated.

Beryllium Copper Alloys

R. W. Carson.
Stress-Relief-Hardening of Beryllium Copper. Mech. Eng., v. 69, n. 8, Aug. 1947, p. 651-4. Unusual characteristics of beryllium copper as material for design of electrical and other products; properties in which beryllium copper excels; fixture hardening process for stress relief;

how beryllium copper made snap action switches possible; merits of beryllium copper mandrel-coiled springs for automatic control elements.

Bucket Elevators

H. H. Wight.
Take-Up for Chain and Bucket Elevator. Commonwealth Engr., v. 34, n. 6, Jan. 1, 1947, p. 219-21. Design, installation and operating features of automatic spring device which overcomes slackness due to expansion of elevator chain when heated; spring take-up is arranged on head drum shaft and holds head drum bearings in two frames that oscillate on four guide rods set parallel to casing; tension in elevator chain maintained by use of compressed helical spring on each side beneath each frame.

Car Springs and Suspension

Anonymous 376.
Springs Carry The Load. Mod. Mach. Shop, v. 20, Oct. 1947, p. 198-199. Production of springs for railroad rolling stock by Crucible Steel Co. of America.

Anonymous 377.
Franklin Frame-Guided Spring Saddle. Il., Ry. Mech. Eng., v. 121, March 1947, p. 146; Ry. Age, v. 122, April 5, 1947, p. 698.

Clocks and Watches

Anonymous 378.
New Strong. Non-magnetic Spring Material has High Corrosion Resistance. Matls. and Methods, v. 25, n. 4, Apr. 1947, p. 94-5. Watch spring and other application data concerning cobalt chromium nickel iron alloy, called Elgiloy, announced by Elgin National Watch Co.; it is relatively hard, highly resistant to corrosion, non-setting, and otherwise superior to high quality carbon steel spring materials.

Anonymous 379.
Alloy to Watch; Elgin's Development is Non-Magnetic, Resists Corrosion. Business Week, March 15, 1947, p. 59-60.

C. B. Clason.
Bench-Welded Watch Springs. Weld. Eng., v. 32, June 1947, p. 40-42. Use of spot welding in assembly of Elgin's "Elgiloy" mainsprings. Spot welded joints were found to be twice as strong as riveted ones.

Design

C. A. ~~Tea~~.
Convolute Flat Springs. Machine Design, v. 18, n. 12, Dec. 1946, p. 109-13. Analysis of design of convolute units comprising light weight low cost assemblies having uniform strength characteristics; how uniform strength beam principle is applied to strip of flat steel bent into zigzag shape to form highly efficient elastic body; strip may be die cut with sinusoidal engines and formed into convolute by spans of zigzag wire interposed between.

V. Tatarinov.
Design of Spiral Springs. Machy. (Lond.), v. 71, n. 1823, Oct. 2, 1947, p. 375-80. Mathematical computation of spiral springs, made from flat material or round wire, used for driving mechanisms such as clocks, speed measuring and other recording instruments; graphs for determining drum/spindle diameter ratio, ratio of spindle diameter to spring thickness, and curves for finding widths of flat springs and diameters of wire springs; examples.

C. Reynal.
Les Ressorts, étude, complète et méthode rapide de calcul. 4th ed. Dunod, editeur, Paris, 1946. 253 p., illus., diagrs., charts, tables, 265 frs. Detailed analysis of design and action of various kinds of springs— laminated, helical, spiral, multiple— and of spring washers; last two chapters contain certain observations on springs in general and describes two special slide rules for making rapid calculations in spring design. Eng. Soc. Lib., N.Y.

Anonymous 380.
A Hot Wound Spring is Another Thing. Mainspring, v. 12, Dec. 1947, p. 2-5. Fundemental principles in the design and selection of materials for hot wound steel coil springs, which are the big ones too heavy to coil cold.

Disk

G. Ashworth.
Disk Spring or Belleville Washer. Bibliog. Il. diags. Inst. Mech. Eng. Jour. and Proc. v. 155, (War Emergency issur no. 16), 1946, p. 93-100.

Electric Locomotives

F. H. Beasant.
New Development in Locomotive Flexible Drives. Diesel Ry. Traction (Supp. to Ry. Gaz.), n. 175, Dec. 1946, p. 171-2, 175. Simplified drive described which uses molded rubber units as means of transmitting tractive force and of providing requisite flexibility in place of coiled springs previously used; arrangement suitable for fitting to existing locomotives using coiled spring

drives; review of railways which operate electric locomotives, with reference to individual axle drives and drives of flexible spring type.

Failure

F. P. Heard.
Chemical Finishing of Metals. Monthly Rev. Am. Electroplaters Soc., v. 34, 1947, p. 1035-1042. Methods for obtaining commercial oxide and phosphate finishes on steel and copper are described in detail. Hydrogen embrittlement of steel springs was found to be due more to prior pickling than to phosphating. Springs with a baked synthetic lacquer finish also showed evidence of hydrogen embrittlement.

H. Chase.
Precise Manufacture; Repeated Tests Minimize Service Failure of Buick Clutch Springs. Il., Steel, v. 120, Feb. 24, 1947, p. 100-102.

C. T. Eakin and H. W. Lownie, Jr.
Reducing Embrittlement in Electroplating of Steel Springs. Bibliog., il. Iron Age, v. 158, Nov. 21, 1946, p. 69-72.

Heat Treatment

H. J. Elmendorf.
Investigation of Tempered Chromium-Silicon Spring Steel. Am. Soc. Metals— Preprint, n. 1, for meeting Oct. 18-24, 1947, 18 p. Results of investigations on effects of heat treating practices on mechanical properties of wire and spring properties under both room temperature and elevated temperature conditions; from results obtained, it is observed that chromium silicon steel is superior to SAE 6150 under conditions studied.

Helical

H. F. Ross.
Application of Tables for Helical Compression and Extension Spring Design. Am. Soc. Mech. Engrs.— Trans., v. 69, n. 7, Oct. 1947, p. 725-34; see also Machine Design, v. 19, n. 3, Mar. 1947, p. 153-8. Indexed in Engineering Index 1946, p. 1063, from Am. Soc. Mech. Engrs.—Advance Paper n. 46—SA-27 for meeting June 17-20, 1946.

Anonymous 381.
Compression Springs. Modern Engr., v. 21, n. 3, Mar. 1947, p. 51-3, 70. Formulas and general data relative to design of open coil helical springs; discussion covers wire diameter, deflection, free length, shot blasting to improve properties, and spring characteristics with respect to buckling, vibration, heat and sudden loading. From "Mechanical Springs", by W. J. Gibson Co.

J. R. Finniecome.
Critical Analysis of Stresses in Helical Springs of Circular Cross Section. Mech. World, v. 121, n. 3149, 3150, 3151, 3152, 3153, May 23, 1947, p. 493-7, May 30, p. 523-7, June 6, p. 558-63, June 13, p. 585-7, June 20, p. 610, 612. Essential facts of various theories; principal formulas summarized in tables; formulas for rapid calculation of various stresses in design of springs, presented graphically; curves for general use; mathematical discrepancies in authoritative results, pointed out; relative merits discussed.

E. J. Rantsch.
Design of Helical Compression Springs. Machine and Tool Blue Book, v. 43 n. 3, Mar. 1947, p. 263-6, 268. Experimental data pertaining to design of springs made from square wire; included is table compiled to facilitate design for springs that will not "set" when compressed to point where coils touch each other.

E. I. Shobert, 2nd.
Maximum Performance of Helical Springs. Am. Soc. Mech. Engrs.— Trans. (J Applied Mechanics), v. 14, n. 1, Mar. 1947, p. A53-A54 (discussion), n. 3, Sept. p. A253-A254. Indexed in Engineering Index 1946, p. 1063, from Advance Paper n. 26— A-6 for meeting Dec. 2-6, 1946.

L. E. Adams.
Shear Stresses in Springs. Engineering, v. 164, n. 4260, Sept. 19, 1947, p. 280. Letter to editor in which writer has calculated values involved in his formula for shear stresses at inner and outer extremities of bar (or wires) of helical spring; rational formula for "proof" stress, or stress to be used when designing spring also given.

Liquid

A. E. Bingham.
Liquid Spring Development. Junior Instn. Engrs.— J v. 57, pt. 9, June 1947, p. 249-60. Liquid compressibility as basis of spring action; history of research on subject; experiments with different materials and types of springs; strength considerations of cylinders, development of high pressure gland; use of fluid compressibility curves; considerations of design, materails and testing with particular reference to such applications as aircraft landing gear shock absorbers.

A. E. Bingham.
Liquid Springing. Engineering, v. 164, n. 4261, Sept. 26, 1947, p. 289-91. Historical review of development and experimentation; compressibilities of large number of fluids determined; identical cylinders were used for these tests and their stretch was known so that absolute figures could be calculated; in liquid spring which also acts as shock absorber, dashpot function must be indorporated; filling of liquid springs.

Anonymous 382.
"Liquid Springing" for Motor Vehicles. Automotive and Aviation Industries, v. 96, n. 11, June 1, 1947, p. 47, 56. Principle developed by Dowty Equipment, Ltd., England, and supplied in large quantities for British military aircraft; reference to program at Gabriel Co., Cleveland, to develop smaller unit suitable for suspension of motor vehicles which will combine functions of both spring and shock absorber.

R. H. Bound.
Liquid Springs. Soc. Engrs.— J and Trans., v. 38, n. 1, Jan.-June 1947, p 21-32 (discussion) 32-7, see also Ry. Gaz. v. 87, n. 9, Aug. 29, 1947, p. 235-6. In 1938 G. H. Dowty conceived idea of using compressive properties of liquids as spring, and at same time making same volume of fluid used act as dashpot medium; intensive research was carried out by Dowty Equipment Ltd. and in due course data was obtained to develop the idea; brief account of principles, construction and application of liquid springs.

Manufacture

Anonymous 383.
Production of Coiled Springs. Machy. (Lond.), v. 71, n. 1829, 1831, Nov. 13, 1947, p. 535-40, Nov. 27, p. 591-7. Nov. 13: Manufacturing methods employed at Works of Geo. Salter and Co., for coiling and finishing of heavy springs; typical spring grinding operations. Nov. 27: Small spring coiling on automatic machines; inspection methods and procedure adopted for control of quality of both raw material and finished springs.

C. R. Bergevin.
Preventive Maintenance of Spring Coiling Machines and Some Spring Coiling Experiments. Wire and Wire Products, v. 22, n. 4, Apr. 1947, p. 288-92. Description of production faults that may be encountered in spring coiling machines and manner in which troubles may be run down and corrected, or prevented; details of experiments conducted by Torrington Mfg. Co., Torrington, Conn., to find ways and means of increasing usefulness and capacity of standard machines.

H. Laurent.
Lowering Production Costs of Bumpers and Springs. Automotive Industries, v. 97, n. 3, Aug. 1, 1947, p. 24-6, 62. Account of what United States Spring and Bumper Co., Los Angeles, has done to modernize its plant for peace time competition, with particular reference to conveyors and lift trucks installed.

J. B. Rauen.
Manufacture of Automobile Springs and Bumpers From Raw Material To Finished Stock. Western Metals, v. 5, n. 4, Apr. 1947, p. 18-21. Major operations

and manufacturing features in practice at United States Spring and Bumper Co.; steel making and rolling mill practice; bumper forming, plating and inspection; spring processing, heat treatment and testing operations.

Fred Burt.
Quantity Production of Springs and Bumpers at United States Spring and Bumper Co., Modern Ind. Press, v. 9, June 1947, p. 22, 24, 38. Operational details including forming and machining.

J. C. Montgomery.
Combined Finish Baking and Stress Relieving. Can. Paint and Varnish Mag., v. 21, n. 9, 1947, p. 28, 53. A specially designed oven and conveyor streamlines the finishing operations at the No-Sag Spring Co. Ltd., London, Ontario.

Anonymous 384.
Crucible Steel Expands Spring-Making Plant. Il., Steel, v. 121, July 7, 1947, p. 70-71.

C. E. Lambert.
Rubber Wheel Cuts Short Springs. Diags., Am. Mach., v. 91, July 31, 1947, p. 107.

W. F. Whiteman.
Short Cuts in Spring Manufacture; William and Harvey Rowland. Inc., il. Steel, v. 114, Nov. 25, 1946, p. 724.

Military Vehicles

Anonymous 385.
Torsion Bar Springs. Metal Progress, v. 51, n. 5, May 1947, p. 771-4. Features of so-called "torsion spring" used for wheel suspension on tank destroyers, tanks and other combat vehicles of tracklaying type; spring details, manufacture and applications based on practice developed by Spencer Mfg. Co., Spencer, Ohio, subcontractor, and Buick Division of General Motors Corp., Flint, Mich., as applied to "M-18, 76-mm Gun Motor Carriage"; peacetime possibilities.

Motor Bus Springs and Suspension

N. E. Bateson.
Torsion Bars for Commercial Vehicles. Soc. Automotive Engrs.— Trans, v. 1, n. 4, Oct. 1947, p. 549-56 (discussion), 556-8. Torsion bar suspension can be used to eliminate suspension troubles; it improves riding and steering despite weight reduction.

W. R. Hubka.
Installation of Torsilastic Springs in Motor Coaches. Abstract. SAE Jour.,

v. 55, Feb. 1947, p. 94-95.

N. E. Bateson.
Problems in Commercial Vehicle Suspensions, and their Elimination by Torsion Bars. Diags., SAE Jour., v. 55, Aug. 1947, p. 32-34; Abstract and Discussion. Iron Age, v. 159, May 1, 1947, p. 110-112.

Patents

Jonas Woodhead and Sons, Ltd. and Allan G. Kyle.
Protective Composition for Laminated Springs. British 566,377, Dec. 28, 1944. Each plate of the spring is inveloped with a covering of an elastic plastic composition of the nonthermosetting kind such as products of nitrocellulose, cellulose acetate, and products of casein, vinyl ester, such as polyvinyl chloride, and neoprene. The composition protects the springs against corrosion.

Samuel Dinerstein.
Alloy for Compensating Watch Springs. (To George W. Borg. Corp.) U.S. 2,419,825, April 29, 1947. The object is to produce an alloy having a constant thermal coefficient of elasticity over a wide temperature range. The alloy described has a constant coefficient over the range -20 to 120°F; it is stainless, nonmagnetic, and hard. The alloy consists of: Ni 35.0, Cr 9, Mn 1.5, Si 1.0, C 0.06, Ca 0.1, Be 0.5%, and Fe the rest. The carbon content is critical, and about 0.1% should be added to the crucible to make up losses in melting. The components should be weighed accurately and melted in a high-frequency induction vacuum furnace, preferably in small lots and then cast as an ingot. The ingot is then machined, drawn down to wire, and rolled to ribbon, with several intermediate anneals at 2060°F to remove strains. When drawn to size, the watch-spring length are cut off, coiled, and hardened by precipitation hardening. This is done by heating to 1250°C for 5 minutes, which treatment precipitates the Be. Springs of this alloy have more than double the temperature range of constant elasticity of the best of prior art products.

Reference Books

J. A. Roberts.
Spring Design and Calculations. Compiler, Technical Research Laboratory, Herbert Terry and Sons, Ltd., Redditch, England 105 and 6d. Practical Aspects of designing a spring to do its job efficiently.

Ring

M. H. Sabine.
Ring Springs. Mech. World, v. 122, n. 3172, Oct. 31, 1947, p. 437-44.

Metallic ring spring is in use for buffer and drawbar springs in railroad practice, general purpose bumper springs, and for aircraft struts, etc.; invented over 20 yr. ago and originally emanating from Germany, it consists of series of inner and outer solid rings having tapered faces, and fitting together in such a manner that any two adjacent rings, inner or outer, are approximately 1/4 of their width apart; properties and proportions of springs; formulas and tables for practical use.

Rubber

D. H. Cornell and J. R. Beatty.
Laboratory Testing of Rubber Torsion Springs. Am. Soc. Mech. Engrs.— Trans., v. 69, n. 7, Oct. 1947, p. 799-804; see also Rubber Age, (N.Y.), v. 60, n. 6, Mar. 1947, p. 679-88. Tests performed to establish load deflection modulus, creep, and fatigue properties of springs; other work done to investigate effect of temperatures on all of named properties; methods developed to find static and dynamic moduli of any rubber torsion spring if its physical dimensions and fundamental data of rubber are known. Bibliography.

C. W. Harris.
Polar Strains. Am. So. Mech. Engrs.— Trans. (J. Applied Mechanics), v. 14, n. 2, June 1947, p. A119-A120. In spring problems involving such materails as mechanical rubber goods, elastomers do not obey Hooke's law in shear; difficulties of calculation avoided by use of polar strain instead of shear strain; polar stress-strain curves may be derived directly from any spring of type described and permit direct calculation of any other such spring with no integration.

A. S. Krotz, R. C. Austin and L. C. Lindblom.
Independent Four-Wheel Suspension Using Rubber Torsion Springs. Soc. Automotive Engrs.— J v. 54, n. 11, Nov. 1946, p. 34-41. Details of experimental passenger car incorporating constant level device in design to hold chassis at designed level regardless of load changes; description of Torsilastic spring which performs its own locating function and needs no bearings, as it resists tilting, axial and radial deflection about its normal axis.

A. S. Krotz.
Rubber and Its Application to Suspensions. Soc. Automotive Engrs. — J v. 55, n. 7, July 1947, p. 40-2. Three types of rubber spring, tension, compression, and shear, are shown and discussed; advantages and limitations of rubber springs as compared with steel.

J. E. Hale.
Rubber Springs for Automotive Equipment. Soc. Automotive Engrs.— J v. 54, n. 11, Nov. 1946, p. 28-33. Classification of basic functional forms into

which rubber can be compounded for vehicle suspensions; sketches illustrate various types and convey basic principle of each form of elastic element.

F. R. Fageol.
Rubber Torsilastic Suspension System. Soc. Automotive Engrs.— J v. 55, n. 6, June 1947, p. 56-8; see also Automobile Engr., v. 37, n. 492, Sept. 1947, p. 347-9. It is pointed out that Torsilastic suspension equipped buses provide maximum passenger comfort and vehicle protection as well as long life and minimum maintenance by exploting rubber's exclusive properties; why rubber more nearly approaches ideal suspension material than alloy steel is explained.

A. S. Krotz and R. W. Brown.
Advantage of Rubber over Steel Springs; Abstract. Bus Trans., v. 26, March, 1947, p. 89.

Shot Peening

L. J. Wieschaus.
Shot Peening of Springs. Metal Prog., v. 52, July 1947, p. 103. Examples of variations in shot peening results as a reply to some comments by Alberto Oreffice in a letter in the October 1946 issue. Clarifying letter from Dr. Oreffice.

Springs (General)

I. Epstein.
Motion of Conical Coil Springs. J Applied Physics, v. 18, n. 4, Apr. 1947, p. 368-74. Elongations and natural frequencies of conically shaped coil springs are derived theoretically for several dynamic boundary conditions; frequencies are verified experimentally on nickel and piano wire springs, attesting reliability of computations.

F. P. Zimmerli.
Selecting Spring Materials. Steel, v. 121, n. 6, Aug. 11, 1947, p. 78-9, 108, 111, 114, 116, 120, 122, 125, 128; see also Matls. and Methods, v. 26, n. 3, Sept. 1947, p. 74-9. Final choice of ferrous or non-ferrous metals depends upon close appraisal of job spring is expected to do; some diversified flat and wire materials used by mechanical or cold forming, and heavy or hot forming spring industries are analyzed; flat steel; round wire; alloy steel; copper alloys; nickel alloys; ferrous materials; brief note on upholstery spring industry. Before Soc. Automotive Engrs.

R. F. Pond.
Buying the Right Springs Right. Purchasing, v. 22, n. 3, Mar. 1947, p. 90-6. Factors to be considered in purchase of all types of springs, for satisfactory performance, proper design specification and economical cost; check list covering details of specification is included.

Anonymous 386.
The Importance of Pre-Spring Engineering. Mainspring, v. 12, June 1947, p. 2-5. Example shows the importance of making design calculations before picking a spring for a job.

Anonymous 387.
Scanning the Field for Ideas. Machine Design, v. 19, Oct. 1947, p. 79-81. Torsion bars replace conventional springs on each pair of intake and exhaust valves in the engine; identification of molecules with microwave spectroscope; upright drawing boards to provide more space for draftsmen; stronger crankshafts and cost savings by molding method utilizing the cooling capacity of the continuous conveyer hangers on which the crankshafts are poured; and hopper feed which utilizes vibration for aligning blanks and introducing them into a centerless thread grinder.

R. F. Pond.
Specifying for Economy in Springs. Mach. Design, v. 19, Nov. 1947, p. 120-122, and Dec. 1947, p. 115-120. Tells how to draw up specifications for springs which will do the job satisfactorily, and yet not be more expensive than necessary.

Steel

H. C. R. Carlson.
Stainless Steels For Springs. Product Eng., v. 18, n. 5, 6, May 1947, p. 103-6, June p. 153-6. May: Specific data and information on properties and workability of stainless steel for springs subjected to corrosive conditions and to elevated or sub-zero temperatures. June: Fatigue life, allowable working stresses, heat treatment, tolerances, prices, etc.; recommended aplication data.

W. Merrill.
Vanadium Data Sheet— Vanadium Spring Steels. Vancoram Review, v. 5, n. 2, p. 12, 13, 18. Tensile properties shown indicate, in a comparative sense, the high ratio of yield point to tensile strength, together with good ductility, which these steels possess.

Stresses

Anonymous 388.
Notes on Stresses in Helical Springs, Mainspring, v. 11, Dec. 1946, 4 p. Methods for evaluating the various stresses set up in helical springs during manufacture and operation; significance of these stresses in terms of fatigue life or excessive set.

Anonymous 389.
Elastic Limits and Permanent Set in Springs. Mainspring, v. 11, Feb. 1947, p. 1-4, and April p. 2-5. Elastic limit and set in springs hardened and

drawn from high carbon steels or from such material pretempered.

Stripper

J. R. Paquin.
Selection of Stripper Springs. Am. Mach., v. 91, Dec. 4, 1947, p. 153. Rules and calculation methods for selection and application of springs for stripper plates in modern high speed dies.

Testing

Anonymous 390.
American Steel Foundaries Coil-Spring Test Machine. Ry. Mech. Engr., v. 121, n. 3, Mar. 1947, p. 120-2. Description of radial airplane type coil spring testing machine designed to take all railroad freight car truck springs, majority of passenger car and locomotive, and industrial helical springs; eight springs, radially disposed about central crank shaft, are alternately compressed and released 12,000 times per hr., making fatigue testing practicable; power is supplied by 15-hp Westignhouse d-c variable speed motor, Type SK, having speed ratio of 3 to 1.

C. W. Kennedy.
Will That Spring Do Its Job? Am. Mach., v. 91, n. 20, Sept. 25, 1947, p. 102-3. Recommended spring testing procedure and equipment for determining spring qualities; typical tester application described.

Anonymous 391.
Testing Motor Brush Holder Springs. Steel, v. 121, Dec. 1, 1947, p. 128. Device developed by Gen. Electric Co.

L. I. Kukanov.
Fatigue Test of Leaf Springs and Torsion Shafts. Factory Laboratory (U.S.S.R.) v. 13, Aug. 1947, p. 997-1002. (In Russian). A new type of machine for testing leaf springs and torsion shafts was designed for a maximum load of 5000 Kg.

Torsion Bar

Anonymous 392.
Torsion Bar Springs. Metal Progress, v. 51, May 1947, p. 771-774. Some metallurgical and design details showing how the spring designer and spring maker have combined the advanced knowledge of elastic action in hardened and overstressed steel to improve greatly the operating characteristics of heavy, track-laying vehicles, such as tanks and gun carriages.

Anonymous 393.
Torsion Springs Ride Rails. Il., Business Week, March 15, 1947, p. 56.

Trailer Springs and Suspension

Anonymous 394.
Fruehauf Gravity Suspension Tandem Features Spring Action. Fleet Owner, v. 37, n. 4, Oct. 1946, p. 94, 176. Features of Fruehauf tandem axle trailer torsion bar suspension system. Similar description indexed in Engineering Index 1946, p. 1160, from Automotive and Aviation Industries, Jan. 15, 1946.

G. Brewer.
New Torsion Rod Suspension Features Welded Construction. Automotive and Aviation Industries, v. 96, n. 9, May 1, 1947, p. 24-7, 84. Results of stress analysis and road tests on torsion rod suspension system of light, 2-wheel trailer known as Kit Kamper, Model C, to determine shear stresses in torque rod under various conditions in order to predict fatigue life of system; physical properties of torque rod meterial; testing conditions and technique; summary of test data.

Anonymous 395.
Processing Torsion Bars with Special Equipment. Automotive and Aviation Industries, v. 96, n. 12, June 15, 1947, p. 52, 67. Forging, heat treating and shot peening operations and equipment employed in making torsion bars for Fruehauf Trailer Co., Gravity Tandem Suspension system.

Anonymous 396.
Torsion Bar Suspension; Application on a Trailer Bogie. Diags. Auto. Eng., v. 37, May 1947, p. 174.

Valve Springs

G. R. Oliver and H. R. Mills.
Surging of Valve Springs. Automobile Engr., v. 37, n. 490, July 1947, p. 265-70. Survey of available literature. From Automobile Research Committee Report No. 1945/R/8 of Instn. of Automobile Engrs.

W. F. Bradley.
Torsion-Bar Valve-Springs of Unusual Design Used in French Engine. Automotive and Aviation Industries, v. 96, n. 7, Apr. 1, 1947, p. 24-6. Details of new valve spring system features on new French light weight Panhard Dyna car; system is claimed to give better valve seating and quicker valve action at high engine speeds, thus eliminating floating valves as limiting factor in engine speed; general engine specifications, car chassis, body, suspension, axle and wheel features.

Alberto Oreffice and Luigi Locati.
Creep in Hot Valve Springs. Metal Prog., v. 51, Feb. 1947, p. 269-270. Creep behavior of small helical steel springs under special applications

exist at 175°F. Its effect is revealed in the loss of load in needle valve springs in the fuel injector of Diesel Engines. Average test readings of four types of spring wire after coiling and pretreating in various ways.

Vibrations

F. Raymond.
Etude des virbations d'un ressort à boudin. Mécanique, v. 30, n. 331, Mar. 1946, p. 73-4. Study of vibrations of spiral spring; relationship shown between longitudinal vibration of spring and torsional vibration of spring wire, based on which, law of dynamic similitude is derived.

Welding

A. Willink.
Resistance Welding of Spring Steel to Low-Carbon Steel. Welding, J v. 26, n. 1, Jan. 1947, p. 30-1. Problems encountered in spot welding of spring component to snap fasteners, such as are normally used in harness hardware; by instant ejection of workpiece, and by instant release of upper electrode, immediately after welding operation, detrimental effects of heat on spring properties are prevented.

1948

Automobile Springs and Suspension

R. R. Peterson.
Basic Car Springing Problems. Abstract. S.A.E. Journal, v.56, March 1948, p. 73-74

A. E. Moulton and O. H. Varga.
Rubber Springing; Survey of the Technical Aspects in Vehicle Suspension. Il. diags. Automobile Eng., v. 38, April 1948, p. 143-148.

J. W. Wunsch.
Motor-Vehicle Suspension. Abstracts. Diags. Mech. Eng., v. 69, Dec. 1947, p. 1040-41, Automobile Eng., v.38, March 1948, p. 108.

Beryllium Copper Alloys

R. W. Carson.
Design Stresses for Beryllium Copper Parts. Elc. Mfg., v. 41, n. 3, Mar. 1948, p. 76-80, 176. For springs and other mechanical parts there are three different alloys: high strength alloy containing 2% beryllium with substantially higher properties than before, lower cost alloy with 1.77% beryllium delivering same performance as prewar 2% composition, and high conductivity alloy containing 0.3% beryllium and 1.4% cobalt with strength comparable to bronze but three times conductivity; design data for manufacture of parts of this material; effect of cold work.

R. W. Carson and W. Martin.
Economies Result When Parts Are Designed for Beryllium Copper. Matls. and Methods, v. 26, n. 6, Dec. 1947, p. 79-84. Four typical case histories demonstrating successful applications; design and economic factors; significant properties utilized in each of following examples: small snap switch blade, two springs in fractional horsepower motor control, four springs in lighting switch, and diaphragm in refrigerator thermostat.

Copper Alloys

Anonymous 397.
Copper and Copper Alloy Springs. Copper Development Assn.— Publ., n. 39, 1947, 61 p. Design and manufacture of flat helical and spiral springs; fatigue, operating temperature and corrosion resistance characteristics of spring materials; spring stability at normal and elevated temperatures; stress effect, hysteresis and drift; aging behavior. Bibliography.

Clocks

Anonymous 398.
The Production of Springs for Alarm Clocks. Machinery (London), v. 73, Sept. 23, 1948, p. 463-466. Methods Employed at Carfin Works of Smith's English Clocks, LTD.

Design

R. F. Pond.
Common Sense of Spring Design. Iron Age, v. 162, n. 1, July 1, 1948, p. 82-5, 93. Basic principles; common errors affecting function and economy; suggestions for assuring maximum performance at minimum cost.

C. I. Johnson.
New Approach to Design of Dynamically Loaded Extension and Compression Springs. Am. Soc. Mech. Engrs.—Advance Paper, n. 48—SA-23 for meeting May 30-June 4, 1948, 12 p, 6 supp. sheets; see also Machy. (N. Y.), v. 54, n. 11, 12, July 1948, p. 174-8, Aug. p. 159-64. Formulas and derivations of design procedure which permits straight forward solutions to spring problems with minimum assumptions; data based upon new method of graphical representation of spring characteristics.

C. P. Nachod.
Nomogram for Designing Steel Torsion Springs. Product Eng., v. 19, n. 9, Sept. 1948, p. 167, 169. Nomogram prepared for use in carbon steel spring design, but can be changed for use with brass, phosphor bronze, monel and stainless steel construction of nomogram and examples of its use.

R. F. Pond.
Specifying for Economy in Springs. Machine Design, v. 19, n. 11, 12, Nov. 1947, p. 120-2, Dec., p. 115-20. Factors entailed in design of mechanical springs for overall economy of manufactured product. Nov.: Specification of spring details as related to manufacturing processes; tolerances, working conditions, materials. Dec.: Specification for particular types of springs such as compression, extension, torsion, and other varieties of springs.

J. A. Roberts.
Spring Design and Manufacture. Wire and Wire Products, v. 23, n. 6, 7, June 1948, p. 479-83, July, p. 583, 586-8, 624-6. Principles involved; testing stress range of high duty helical springs; valve springs; volute torsion, and spiral springs; coil spring manufacture; gaging.

J. A. Roberts.
Spring Design and Calculations, compiled by J. A. Roberts. Tech. Research Laboratory, Herbert Terry and Sons, Redditch, England, 1947. 114 p., illus, diagrs, charts, tables, 10s 6d. Examples of practical design calculations for variety of spring types; Belleville washers, retaining rings and spring driving belts also covered; power and natural frequency of springs, surging of valve spirngs, and combined axial and horizontal loading on compression springs; helpful hints given for ordering springs. Eng. Soc. Lib., N. Y.

A. Bodenshatz.
Formulas for Spring Redesign. Product. Eng., v. 19, April 1948, p. 143. Equations to solve problems of reducing spring stress without changing spring rate, installed height, or solid height, of circuit-breaker springs.

O. G. Meyers.
Quality Control for the Designer of Coil Springs. Electrical Manufacturing, v. 42, Sept. 1948, p. 86-89. Application of statistical methods in designing product involving springs, specifying the springs themselves, and arriving at load tolerances and life requirements.

Disk

J. A. Haringx.
Conical Disc Springs. Philips Tech. Rev., v. 10, n. 2, Aug. 1948, p. 61-6. In respect to amount of energy that can be absorbed disk spring has no fundamental superiority over helical spring, but in certain cases it makes construction simpler and more efficient; consideration of such cases; properties of disk spring; examples of design of two particular springs; how most favorable shape for given load and maximum permissible stress can be easily determined by graphs.

Failure

H. McLoughlin.
Notes on Wartime Inspection of Over Two Million Hardened and Tempered Medium and Large Coil Springs for Gun Mountings. Eng. Inspection, v. 11, n. 4, Winter 1947, p. 31-3. Springs of rectangular cross section had been failing in service in spite of 100% inspection; discussion of possible causes of breakage, of various tests performed in investigating difficulties, and of action taken which proved effective.

G. I. Pogodin-Alekseev.
Influence of the Location of Longitudinal Cracks on the Impact Strength of Tempered Spring Steel. (In Russian). Zavodskaya Laboratoriya (Factory Laboratory), v. 13, Dec. 1947, p. 1500. It is claimed that

strength may double when cracks perpendicular to the direction of impact are present. This indicates the possibility of increasing the strength of structural parts by making them in laminated form.

Fatigue

F. P. Zimmerli.
Shot Quality—How it Affects Fatigue Life. Steel, v. 123, n. 16, Oct. 18, 1948, p. 126-9. Results of research program of SAE Shot Peening Committee to determine how various shot hardnesses affect endurance life of helical springs; shot used, hardness, size classification, etc.; testing procedure; intensity of shot peening as measured by Almen A strips; measurement of shot peening effect by X-ray diffraction methods; test data and conclusions.

L. I. Kukanov.
Fatigue Testing of Spring Steel and the Influence of Surface Defects in the Data Obtained (In Russian). Zavodskaya Laboratoriya (Factory Laboratory), v. 14, Aug. 1948, p. 977-984. Data obtained from fatigue tests on the above test specimens indicate the influence of surface defects in fatigue strength. Surface treatment, such as sand blasting, shot peening, and polishing, does not always result in the expected improvement of fatigue strength.

Helical

D. G. Sopwith.
Production of Favorable Internal Stresses in Helical Compression Springs by Pre-Stressing. Engrs' Digest (Am. Edition), v. 4, n. 12, Dec. 1947, p. 558-60. In investigation described springs used were hot wound from one cast silicon manganese steel; best number of compressions found to be 12. From paper before Inst. Metals.

Anonymous 399.
New Works for Manufacture of Helical Spring Washers. Mech. World, v. 124, n. 3209, July 16, 1948, p. 62-3; see also Engineering, v. 166, n. 4306, Aug. 6, 1948, p. 127. Methods and equipment used by Reliance Works at Aycliffe, of Toledo-Woodhead Springs, Ltd; forming wire; coiling; hardening and tempering; testing; theory of washers.

Anonymous 400.
Typical Ends of Commercial Helical Springs; diagrams; reference book sheets. Am. Mach., v. 93, April 8, 1948, p. 143.

Leaf

F. Heller.
Leaf-spring Deflection. Machy (Lond.), v. 72, n. 1844, Feb. 26, 1948, p. 274-6. Explanation and typical example of method for deflection calculation, applicable to all shapes composed of straight lines and circular arcs; method consists of evaluation with regard to coordinate system whose origin is at center of gravity of line element and whose axis is axis of symmetry, and transformation of coordinates; treatment restricted to strips of constant cross section.

J. E. Reeve.
Leaf-spring Deflection. Machinery (London), v. 72, May 20, 1948, p. 624-625. Calculations said to simplify evaluation of line integrals, in connection with an article by Heller in the Feb. 26 issue.

Anonymous 401.
Duo-Flex Spring. Automobile Engr., v. 38, n. 499, Mar. 1948, p. 109-10. Features of leaf spring developed for use on ACF-Brill bus. Similar description indexed in Engineering Index 1946, p. 729, from Bus Transportation Apr. 1946.

G. E. Stedman.
"Submarine" Quench Technique Employed in Forming and Hardening Auto Leaf Springs. Steel, v. 122, n. 23, June 7, 1948, p. 92-4. Press forming and hardening practices at U. S. Spring and Bumper Co., Vernon, Calif.; work is clamped to forming die on each of nine stations or "paddles" of wheel shaped revolving unit and immediately quenched before tempering; modified version of process used for bumper plating; centralized pyrometric control of all furnaces.

Liquid

H. Shawbrook.
Liquid Springs for Aircraft. Aero Digest, v. 57, n. 2, Aug. 1948, p. 53-5, 104-5; see also similar unsigned article in Flight, v. 54, n. 2069, Aug. 19, 1948, p. 219-20. Investigation leading to G. Dowty's development of spring using compressive properties of liquids; variables affecting design problems discussed and illustrated with curves; experimentation resulted in development of landing gear strut remarkably low in maintenance.

Manufacture

Anonymous. 402.
Spring Steels 'Air-Fabricated' at West Coast Automotive Parts Plant. Steel, v. 123, Sept. 20, 1948, p. 110, 113. Compressed air applications in processing, assembly and testing of springs steel products at United States Spring and Bumper Co., Los Angeles.

R. Vicker.
Batch Electropolishing of Small Parts. Steel Processing, v. 34, n. 5, May 1948, p. 259-60. Experiments at American Rolling Mill Co., with method that employs easy racking, by scoopful rather than by individual placement; uniform current density is obtainable; polishing setup and rack details; process makes possible polishing of small steel articles such as screws, bolts, nuts, springs, and various stampings.

Gerald E. Stedman.
An advance in Spring Fabrication Methods. Industrial Gaz., v. 26, May 1948, p. 12-13, 21-23.

Anonymous 403.
Production Procedure. Springs for Western-built Freight cars. Western Machinery and Mach. World, v. 39, Nov. 1948, p. 118-119. Production of above, and also other types of leaf and coil springs down to very small ones.

Anonymous. 404.
Special-purpose Tools Boost Steel Spring Production. Prod. Eng. and Management, v. 21, April 1948, p. 67-69.

A. W. Jessup.
Spring Roll-weighting System developed by Japanese. Il. Textile World, v. 98, June 1948, p. 246.

Anonymous. 405.
New Method for Fabricating Coil Springs, Automotive Industry, v. 98, April 15, 1948, p. 29.

Nickel Alloys

F. C. Ochsner.
Age-Hardening Nickel Alloys. Product Eng., v. 19, n. 10, Oct. 1948, p. 126-8. Properties and uses of Ni-Span alloys made basically of nickel, iron and titanium, with or without chromium; consisting of high and low expansion and constant modulus alloy groups combining controlled elastic characteristics and high strength, these alloys

have unusual thermoelastic properties, but are age hardening and can be heat treated from annealed condition or from any degree of cold working to obtain high physical and mechanical properties.

Rubber

W. Hollstein.
Gummifederungen bei Werkzeugmaschinen. Werkstatt und Betrieb, v. 80, n. 6, June 1947, p. 133-6, Rubber springs for machine tools; examples given of rubber mountings for various machine tools, including grinding machines; sectional drawings.

J. F. D. Smith.
Rubber Springs— Shear Loading—II. Am. Soc. Mech. Engrs.—Trans., v. 70, n. 3, Apr. 1948, p. 227-32. In previous paper indexed in Engineering Index 1939, p. 1105, from Am. Soc. Mech. Engrs.—Trans. (J Applied Mechanics), Dec. 1939, author developed theoretical stress strain relationships for rubber of various shapes loaded in shear; in present paper, additional theory and data are presented.

Shot-Peening

F. P. Zimmerli, J. Straub.
Shot Peening. Soc. Automotive Engrs.— J v 56, n. 11, Nov. 1948, p. 36-9. Effect of Shot Type on Spring Fatigue Life. Why Peening Calls for Uniform Shot. Based on papers before Shot Peening Division of SAE Iron and Steel Tech. Committee.

Alberto Oreffice.
Advantages of Shot-peening. Metal Progress, v. 53, June 1948, p. 848-849. Data on two series of tests on spring materials. Highly beneficial effects of shot peening are indicated from tests on SAE 9260, Si-Mn, leaf spring stock, and SAE 1070 coil spring stock.

Spiral

G. A. Berner.
Spiral—son choix en horlogerie et pour l'appareillage électrique. Microtecnic v. 1, n. 2, Apr. 1947, p. 77-87 (English translation in separate section, p. 30-6). Hairspring—its choice in horology and for electric apparatus; mechanical and geometrical properties; standardization and numeration of hairsprings in watchmaking and for electric apparatus; torques and their direct measurement by spiral meter.

Springs (General)

F. P. Zimmerli.
Proper Use of Spring Materials. Soc. Automotive Engrs.— Trans., v. 2, n. 1, Jan. 1948, p. 157-68. Original of paper indexed in Engineering Index 1947, p. 1092, from Steel Aug. 11, 1947.

Anonymous 406.
Die for Forming Irregular Shaped Spring. Machinery (London), v. 72, Jan. 29, 1948, p. 144.

Anonymous 407.
Coil Springs from a Western Plant for Western Use. Western Metals, v. 6, Oct. 1948, p. 32-33.

Anonymous 408.
Revolutionary Cessna Landing Gear relies on Chromium-Vanadium Steel Spring. Vancoram Review, v. 5, no. 3, 1948, p. 3-5, 20. Includes mechanical properties of steel used (SAE 6150), and results of service tests.

Anonymous 409.
Coil Spring Research. Wire Industry, v. 15, Feb. 1948, p. 112-118. Research progress on four different problems in connection with coil springs, by the Coil Spring Research Organization in Britain.

Steel

Anonymous 410.
Annealed Steel Wire for Oil-Hardened and Tempered Springs (For General Engineering Purposes). Brit. Standards Instn.—Brit. Standard, n. 1429-1948 10 p. Standard relates to annealed steel wire for manufacture of springs which are to be heat treated after fabrication; tests on wire and wire rod; tolerances; circularity; identification; chemcial composition.

Anonymous 411.
Hard Drawn Steel Wire for Springs. Brit. Standards Instn.—Brit. Standard n. 1408—1947, 15 p. Standard provides for supply of four qualities of hard drawn steel wire for springs; most of tests are only applicable to round wire, but standard may be used in respect of analysis, tensile strength and other relevant tests for sections other than round; four qualities of wire are: En.49A, hard drawn wire in diameters 0.116 in.and greater; En.49B, hard drawn patented wire not for high duty; En.49C, high duty wire not ground; En.490, high duty wire ground.

Stresses

J. A. Pope.
Pre-Stressing of Springs. Wire Industry, v. 15, July 1948, p. 446- 455. Results obtained from preliminary static torsion tests on over strained specimens of carbon spring steel. This exploratory work gives a picture of the type of change in properties in a torsionally over strained bar, the overall effect of the change in apparent properties of the bar; and possible limitations which have to be observed in order to obtain maximum benefits from pre-stressing alone.

Anonymous 412.
Three Methods for Spring Stress Calculation. Mainspring, v. 12, Feb. 1948, p. 1-4. Outlines the ordinary-stress method; the average-stress method; and the corrected-stress method; and compares their accuracy and usefulness.

Testing

Anonymous 413.
Spring Tester; Hunter Pressed Steel, il. Instruments, v. 21, Sept. 1948, p. 824.

Anonymous 414.
Testing Motor Brush Holder Springs, il, Steel, vol. 121, Dec. 1, 1947, p. 128.

Torsion Bar

H. E. Simi.
Improvements in Steel Torsion Rod Springing. Automotive Industries, v. 98, n. 9, May 15, 1948, p. 30-2, 86. Features of "Gravity Spring" torsion rod suspension system for buses; new system uses threaded type bearings which provide right amount of friction for torsion spring suspension and eliminates need for thrust adjustment and seals; each thread forms thrust shoulder, and discourages entry of dirt and moisture; threads are excellent for retaining lubricant, and therefore do not require grease seals, producing more uniform spring action and lower maintenance cost.

O. Foeppl.
Investigations on Torsion-Bar Suspension Springs. Engrs.' Digest (Brit. Edition), v. 9, n. 4, Apr. 1948, p. 117-20; see also Engrs.' Digest (Am. Edition), v. 5, n. 4, May-June 1948, p. 161-4. Review of three papers by author as follows: Optimum Conditions for Surface Rolling (Shot Peening) Process on Torsion Bars, from Metalloberflaeche v. 1, n. 6, 1947; Static Calibration and Permanent Set of Torsion Bar Springs, from Werkstatt u Betrieb, v. 79, n. 9, Dec. 1946; Damping Properties of Torsion Bars under Static and Superimposed Dynamic Loads, from Ingenieur-Archiv, v. 16, n. 2, 1947.

F. Kurtis and A. Ward.
Practical Approach to Torsion Bar Spring Design. Automotive Industries, v. 99, n. 8, Oct. 15, 1948, p. 28-9, 86. Important factors in application of torsion bar suspension to racing cars; design data covering loading, maintenance, weight and installation essentials derived from actual performance tests by racing car builder.

O. Foeppl.
Statische Eichung und Setzgefahr von Verdrehungsstaeben. Werkstatt u Betrieb, v. 79, n. 9, Dec. 1946, p. 205-8. Static calibration and permanent set of torsion bar springs; method and results of test on automobile suspension springs, which only show permanent set when plastic deformations are of same order of magnitude as elastic deformations; it seems safe to permit plastic deformation of 15 to 20% of elastic deformation; independently of danger of permanent set, fatigue strength of spring limits maximum permissible stress.

D. Bastow.
Torsion Bar Springs. Product Eng., v. 19, n. 9, 10, Sept. 1948, p. 111-6, Oct. p. 104-6. Sept.: Basic formulas for stress distribution, energy storage, spring rates and load capacity for torsion bars of six types of cross-sections; damping principles and function; material selection and heat treatment. Oct.: Methods of shortening spring length; relationships between energy storage, stress level, diameter, lever length, and load.

H. Elvidge.
Torsion Bars. Automobile Engr., v. 38, n. 502, June 1948, p. 211-4. Graphs and calculation data for obtaining answers to various problems involved in design and installation of torsion bars.

Anonymous 415.
Another "Twist" to Torsion Springs. Mainspring, v. 12, April 1948, p. 2-7. Design formulas, tables, and applications.

Anonymous. 416.
Torsion Bar Springs. Engineering, v. 85, Jan. 30, 1948, p. 115. Translated and condensed from a paper by O. Föppl. Automobiltechnische Zeitschrift, no. 4, 1947. Use of "roller-peening" process to increase resistance to fracture of suspension springs used in German tanks. The principle of "roller-peening" is the same as that of shot peening. Föppl preferred the former.

O. Föppl.
Optimum Surface Working of Cylindrical Torsion-Rod Springs. (In German), Metalloberfläche, v. 1, June 1947, p. 133-137. Theory and different methods of increasing fatigue strength of metals by means of surface working. The effect of crystal size, amount of pressure, and time of pressure application.

1949

Automobile Springs and Suspension

B. Mackenzie.
Automobile Suspension Springs. Instn. Mech. Engrs.— Proc. (Automobile Div.), pt. 3, 1947-8, p. 122-30 (discussion), 130-5, 2 supp. plates. Although suspension springs are designed for very high working stresses, reliability is of paramount importance, and cost must also be taken into consideration; resulting conflicting requirements necessitate compromise in solution of design problems; factors involved with particular reference to leaf, torsion bar and helical coil springs.

Hemmaire.
Observations sur les barres de torsion. Technique Automobile et Aérienne v. 39, n. 244, Aug. 1948, p. 60-4. Observations on torsion bars for motor vehicles; resistance of steel bars subjected to torsion can be increased by shot peening; Hertz theory concerning deformation of spheres cannot be applied; tests made to find relation between force and deformations; damping qualities of bars subjected to torsion under simultaneous action of static and dynamic forces.

H. Chase.
Steel Balls Reduce Friction Between Spring Leaves. Automotive Industries, v. 100, n. 5, Mar. 1, 1949, p. 33, 61. Steel balls, used by Studebaker Corp. in form of hardened peening shot, roll short distance when springs are flexed thus reducing resistance to spring action; special machine coats cotton fabric adhesive tape with shot; tape is convenient means of application of shot to tips of spring leaves.

Anonymous 417.
Coil Spring Production Boosted to 650 Per Hour. Steel, v. 123, n. 24, Dec. 13, 1948, p. 87. Mechanized processing and handling operations at Hamilton, Ohio, plant of Ford Motor Co.'s parts and equipment manufacturing division.

John Raven Jr.
Coil Springs from the United States. Western Machinery and Steel World, v. 40, May 1949, p. 84-85. Fabrication of automotive suspension coil springs by the United Stated Spring and Bumper Co.

Beryllium Copper

J. T. Richards.
Beryllium Copper as Spring Material. Machy. (N.Y.), v. 55, n. 8, Apr. 1949, p. 169-74; see also Machy. (Lond.), v. 75, n. 1920, Aug. 11, 1949,

p. 183-7. High strength, hardness, electric conductivity and resistance to corrosion qualify beryllium copper for spring material; heat treatable and pretempered copper wire used in production of helical springs; tables.

Copper Alloy

A. I. Heim.
Brass and Bronze for Electrical Springs. Elec. Mfg., v. 43, n. 4, Apr. 1949, p. 114-7, 204, 206. Discussion of four types of copper alloys: cartridge brass, (70-30), high silicon bronze, (A), phosphor bronze, 5% (A), phosphor bronze, 8% (C); important advantage of these alloys is their corrosion resistance as compared with steel; tabular data on standard specifications and properties.

H. C. R. Carlson.
Copper-Base Alloys for Springs. Product Eng., v. 20, n. 2, 3 Feb. 1949, p. 103-7, Mar. p. 86-91. Theory of corrosion and causes of galvanic corrosion and stress corrosion cracking; workability and possible methods for joining alloys; mechanical properties of spring brass, phosphor bronze, beryllium copper and other copper base alloy wire and strip stock for springs; improved properties derived from cold work and heat treatments; field of application for each alloy in mechanical and electrical products.

D. Kuhlmann and G. Masing.
Untersuchungen zur plastischen deformation an Kupferdraht. Zeit fuer Metallkunde, v. 39, n. 12, Dec. 1948, p. 361-75. Investigation of plastic deformation of copper wire; review of earlier papers; expansion time data on springs show two different deformation processes: spontaneous initial deformation and slow flowing of metal; mathematical theoretical discussion.

Car Springs and Suspension

E. Sperling.
Berechnung der Federn von Eisenbahnwagen. VDI Zeit, v. 90, n. 10, Oct. 1948, p. 318-22. Calculation of railroad car springs; most important factors to be taken in consideration; method of calculating leaf and helical springs; sectional drawings, charts.

Clocks

S. Koshiba and K. Nobara.
Investigation of Timepiece Springs. (In Japanese). Journal of Japan Institute of Metals, v. 13, May 1949, p. 43-49. Two kinds of 1% carbon

steel wire studied, one made from a magnetic ore and the other from scrap iron. Comparative mechanical properties, and effects of cold rolling and heat treatment variables.

Design

W. J. Cook and P. C. Clarke.
Negative Spring—Basic New Elastic Member. Product Eng., v. 20, n. 7, July, 1949, p. 136-40; see also abstract in Engrs.' Digest, v. 10, n. 10, Oct. 1949, p. 359-60. New spring mechanism, Neg'ator, can be made with flat, negative or varying force deflection characteristics; five basic uses for device described: self winding tapes; clip, formed to full 357° from stainless steel; wrapping; clamp holding two 1/2 lb. steel disks; telescopic tube form; other possible applications.

C. I. Johnson.
New Approach to Design of Dynamically Loaded Extension and Compression Springs. Am. Soc. Mech. Engrs.—Trans., v. 71, n. 3, Apr. 1949, p. 215-23 (discussion) 223-6; see also Machy. (Lond.), v. 73, n. 1879, 1883, Oct. 28, 1948, p. 603-7, Nov. 25, p. 727-32. Indexed in Engineering Index 1948, p. 1168, from Am. Soc. Mech. Engrs.—Advance Paper, n. 48—SA-23 for meeting May 30-June 4, 1948.

Anonymous 418.
New Spring Principle Permits Revised Design Methods. Iron Age, v.164, n. 7, Aug. 18, 1949, p. 87. Properties of Neg'ator, elastic member that resists less the more it is deformed, developed by Hunter Spring Co., Lansdale, Pa.; its most significant feature is that only short section of spring stock produces resisting force at any time.

E. R. Squire.
Some Mathematical Instruments Used in Spring Trade. Junior Instn. Engrs.—J v 59, pt. 10, July 1949, p. 304-13. Machines facilitating calculations entailed in design of springs; features of C. E. Squire's machine; applicability of apparatus for studying stretched membranes; results of tests.

J. A. Roberts.
Spring Design and Manufacture. Eng. Inspection, v. 12, n. 4, Winter, 1948, p. 25-35. Purposes and uses of springs; research in progress in England; types of spring tests made;material control and testing; design of helical compression and extension springs, valve springs, volute and conical springs, torsion and spiral springs; production techniques.

W. A. Wolf.
Vereinfachte Berechnung von Druckfedern mit Rechteck querschnitt fuer begrenzte Einbauverhaeltnisse. Werkstatt und Betrieb, v. 82, n. 1,

Jan. 1949, p. 7-9. Simplified calculation of compression springs having rectangular cross section for installation in limited space; method of calculation for wire springs; five examples given.

D. G. Meyers.
Negative Spring: New Tool for Engineers. Il. diag. Business World, July 1949, p. 40-42.

Anonymous 228.
Maximum Design Load vs. Temperature for Springs. Product Eng., v. 20, Dec. 1949, p. 161. Curves for six common spring alloys.

Disk

L. W. Jones.
Belleville Spring Design Charts. Product Eng., v. 20, n. 1, 3, 4, 6, 8, Jan. 1949, p. 161, 163, 165, 167, Mar. p. 159, 161, Apr. p. 157, 159, June p. 181, 183, Aug. p. 151, 153. Nomographic charts for plain carbon steel springs based on given data presented: Jan.: Charts for zero, 10 and 20% pressure rise. Mar.: Chart for 25% rate pressure drop; chart for 10% pressure drop. Apr., June: Charts for springs having 40, 50, 60 and 75% pressure drop. Aug.: Charts for springs having 90 and 100% pressure drop.

R. Wittlinger.
Die Tellerfeder in der Praxis. Werkstatt und Betrieb, v. 81, n. 10, Oct. 1948, p. 298-9. Disk springs or Belleville washer in practice; calculation, advantages and uses discussed; illustrations.

Electric Circuit Breakers

W. Wyman and E. J. Casey.
Spring Mechanism for Circuit Breakers. Elec. Eng., v. 68, n. 10, Oct. 1949, p. 842. New manually charged mechanism makes available for first time, magne-blast oilless circuit breakers rated 2300 to 15,000 v for applications where no dependable source of electric control power is available; closing speed and output force of mechanism are sufficient to latch circuit breaker against its full momentary current rating without stalling or excessive contact burning. Digest of AIEE paper 49-93.

Failure

Anonymous 419.
A clinical Diagnosis on a Springmaker's Malady—Acid Brittleness. Mainspring, v. 13, Oct. 1949. Practical analysis of the problem and its solution. Acid brittleness of steel, otherwise known as Hydrogen Embrittlement is usually created by absorption during pickling, and can be removed by one of many suitable combinations of time and temperature.

Finishing

R. F. Pond.
Selecting Protective Finishings for Springs. Machine Design, v. 20, n. 12, Dec. 1948, p. 128-32, 194, 196. Design problems in determining finish to be applied to new spring, particularly when objectives of desired appearance, corrosion resistance and maximum economy are to be attained; difficulties of plating or japanning; expedients against corrosion and abrasion; influence of kind of material, type of surface, deflection required and proportions of spring, upon effective plating; action of plating on structure.

Helical

G. F. A. Trewby.
Analysis of Stresses in Helical Springs of Circular Section. Engineering, v. 168, n. 4355, July 15, 1949, p. 51. Analysis by author in Applied Mechanics Department of Royal Naval College, Greenwich, to give simplest treatment possible while taking into account curvature of wire.

V. Tatarinov.
Design of Helical Springs for Minimum Overall Dimensions. Machy. (Lond.) v. 74, n. 1890, Jan. 13, 1949, p. 39-41. Method described reduces height of spring arrangement by using different combinations and various cross sections of material.

G. Payne.
Design of Light Helical Springs. Marconi Rev., v. 11, n. 91, Oct-Dec. 1948, p. 109-11. Formulas for calculation of performance and stress of springs presented in form of nomograph type charts called ABACS, calibrated in terms of standard wire gage so that quick approximation can be made of possible performance.

J. A. Haringx.
Elastic Stability of Helical Springs at Compression Larger than Original Length. Applied Sci. Research, v. A1, n. 5-6, 1949, p. 417-34; see also Philips' Gloeilampenfabrieken—Paper n. 1876, 18 p. Consideration of behavior differences occurring for various end conditions of springs for compressions greater than original length; study of spring by simply turning it inside out; phenomena which accompany transition from stable to unstable state; theoretical and experimental results.

J. A. Haringx.
On Highly Compressible Helical Springs and Rubber Rods, and Their Application for Vibration-Free Mountings. Philips Research Reports, v. 3, n. 6, Dec. 1948, p. 401-49, v. 4, n. 1, 3, 4, Feb. 1949, p. 49-80, June, p. 206-20, Aug. p. 261-90. Design of mountings with

appropriate resilient and damping elements. Dec. 1948: Study of elastic stability of springs under compression, or under combined compression and twist. Feb. 1949: Lateral rigidity of helical spring; natural frequencies. June: Elastic stability and lateral rigidity of highly compressible rubber rods. Aug.: One-dimensional vibration free mountings.

A. Leyer.
Ueber die Knickgefahr schraubenfoermig gewundener Druckfedern. Schweiz Bauzeitung, v. 67, n. 20, May 14, 1949, p. 281-2. Buckling of helical compression springs; formula based on Euler's buckling formula for straight bars; diagrams.

D. G. Sapwith.
The Production of Favorable Internal Stresses in Helical Compression Springs by Prestressing. Institute of Metals, 1948, p. 195-207, 398-431. The principles underlying the process and the distribution of the residual stresses and of the stresses under load. Application of these principles to various design problems.

Instruments

R. E. Tricker.
Metals in Clock and Instrument Manufacture. Inst. Metals.—J v 75, pt 2, July 1949, p. 881-98, 4 supp. plates; see also Machy. Market, n. 2557, 2558, Nov. 18, 1949, p. 777-8, Nov. 25, p. 794. Ferrous and nonferrous metals used in clock and instrument industry discussed; turned components, dealing with brass and steels; die castings made of zinc, aluminum and tin base alloys; components blanked and formed from brass and steel strip; materials for mainsprings, hairsprings, bellows, diaphragms and capsules, bourdon tubes and wire; magnet alloys and magnetic compensating alloys; tables.

Leaf

Anonymous 420.
Walking Beam Furnace Keeps Spring Leaves Aligned as They are Heated. Industrial Heating, v. 15, Dec. 1948, p. 2112-2114. New furnace designed and built to heat spring leaves prior to forming.

M. A. Shklyar.
Testing of non-ferrous Metals for Production of Flat Springs. (In Russian). Factory Laboratory, v. 15, April 1949, p. 474. Simplified

method based on that proposed by Butra. This method, already applied in an industrial scale, is valued because of its simplicity and rapidity.

Liquid

R. H. Bound.
Liquid Springs. Ingenieur v. 60, n. 49, Dec. 3, 1948, p. L55-8 (discussion) L58-9. Development for use on aircraft; compressibility of fluid and of gland material; operation and testing. (In English).

Machinery

R. Hammond.
Springs Control Forging Hammer Vibration. American Machanist, v. 93, June 2, 1949, p. 98-100.

Manufacture

R. F. Pond.
Selecting Protective Finishings for Springs. Machine Design, v. 20, n. 12, Dec. 1948, p. 128-32, 194, 196. Design problems in determining finish to be applied to new spring, particularly when objectives of desired appearance, corrosion resistance and maximum economy are to be attained; difficulties of plating or japanning; expedients against corrosion and abrasion; influence of kind of material, type of surface deflection required and proportions of spring, upon effective plating; action of plating on structure.

Stephan Thyssen-Bornemisza.
The Manufacture of Springs with Low Thermal Coefficients of the Modulus of Elasticity. Microtecnic, (English Edition), v. 3, May-June 1949, p. 129-133. Object of spring treatment. Methods used for influencing the thermal coefficient of the modulus of elasticity. (To be continued).

Stephan Thyssen-Bornemisza.
Same as preceding reference (concluded). July-August 1949, p. 159-164. Annealing of Cr, Cu, and Ni plating to produce low thermal coefficients; and reduction of the elastic after-effect by aging. Manufacturing process for precision springs; variation of modulus of elasticity with temperature for various compositions.

J. R. Paquin.
Double-Flange winding Arbor finishes Heavy Springs in Lathe. American Machinist, diags., v. 93, July 28, 1949, p. 106.

Anonymous 421.
Central Inspection Department solves Daily Production Problems at Hunter Spring. Steel, v. 124, Feb. 21, 1949, p. 123-124.

Nickel Alloy

Anonymous 422.
Springs; the Applications of Nickel Alloy Material. Metal Industry, v. 75, Nov. 25, 1949, p. 451-4. Mechanical properties of the different commercial nickel alloys, applications, temperature effects, and manufacturing methods.

Patents

Reinhard Straumann.
Nickel-iron Alloys adapted for springs in thermocompensated oscillating systems. U. S. Patent 2,466,285, Apr. 5, 1949. Alloys having higher additions of carbon will yield springs with a higher compensating range of temperature but are sensitive to magnetic influences. Carbon, in an amt. 0.2— 0.8% is added to a Ni-Fe alloy containing Be, Ti, and at least one of the metals in the Cr group, raising the Curie point to +80° to +100°. Carbon added in amts. of 0.005—0.2% raises the Curie point to +40° to +80°. An example of such an alloy yielding springs having (1) nearly rectilinear form of the temp. running curve, (2) low straying effect of thermoelastic coefficient, and (3) lower fixing temp. is given.

Repair

H. G. Jarman.
Custom Re-springing. Can. Metals and Met. Industries, v. 12, n. 8, Aug. 1949, p. 12-13, 38. How McRobert Spring Service, Montreal repairs and replaces 75,000 springs per year by using modern mass production methods; photographs.

Rubber

E. F. Goebel.
Gummifedern. VDI Zeit, v. 91, n. 10, May 15, 1949, p. 225-6. Rubber springs; property requirements of rubber; manufacture and types; examples of applications.

Shot-Peening

J. C. W. Humfrey.
Stresses Induced by the Shot-Peening of Leaf Springs. Institute of Metals, Symposium on Internal Stresses in Metals and Alloys, 1948, p. 189-193, p. 398-431. A series of fatigue tests on vehicle leaf springs after shot-peening under various conditions; measurement of the surface compressive stresses induced by the peening. How stress values can be obtained from changes of camber. Results showing variation in compressive stress with depth.

Spiral

J. A. Haringx.
Elastic Stability of Flat Spiral Springs. Applied Sci. Research, v. A2, n. 1, 1949, p. 9-30; see also Philips' Gloeilampenfabrieken—Paper n. 1883, 22 p. Calculation for springs having large number of coils shows that critical number of turns which spring has to be wound or unwound to reach instability is determined only by ratio of sides of rectangular wire section; it depends neither upon number of coils nor upon Young's modulus.

Springs (General)

Anonymous 424.
Spring Problems. Soc. Automotive Engrs., Inc. New York, (1949) 91 p., 11 supp. p., illus., tables, diagrs. Treatise on highly stressed springs subject to rapid impact loading such as are used in fast firing automatic weapons; present state of art in United States. Translation of German book "Federfragen" by K. Walz, written in 1944. Bibliography.

B. Coates.
The Treatment and Properties of Springs. Jour. Birmingham Metallurgical Soc., v. 29, March 1949, p. 21-39 and 40-49. Types of Springs; materials used; physical properties; heat treatment; surface finish, and special coatings and finishes.

Anonymous 425.
What goes on in a Spring during Presetting, Mainspring, v. 12, April 1949, p. 1-5. Simplified explanation of the theory behind presetting.

Anonymous 426.
Why can't closer Tolerances be Held for Coiled Springs Commercially?

(Concluded), Mainspring, v. 12, Feb. 1949, p. 3, 6-7. Variation in free length is the fifth variable now discussed.

Steel

W. E. Bardgett and F. Gartside.
Effect of Variation in Silicon Content on Properties of Silicon-Manganese Spring Steel. Metallurgia, v. 39, n. 232, Feb. 1949, p. 171-7. Investigation on effect of varying silicon content between 0.5 and 2.64%, on susceptibility to decarburization, tempering, hardenability and mechanical properties, including fatigue; tests prove that by increasing silicon content above 1.50% increased resistance to decarburization is obtained; tables; diagrams.

Stresses

Anonymous 427.
Infrared Installation used for stress Relieving Springs. Modern Machine Shop, v. 21, Feb. 1949, p. 190-192 and 194.

Anonymous 428.
Excess Spring Stress; Points to be Watched in Spring Making. Wire and Wire Products, v. 15, Dec. 1948, p. 816. Practical recommendations.

Testing

Max Hempel.
Long-Time Tests on Coil Springs. Stahl und Eisen, v. 69, Sept. 29, 1949, p. 712-713. Tests results on alloy and Carbon steel springs. The tests were made at room temperature and at 250°C.

N. M. Stepanov-Grebennekov.
Apparatus for Testing of Springs in Compression and Tension on the Rockwell Apparatus. (In Russian). Factory Laboratory, v. 15, March 1949, p. 378-379. Apparatus and Method of its calibration and operation. It is designed for loads of 10-150 Kg and for springs, tested in compression, of 150 mm length, and in tension of 100 mm length.

Anonymous 423.
Amer. Soc. for Testing Materials, Standards, 1948 Supplement. Metals, Ferrous Tentative standard for tension testing of steel spring wire.

1950

Automobile Springs and Suspension

A. H. Allen.
Three-Leaf Automobile Spring Built at Less Cost. Steel v. 126, n. 12, Mar. 20, 1950, p. 80-1, 106. New "broadbeam" unit, designed primarily for passenger car use, developed by Spring Perch Co., Lackawanna, N. Y.; it requires less labor in fabrication and assembly, and considerably less steel; manufacturing details and test procedures indicated; 3-leaf spring is made with same eye sizes and overall lengths as most present leaf springs, and is interchangeable with them; excellent mechanical characteristics stressed.

W. F. Bradley.
Trend in Europe to Torsion Bar Suspension. Automotive Industries, v. 102, n. 3, 4, Feb. 1, 1950, p. 38-43, Feb. 15, p. 42-6, 88. Torsion bar systems on 14 makes of passenger cars and some typical designs described and illustrated.

C. R. McCormick.
Automation Expedites Coil Spring Production. Automotive Industries, v. 10, n. 12, Dec. 15, 1949, p. 42-4, 76, 78. Equipment and operations in manufacture of springs for Ford, Mercury and Lincoln passenger cars; new setup at Ford's Hamilton plant minimizes handling and helps to maintain uniformly high quality; output is 10,000 per day.

F. M. Burt.
Materials Handling, Close Control, Results in High Output. Machine and Tool Blue Book, v. 46, n. 7, July 1950, p. 71-74. Manufacturing and mechanical handling operations in production of automobile coil suspension springs by United States Bumper and Spring Co.; standards and methods setup stressed.

Anonymous 429.
"Comparing Fundamentals of Spring Suspensions." Vancoram Review, v. 6, no. 3, 1950, p. 3-5, 20-21. Based on a paper by N. E. Hendrickson. Efficiency of various types of springs was studied by comparing the "energy storage" each could provide. The fundamental principles are applicable to all springs, whether made of steel or non-ferrous metals. Formulas for calculating the theoretical weight of spring steel required in each type for a given load deflection and stress.

Car Springs and Suspension

J. L. Koffman.
Railcar Bolster Suspension. Diesel Ry. Traction (Supp. to Ry. Gaz.), v. 4,

n. 127, June 1950, p. 132-6. Three designs of bolster spring arrangements described, i.e., Pullman or Pennsylvania truck used in United States and Western Europe, Goerlitz truck used in Central and Eastern Europe, and Fette truck used in most Russian vehicles; bolsters are carried by elliptical or semi-elliptical springs, and additional coil springs are sometimes used in series with laminated springs; diagrammatic layouts shown.

Cobalt and Cobalt Alloys

K. Rose.
Highly Corrosion Resistant Spring Material Finds Varied Use. Matls. and Methods, v. 32, n. 3, Sept. 1950, p. 54-5. Properties of cobalt chromium nickel alloy called Elgiloy; it is applied for pen nibs of Parker 21 fountain pen; flapper valves for small gasoline motors previously made of best Swedish steel are now produced from Elgiloy and give three times life of Swedish steel.

H. H. Symonds.
"From a Metallurgists Notebook: Laundry Springs." Metal Industry, v. 76, Apr. 21, 1950, p. 306. The permanent set encountered in CO-base laundry-press springs operating in a moisture-laden atmosphere at 200-300° F. was investigated. Compositional and design factors.

Copper and Copper Alloys

E. Tschanter.
"Copper and Copper-Alloy Springs." (In German.) Metall, v. 3, Dec. 1949, p. 424-426. Physical properties of copper and 12 Cu. alloys; procedure of manufacturing the springs; the fatigue behavior of copper and of Cu binary and ternary alloys with Zn, Sn, Ni, Be, Co, Si, Mn, Cr, Al, and Fe, and the effect of temperature on their respective elasticity moduli.

Anonymous 430.
"Why Beryllium Copper for Springs?" Mainspring, v. 13, Apr. 1950, p. 1-5. Physical and mechanical properties; design information.

Anonymous 431.
"Force Indicator Simplifies Design of Spring Operating Mechanisms. il. diag. Steel 127:96, Oct. 2, 1950

Design

W. S. Rouverol.
Accurate Spring Counterbalancing. Am. Soc. Mech. Engrs.—Advance Paper, n. 50—SA-6 for meeting June 19-23, 1950, 4 p. Method described for attaining perfect full rotation counterbalancing by proper connection of standard helical spring, which is utilized in such way as to produce

perfect static equilibrium at all angles of elevation of load; mounting of this spring is only slightly more involved than in simplest type of direct spring loading.

L. W. Jones.
Belleville Spring Design Charts. Product Eng., v. 20, n. 10, 11, Oct. 1949, p. 163; 165, Nov. p. 161, 163. Oct.: Charts for spring having 10 and 25% negative pressure. Nov.: Charts for 50 and 75% negative pressure.

J. Stoller.
Eine neuartige mechanische Funktionsleitertafel gezeigt am Aufbau eines Federrechners. VDI Zeit, v. 92, n. 20, July 11, 1950, p. 555-8. Novel Mechanical nomogram applied to design of springs; requirements for mechanized nomogram consisting of group of movable scales; photographs, diagrams.

N. W. Carey.
Springs. Machine Design, v. 22, n. 3, Mar. 1950, p. 129-31. Problem of designing spring to meet specific energy requirement over given travel; methods of determining maximum energy in minimum length for given coil diameter; illustrative example.

Anonymous 432.
"Spring Motor Gives Constant Torque Output." Diags. Product Eng. 21:188 October, 1950.

Disk

J. A. Haringx.
Load-deflection. Characteristics of Conical Disc Springs. Machy. (Lond.), v. 76, n. 1943, Jan. 19, 1950, p. 91-2. Indexed in Engineering Index 1948, p. 1168, from Phillips Tech. Rev., Aug. 1948.

Electric Circuit Breakers

B. W. Wyman and E. J. Casey.
Manually-Operated Spring Mechanism for Medium Voltage Oilless Circuit Breakers. Am. Inst. Elec. Engrs.—Trans., v. 68, pt. 1, 1949, p. 357-61 (discussion) 361-3. Description of new type of mechanism for operating magnetic breakers rated 2300 to 15,000 v; energy is manually supplied to this mechanism where it is stored in heavy compression springs until it is

released to close breaker; springs transfer energy to rotating mass which in turn drives circuit breaker contacts. AIEE paper 49-93.

Failure

P. Kohn.
"The Breaking of Valve Springs." Engineers' Digest, v. 11, Oct. 1950, p. 358-361. Translated and condensed from Strojnicky Obzor, v. 30, May 1950, p. 65-70. Causes and means for prevention of breakage. The influence of fluctuations in rotation of the camshaft on the oscillation of valve springs which in many cases is likely to be the cause of apparently inexplicable spring breakages. Alloys used are not discussed.

Helical

E. Abicht.
Ein neues einfaches Geraet zur Berechnung zylindrischer Schraubenfedern von rundes und quadraitischem Drahtquerschnitt. Konstruktion, v. 1, n. 12, 1949, p. 359-62. New, simple device for calculation of cylindrical helical springs of circular and square wire; Abicht slide rule for springs; examples of application.

W. A. Wolf.
Ein neues Rechenhilfsmittel fuer zylindrische Schraubenfedern mit Kreis- und Rechteckquerschnitt. Werkstatt u Betrieb v. 82, n. 6, June 1949, p. 216-8. New nomogram and method for calculating cylindrical helical springs with circular and rectangular cross section, presented; examples of application.

J. A. Haringx.
Het merkwaardige gedrag van op druk belaste schroefveren. Koninklijk Instituut van Ingenieurs— Voordrachten v. 1, n. 3, May 1949, p. 298-312 (discussion) 312-3. Remarkable characteristics of compression loaded helical springs with respect to their elastic stability, lateral rigidity and natural frequencies for transverse vibrations reviewed.

J. A. Haringx.
On Highly Compressible Helical Springs and Rubber Rods, and their Application for Vibration-Free Mountings. Philips Research Reports v. 4, n. 5, 6 Oct. 1949, p. 375-400, Dec. p. 407-48. Oct.: Behavior of different types of vibration free mounting, starting from simple construction of resiliently supported body to damped dynamic vibration absorber with auxiliary mass. Dec.: Actual construction of some vibration free mountings; design data. See also Engineering Index 1949 p. 1114.

A. J. Kwossek.
Simplified Design Procedure for Helical Wire Springs. Product Eng., v. 21, n. 2, Feb. 1950, p. 140-3. Fundamental design equations are presented and new equations derived that contain parametric constants dependant on diameter and physical properties of spring wire design data for springs and constants for following spring materials: music wire, stainless steel, Z-nickel, K-monel, beryllium copper, phosphor bronze and brass; two examples for use of data and constant values presented.

A. Morley.
Torsional Stress in Close-Coiled Helical Springs. Engineering, v. 169, n. 4388, Mar. 3, 1950, p. 231-2, (discussion) n. 4404, June 23, p. 708, v. 170, n 4406, 4407, 4408, 4411, July 7 p. 15-6, July 14, p. 40, July 21, p. 63-4, Aug. 11, p. 135. Method of calculation developed claimed to be simpler, and just as exact as formulas earlier derived by L. E. Adams for stress and deflection.

A. Leyer.
Zur Knickgefahr der gedrueckten Schraubenfeder. Schweiz Bauzeitung, v. 67, n. 29, July 16, 1949, p. 404-5. Buckling of helical compression spring; discussion of paper indexed in Engineering Index 1949, p. 1114, from May 14, 1949 issue.

P. E. Eckberg.
"Hardening, Quenching, and Tempering in the Helical Spring Production Line. Industrial Gaz., v. 28, Jan. 1950, p. 3-5.

Leaf

S. P. Clurman.
Design of Nonlinear Leaf Springs. Am. Soc. Mech. Engrs.—Advance Paper, n. 50—F-5 for meeting Sept. 19-21, 1950, 7 p. At times need arises to incorporate into mechanism, spring having particular nonlinear force-deflection relationship; such need may arise in design of computers, certain control mechanisms, and special shock absorbing systems; technique is developed whereby leaf springs may be designed to follow arbitrary functions having increasing first derivatives; device yielding decreasing derivative.

G. W. C. Hirst.
Laminated Springs. Australasian Engr., v. 43, June 1950, p. 70-5. Stress

analysis: constants relating to elasticity; stress in leaf of laminated spring; graphical and analytical method for determination of length of longest leaf; effect of interleaf friction; fatigue failures of spring leaves; spring design formulas.

Machinery

J. A. J. Bronkhorst.
Nomogram voor het ontwerpen van cilindrische rubber drukveren voor machines, die storende trillingen in de omgeving veroorzaken. Technische-Wetenschappelijk Tijdschrift v. 18, n. 12, Dec. 1949, p. 262-4. Nomogram for design of cylindrical rubber compression springs used for damping of vibrations caused by machines.

Manufacture

A. L. Godshall.
Compressing Springs Hydraulically. Applied Hydraulics, v. 3, n. 1, Feb. 1950, p. 11-3, 28-9. New spring compressing machine, hydraulically actuated and designed for automatic operation, built by Hunter Spring Co.; hydraulic and electric control methods; increased production, flexibility of power and pressure, and minimum maintenance, among principal advantages; illustrations.

S. Thyssen-Bornemisza.
Manufacture of Springs with Low Thermal Coefficients of Modulus of Elasticity. Microtecnic, v. 3, n. 3, 4, May-June 1949, p. 129-33, July-Aug.p. 159-64. Survey of most important methods used for influencing thermal coefficient; reduction of elastic after effect; manufacturing of precision spring; variation of modulus of elasticity with temperature.

Dan Chiegar.
"Painting Coil Springs in Centrifugal Machines." Industrial Finishing, v. 26, Mar. 1950, p. 36-38, 41-42.

Anonymous 433.
"Finishing Operations on Springs." Machinery (Lond.), v. 77, July 13, 1950, Supplementary issue, p. 61-67. (Date on cover. Sept. 28, 1950). Problems involved in the finishing of springs. Methods of finishing both steel and non-ferrous metal springs similar to those used for other metal components. Use of pre- coated wire electroplating, hydrogen embrittlement phosphate treatments, shot peening, and design of springs in relation to subsequent finishing.

H. E. Machado.
"Approximate Relative Costs of Various Spring Materials." Product Engineering, v. 21, Mar. 1950, p. 161. Chart shows relative costs vs. wire diameters for ten common ferrous and non-ferrous materials.

J. D. Thompson and G. W. Rada.
"Chain Feed carries Springs Through Forming Die; Springs Used for Cross-bar Relays used in Telephone Central-office equipment." il. diags., Am. Mach. 94, 86-7, October 2, 1950.

Steel

A. S. Kenneford and G. Ellis.
Comparison of Six Spring Steels. Iron and Steel Inst.— J. V. 164, pt. 3, Mar. 1950, p. 265-77, 3 supp. plates. Report of investigation into heat treatment and properties of four spring steels governed by specification S.T.A. 2, and also chromium molybdenum steel S.T.A. 12 and nickel chromium molybdenum steel to specification B.S. En 25; hardenability and resistance to grain growth and decarburization; Jominy hardenability and mechanical properties after hardening and tempering. Bibliography.

Anonymous 434.
Controlled Heat Treatment of Clock Springs. Indus. Heating, v. 17, n. 4, Apr. 1950, p. 608, 610, 612. How hair springs for automobile electric clocks are effectively age hardened in tube type electric furnaces at Borg Products Division of George Borg Corp, Delavan, Wis.; information on manufacture of hair spring wire, hardening operation and furnace particulars.

Alberto Oreffice.
"American and Swedish Spring Wire." Metal Progress. v. 58, Aug. 1950, p. 198. Wires were subjected to chemical analysis and mechanical testing (especially fatigue testing) by an Italian laboratory. Results indicate that at present American wire for valve springs (quality, oil-tempered, carbon-steel wire) is comparable in quality and fatigue properties with the better Swedish wire.

Stresses

J. A. Haringx.
Instability of Springs. Philips Tech. Rev., v. 11, n. 8, Feb. 1950, p. 245-51. Properties of helical springs, rubber rods and flat spiral springs (as used in timepieces) in relation to buckling; relative compression at which spring of circular wire section buckles depends only upon ratio of length to diameter of spring and upon manner in which ends are fixed; results for rubber rods and flat springs.

W. A. Wolf
Vereinfachte Formeln zur Berechnung zylindrischer Schrauben-Druck- und Zugfedern mit Rechteckquerschnitt. VDI Zeit v. 91, n. 11, June 1, 1949,

p. 259-61. Simplified equations for calculation of cylindrical helical compression and tension springs with rectangular cross section; calculation of shearing stress and spring characteristics for various rectangular shapes; charts.

V. Ya. Zubov.
"Determination of Conditional Limit of Elasticity of Flat Springs Under Pure Bending Stress." (In Russian) Zavodskaya Laboratoriya (Factory Laboratory), v. 15, Dec. 1949, p. 1486-1487. Theoretical analysis. Influence of temperature of annealing on steel springs.

Testing

V. B. Raitses.
"Fatigue Testing of Valve Springs With Surface Defects." (In Russian.) Zavodskaya Laboratoriya (Factory Laboratory), v. 15, Dec. 1949, p. 1494-1496. Types of surface defects and their influence on fatigue strength of valve springs. Test data indicate that the most reliable method for their evaluation is a fatigue test under operating stress for at least 15-17 million cycles.

Vibrations

W. Wuest.
Richtkraft und Eigenschwingungszahl von Roehrenfedern. Technik, v. 4, n. 6, June 1949, p. 277-81. Directional force and natural frequency of Bourdon springs; discussion of dynamic characteristics; diagrams.

1951

Automobile Springs and Suspension

Anonymous 435.
Laminated Torsion Bars. Engineering, v. 191, March 16, 1951, p. 349-50. Results of tests on car fitted on off side with laminated bar in place of one of the original solid units; solid bar allowed definite "bottoming" far more frequently than laminated, while "pitching" on "corrugations" was definitely "corner to corner", indicating more clamping on one side.

Anonymous 436.
Polyethylene in Car Spring Liners. Modern Plastics, v. 28, Feb. 1951, p. 64-65. Two automobile manufactuers have adopted polyethylene spring liners which eliminate squeaks, seal out dirt and grit, and maintain alignment for life of spring.

A. G. Ligier.
Application of Torsion Bar to Suspension of Vehicles. (In French).

Revue Genirale de Micanique, v. 34, April 16, 1950, p. 127-131. Advantages; Manufacture of Torsion Bars; Diagrams.

Clocks

Tetsutara Mitsuhashi and Manabu Ueno.
The Study of Timepiece Springs II. (In Japanese). Journal of Mechanical Laboratory, v. 4, Sept. 1950, p. 174-179. Heat treatment procedures for improving fatigue limit. Refers to 1948 articles in Metal Progress.

Tetsutara Mitsuhashi.
Heat Treatment of Spring Steels for Watches and Clocks. (In Japanese). Journal of Mechanical Laboratory, v. 4, no. 7, Oct. 1950, p. 257-262. Scaling and decarburization, grain growth characteristics, softening speed on tempering, and hardness change on isothermal transformation were studied for spring steels, 0.4 mm thick and containing 0.94 and 1.19% carbon.

Tetsutara Mitsuhashi and Kayuo Tsuya.
Fatigue Strength and Damping Capacity of Timepiece Springs. (In Japanese). Journal of Mechanical Laboratory, v. 4, Sept. 1950, p. 180-185. The relation between damping capacity and fatigue strength of timepiece springs. Results are summarized in English.

Design

W. S. Rouverol.
"Accurate Spring Counterbalancing". Am. Soc. Mech. Engrs.—Trans., v. 73, Feb. 2, 1951, p. 141-4, 144-5.

J. Stoller.
"Novel Mechanical Nomogram Applied to Design of Springs". VDI Zeit, (In German), v. 92, July 11, 1950, p. 555-8. Requirements for mechanized nomogram consisting of group of movable scales; photographs, diagrams.

R. E. Blaney.
"Mill Corrects Helix Pitch". Il. diags. Machine Design, 23:123, July, 1951.

Clyde W. Oicles and Fred K. Landeker.
"Multiple Spring Life Without Changing Design". Iron Age, v. 166, Dec. 21, 1950, p. 80-2. How 11 times more fatigue resistance was imparted to the springs in the Web Wilson oil well drill-pipe tongs. To do it, a change from SAE 1095 to SAE 6150 steel, a change in heat treating methods and adoption of stress peening was required.

L. Kulze.
"Designing Wave Springs". Machine Design, 25:109-10, July 1951. When static load or small working room is required of the spring and allowable amount of axial space is small, use of wave washer is effective method of obtaining the desired load, such springs are often used as cushion springs or spacers between parts on shafts, method of design given.

B. Alexander.
"Methods of Spiral Spring Design". Aircraft Eng., v. 23, Apr. 1951, p. 113-116. Mathematical treatment which has been found extremely useful in design of spiral springs; enables determination of physical dimensions of spring and also its behavior when subject to straining action.

Failure

J. O. Almen.
"Torsional Fatigue Failures". Product Engineering, vol. 22, Sept. 1951, p. 167-82.

J. O. Almen.
"Fatigue Failures From Nominal Compressive Stress, Belleville Type Springs". Il. diags., Product Engineering, vol. 22, Sept. 1951, p. 199, 201, 203.

Finishing

H. H Symonds.
"From a Metallurgist's Notebook: Plated Coil Springs". Metal Industry, vol. 78, June 8, 1951, p. 469. Isolated intergranular films of oxide were found to be the cause of cracking in Ag-plated brass coil springs submitted for examination.

Louis A. Berard.
"Western Spring Manufacturer Develops New Coating and Novel Dipping Process". Western Metals, vol. 9, Jan. 1951, p. 31-32. New process for latex dip coating of bed and cushion springs.

Helical

Anonymous 437.
Guide to Method of Specifying Helical Compression Springs. British Standards Institution, British Standards. 1951, p. 37. Standard applies to hot and cold coiled springs hardened and tempered after coiling; cold coiled springs not hardened and tempered after coiling; design recommendation given for springs made of steel, and other materials.

J. A. Keyes.
Monographic Design of Helical Springs. Machine Design, 22:12, Dec. 1950, pp. 173-174. Chart presented for determining dimensions of steel helical springs to meet given specification of load and travel, and for determining behavior of spring to fit within given space.

W. M. Shepard.
On stresses in Close-Coiled Helical Springs. Quarterly J. Mechanics and Applied Mathematics, v. 3, pt. 4, Dec. 1950, p. 459-68. Spring stresses are studied by considering stresses in incomplete circular ring; it is found that cross section of ring made from originally circular wire is almost exactly circular, but other shapes of cross section would be very considerably modified, especially if ratio of coil radius to wire radius were small; stresses in ring of circular cross section are obtained.

C. H. Sacks.
Dimensional Tolerance Chart for Helical Springs. Reference Book Sheet, Product Engineering, 22:199, 201 and 203, Sept. 1951.

O. G. Meyers.
"Working Stresses for Helical Springs". Machine Design, v. 23, Nov. 11, 1951, p. 135-8, 190. Maximum allowable design stress not constant for given spring material, but varies with wire diameter, stress range, and number of operating cycles; value of stress vs. cycles, how S-N curve is derived from two types of tests can be correlated, permitting application of data from convenient rotating beam tests to be used in design.

C. Thumin and H. A. Riester.
"Simplified Helical Spring Design". Product Engineering, vol. 22, p. 136-40, March 1951. Design procedure outlined; spring calculated tolerances in commercial springs; examples given, data presented in tables and charts, cover design and manufacturing phase.

R. C. A. Thurston.
Strength Characteristics of Helical Springs. Canadian Mining and Metallurgical Bulletin, v. 44, Oct. 1951, p. 658-667; disc. p. 667-668. Transactions of the Canadian Institute of Mining and Metallurgy, v. 54, 1951, p. 414-423; disc. p. 423-424. Numerous considerations affecting the design of helical compression springs. Brief mention of modern methods of spring manufacture, particularly as regards their effort on strength characteristics. A critical analysis of stresses in such springs, and results of laboratory tests under static-loading on a series of truck bolster springs. Efforts of the various methods developed for increasing life or endurance of compression springs, such as shot-peening and scragging.

H. F. Ross.
Torsion Spring Charts for Round or Square Wire. Product Engineering, v. 22, Oct. 1951, p. 203 and 205. Three charts are included for the rapid calculation of helical types of torsional springs which are loaded in a direction tending to reduce the diameter of the coil. These data hold for average conditions where either static or relatively slow varying loads are applied.

Instruments

J. W. Rockefeller Jr.
"Instrument Springs and Spring Instruments". Wire and Wire Products, v. 26, Sept. 1951, p. 764-765, 802-807. The properties required in springs to make them suitable for precision-instrument applications. Properties and applications of different spring alloys.

R. V. Jones.
"Parallel and Rectilinear Spring Movements". J. Sci. Instruments, v. 28, Feb. 2, 1951, p. 38-41. Design of instrument movements in which moving member is held by two equal and parallel leaf springs; member can be moved parallel to itself by pushing it normally to springs; in model parallelism was maintained to within $\pm$ 3.5 sec. of arc over 6 mm. of travel by balancing springs; combining two or more spring systems to develop rectilinear movement.

Leaf

A. Pistocchi.
"Influence of Flush Trimming of Semi-elliptical Leaf Springs Following Castigleano Procedure". (In Italian). Ingegneria Ferroviaria, v. 6, July-August 1951, p. 559-69.

S. P. Clurman.
"Design of Nonlinear Leaf Springs". ASME Trans. 73:155-61. Feb. 1951.

Anonymous 438.
Mechanized Production of Railway Laminated Springs. Engineering, v. 191, Feb. 9, 1951, p. 149-152.

Anonymous 439.
Mechanized Laminated Spring Manufacturing Plant. Engineering, v. 191, Feb. 2, 1951, p. 166-168. English Steel Corporations full scale plant at Grimesthrope Works, Sheffield, and process carried out from incoming flat bar steel to inspection of finished springs at rate of 40 springs per hour; fundamental factor is use of oil hardening instead of water hardening steel; illustrated description of heat treating furnace and

other equipment.

Hisao Matsumoto and Kaoru Kamata.
Form Effects (Gastelt-Festigkeit) of the Leaf Springs. (In Japanese). Journal of Mechanical Laboratory, v. 4, Sept. 1950, p. 186-190. Effects of lowering the stress concentration of the center bolthole by changing hole shape and section shape.

Anonymous 440.
Laminated Springs. Iron and Steel, v. 24, Sept. 1951, p. 443-445. Mechanized production of railway springs is now being carried out at English Steel Corp's. Grimesthrope works. Two furnaces are provided, one for heating the spring packs prior to forming and quenching, the other for tempering.

Machinery

D. H. Vance.
"Steel Spring Type Vibration Mountings for Machine Tools". Tool Engineering, vol. 27, July 3, 1951, p. 47-9. August 5, 1951, p. 55-7.

Manufacture

W. R. Hills.
Are Tangled Springs adding to your Cost? Purchasing, v. 30, March 3, 1951, p. 81-83. Tangling of springs and spring components during shipment is materials handling problem shared by spring manufacturer and industrial user; special attention to design and packing may eliminate trouble.

M. J. Sargeaunt and M. A. Hons.
The Manufacture of Springs. Machinery Lloyd (Overseas Ed.), v. 23, Sept. 25, 1951, p. 77, 79, 81, 81-85. The town of Radditch in England is famous for the manufacture of the smaller types of springs. Some of the methods and equipment used.

W. M. Halladay.
Tensioning Holder for Coiling Spring Wire. Machinery, v. 58, Sept. 1951, p. 192-193.

Shot-Peening

A. B. Brown.
"Shot Peening of Spring Steel". Engineering, vol. 191, May 25, 1951. p. 685.

Springs (General)

Anonymous 441.
Prestressed Springs. Machine Design, v. 23, Jan. 1951, p. 141-142. Experience with recently developed neg'ator spring has proved its adaptability to unusual design applications, such as constant torque output timing device; two outstanding characteristics of prestressed springs are controlled constant, positive or negative force deflection characteristic and extremely large deflection.

H. L. Milo Jr.
Overriding Spring Mechanisms for Low-Torque Drives. Product Eng., v. 22, Oct. 1951, p. 168-169.

A. F. Roogeveld.
Single Spring System for Railway Stock for High Speeds. (In Dutch). Ingenieur, v. 62, Dec. 8, 1950, p. 57-60. The location of bearing springs in Locomotive and cars; comparison between inside and outside bearing springs; why the different locations are maintained.

A. G. Ligier.
Problems relating to Springs. (In French). Revue Genirale de Mecanique, v. 34, June 18, 1950, p. 213-218.

C. Reynal.
The solution of dynamic problems; diagrams. Detailed Analysis of Spring Characteristics and Spring Action. (In French), Dunod, 1950. Covering the following main types: Laminated Leaf Springs; Helical springs of cylindrical, conical and parabolic form; spiral springs; multiple helical springs; and flat annular springs, such as spring washers; spring action under various conditions, general observations on coil springs, and certain specialized types and adaptations dealt with.

E. E. Schiesel.
Prediction and Production of Springs by Statistical Quality Control. Wire and Wire Products, v. 26, May 5, 1951, p. 385-388. Mattatuck Manufacturing Co. has produced over 7,000,000 springs for ammunition fuses without 100% inspection that have fulfilled all government specifications; basic devices for controlling processing consist of frequency distributions and control charts for variables; checking specifications; load testing; heat treating; charting the coils; ploting control; graphs.

Anonymous 442.
New Hand Operated Spring Coiler proves Useful in Industry. Wire and Wire Products, v. 26, April 4, 1951, p. 115-116 and 342.

Description of device manufactured by Carlson Co., New York, for short runs in special spring making; machine semi-automatic, and winds right and left hand compression extension and torsion springs; handles wire diameters up to 0.063 in., OD up to 0.75 in., OA lengths up to 4 in., 25 coils for compression and 100 coils for extension and torsion springs and pitches from 0.0 up to 1.0 inch.

Steel

Anonymous 443.
"New Alloy for Springs, Chromium- Molybdinum Vanadium Alloy Steel". Steel, vol. 129. July 23, 1951, p. 40.

Anonymous 444.
"Typical Properties of Vanadium Spring Steels". Engineering File Facts, 1951.

Anonymous 445.
"Carbon Spring Steel Flat Wire". Am. Iron and Steel Institution. Steel Products Manual, sec. 30, March, 1951, p. 70. Metallurgical aspects; manufacturing practices including rolling heat treating, tolerances, hardening, finishing and inspection requirements of quality, chemical requirements, marking and loading methods.

Stress

J. A. Haringx.
"Instability of Springs". Diags., Product Engineering, vol. 22, July, 1951, p. 227-8.

Victor Tatarinov.
"Strength of Pipes and Spring Material as Affected by Length". Steel Processing, vol. 37, June 1951, p. 284-285, 309. Tests conducted to determine ultimate strength in torsion require certain corrections on specimens length effect. For that purpose, a reasonable correction factor was introduced into the classical strength formulas. Its values were established from test data, and are plotted.

Testing

W. E. Bardgett and F. Gartside.
Fatigue of Coiled Springs; Tests on Heavy Silicon-Manganese Steel Tank Components. Iron and Steel, v. 24, August 1951, p. 375-379. Details of construction of special equipment designed for fatigue tests of coiled springs. Effects of various production factors were determined. (To be continued).

W. E. Bardgett and F. Gartside.
Heavy coiled springs: Fatigue properties of Silicon-Manganese Steel Tank Components, (concluded). Iron and Steel, v. 24, Sept. 1951, p. 411-416; Oct. 1951, p. 454-458. Results of a series of tests designed to investigate the effect of difference in method of preparation, of shot peening and of internal stress. Factors which influence endurance behavior such as structure, hardness, degree of decarburization, internal stress of scragging, and relief of stress in testing,

1952

Airplane Springs and Suspension

Anonymous 446.
Temperature Compensated Spring for Eclipse Pioneer Aircraft Accelerometer. Il., diag., Prod. Eng., v. 23, March 1952, p. 152-153.

Automobile Springs and Suspension

F. T. Rowland.
Modern Leaf Spring Design. Automotive Industries, v. 105, n. 12, Dec. 15, 1951, p. 38-40. Operating stresses and stress patterns discussed; longer springs employed in order to reduce possibility of overstressing due to torque application; use of strain gage and typical recordings indicated; stress pattern of main leaf under static plus dynamic loadings shown; illustrations.

F. C. Badke.
Overhead Handling Facilitates Automobile Seat Spring Production; Universal Wire Spring Co. Il., Steel, v. 129, Oct. 29, 1951, p. 70-71.

Clocks and Watches

Tetsutaro Mitsuhashi, Ryuichi Nakagawa, and Saburo Saito.
The Stress-Strain Diagram of Timepiece Springs. (In Japanese.) Journal of Mechanical Laboraotry, v. 5, Oct. 1951, p. 247-251. To determine permanent set, an apparatus was developed to record the stress-strain curve. The specimen was high-carbon steel wire drawn to 0.5 mm diam. Apparatus is diagrammed. Data are charted and tabulated.

Design

R. M Conklin and D. R. Forry.
Design of Flat-Wound Tension Springs. Am. Soc. Mech. Engrs.— Advance Paper, n. 51—A-59 for meeting Nov. 25-30, 1951, 7 p. Advantages of flat

wound spring; over center snap action and similar devices can be made appreciably more compact because of narrow width of spring; equations for deflection and stress of flat wound springs; nomogram for solving stress deflection equations simultaneously for square and round wire springs; experimental results in support of theory.

M. G. Fangemann.
Designing Springs for Precision Measurement. Product Eng., v. 23, n. 4, Apr. 1952, p. 152-5. Behavior of various spring materials; their properties and uses; analysis of sources of error; suggestions for proper physical design of spring assemblies; coil construction, calibrator design and space considerations; illustrations.

W. R. Berry.
Spring Design— 4-8. Mech. World, v. 130, n. 3374, 3375, 3381, 3382, 3383, Sept.14, 1951, p. 241-5, Sept. 21, p. 269-71, Nov. 2, p. 408-10, Nov. 9, p. 439-40, Nov. 16, p. 466-9. Sept. 14 and 21: Materials from which coiled springs may be made; some of author's original work on spring design introduced. Nov. 2, 9, 16: How to construct more directly usable charts; practical design of tension springs; charts, tables. See also Engineering Index 1950.

F. A. Votta, Jr.
Substitutes for Scarce Materials in Spring Design. Elec. Mfg., v. 49, n. 2, Feb. 1952, p. 116-9, 268, 270. Restricted supply of two popular spring materials, type 302 stainless and phosphor bronze, calls for redesign when substituting more available materials; design steps to follow in changing over.

F. A. Votta, Jr.
Theory and Design of Long-Deflection Constant-Force Spring Elements. Am. Soc. Mech. Engrs.— Trans., v. 74, n. 4, May 1952, p. 439-47 (discussion) 447-50. Discussion of neg'ator or strip of flat spring material given curvature by continuous heavy forming so that in its relaxed or unstressed condition it has form of tightly wound sprial; neg'ator exerts constant or controlled varying force through theoretically infinite deflection; design formulas and operation of three major forms of neg'ator.

Failure

J. O. Almen.
Torsional Fatigue Failures—2. Product Eng., v. 23, n. 3, Mar. 1952, p. 168-74. Analytical studies of fatigue fractures in torsion bar springs for military vehicles that, in spite of inherent planes of weakness, show that torsional fatigue failures are caused by and developed normal to

tensile component of applied stress; data bearing on characteristics of torsional failures obtained from fatigue tests of torsion bars subjected to experimental variations in processing. (See also pt. 1 indexed in Engineering Index 1951 from Sept. 1951 issue).

J. O. Almen.
Torsional Fatigue Failures. Product Engineering, v. 23, Mar. 1952, p. 168-70. Analytical studies of fatigue fractures in alloy steel torsion-bar springs for military vehicles, in spite of inherent planes of weakness, show that torsional fatigue failures are caused by, and develop normal to, the tensile component of the applied stress. Characteristics of torsional failures obtained from fatigue tests of torsion bars which were subjected to experimental variations in processing.

S. S. Nosyreva, T. M. Pogrebetskaya, and A. A. Yurgenson.
Hydrogen Embrittlement of Valve Springs. Vestsnik Mashinostroeniya, (In Russian), v. 31, n. 5, 1951, p. 53-54. Inspection of broken Diesel valve springs showed characteristics of hydrogen embrittlement. To study this further, specimens of spring steel were hardened from 860°C in oil at 70°C and then zinc plated for 5-120 minutes in a bath containing ZnO 40-50, NaOH 70-85, NaCN 70-85, Na_2S 0.5-5, and glycerol 5-8 g/l. Longer plating exposed the steel to longer action of hydrogen. This was confirmed by subsequent tests. Hydrogen brittleness appeared after 5-15 min. plating. Rinsing in hot H_2O, oven drying, and then annealing at 180-200°C, removed brittleness. Prolonged or repeated plating induced irreversible brittleness.

Fatigue

W. E. Bardgett and F. Gartside.
Fatigue of Coiled Springs. Iron and Steel, (London), 24, 375-9, 454-8, (1951). The effects of method of coiling, of variations in the shot-peening intensity, and of residual stress (low hardness plus high stress versus high hardness plus low stress) on large springs of C 0.59, Mn 1.08, and Si 1.77% steel were determined. Increases in shot-peening increased the endurance but also increased the scatter. The effect of raising or lowering the tempering temp. from the normal figure of 470°C was to lower the endurance.

Helical

A. M. Wahl.
Calculation of Rectangular Bar Helical Springs. Am. Soc. Mech. Engrs.—Trans. (J. Applied Mechanics), v. 19, n. 1, Mar. 1952, p. 119-22. Formulas and charts for calculating deflection and stress in helical compression or tension springs of rectangular cross section taking

curvature effects into account; such curvature effects are of importance particularly in small index springs in calculating stress (where fatigue is involved) and in calculating deflections for springs coiled flatwise.

A. G. Ligier.
Considérations théoriques et pratiques sur le ressort à boudin cylindrique. Revue Générale de Mécanique, v. 35, n. 28, Apr. 1951, p. 103-10. Theoretcial and practical consideration of cylindrical helical springs; basic elements of theory; dynamic effects; springs for traction and compression; manufacture of springs; diagrams.

J. A. Haringx.
On Highly Compressible Helical Springs and Rubber Rods, and Their Application for Vibration-Free Mountings. NV Philips Gloeilampenfabrieken, Eindhoven, Netherlands, 1950, 196 p., diagrs. Philips Research Laboratories; presentation in book form, of its serially published papers indexed in Engineering Index 1949, p. 1114, from Philips Research Reports, Dec. 1948, Feb., June, Aug., 1949, and in Engineering Index 1950, p. 1105, from same source Oct., Dec., 1949.

A. Yorgiadis.
Streamlining Selection of Rectangular Wire Helical Springs. Product Eng., v. 23, n. 6, June 1952, p. 155-7. New method of plotting stress and deflection data presented in which factor of higher capacity per unit volume of most rectangular wire springs has been incorporated; saving of time and effort, and other advantages of revised method stressed.

Manufacture

Anonymous 447.
Standardization Cuts Inventory of Extension Springs. Prod. Eng., v. 22, Nov. 1951, p. 183.

C. Y. Lee.
Spring-Winder Attachment Powered by Lathe Spindle. Diags., Amer. Mach., v. 96, Jan. 7, 1952, p. 156.

Nickel Alloys

Anonymous 448.
Unusual Spring Alloy Solves Variable Temperature Problem. Inco., v. 24, n. 3, 1951, p. 18-9, 27. Composition and mechanical properties of Iso-Elastic Alloy which has been successfully used by Bendix Aviation Corp's Eclipse-Pioneer Division to reduce temperature errors in Magnesyn pressure indicating systems; Iso-Elastic reduces gage calibration spring errors over wide range and offers low creep and hysteresis.

Rubber

R. Iredell.
Elastic Rubber Cushion Springs for Torque Load Applications. Product Eng., v. 23, n. 3, Mar. 1952, p. 119-23. New torsion spring consists of combination of rubber and metal parts; load deflection characteristics and basic design proportions for torsional applications; test data obtained from springs of several designs and sizes show that ultimate design load is function of square of diameter of rubber element; illustrations.

Shot Peening

Anonymous 449.
SAE Manual on Shot Peening. Soc. Automotive Engrs.— Publ. n. SP-84, Mar. 1952, 45 p., diagrs, charts. Shot peening process and machines for improving fatigue properties of metals, materials used; effect of peening; process specification; examples of shot peening of springs; illustrations. Bibliography.

Spiral

Anonymous 450.
Manufacture of Small Spiral Springs. Mech. World, v. 130, n. 3373, Sept. 7, 1951, p. 222-3. New nonmagnetic alloy spring material introduced by American Elgin National Watch Co. has high degree of corrosion resistance; predicted industrial applications include power plant and electronic equipment; spring material is manufactured first in strip form; for manufacture of watch springs Elgin uses welded brace assembly at spring end; no information on composition of new alloy available.

Springs (General)

M. G. Fangemann.
How to Choose Spring Materials. Matls and Methods, v. 35, n. 1, 5, Jan. 1952, p. 85-9, May p. 112-6. Jan.: Available spring types described including compression and extension springs, torsion, and flat springs; spring equations and definitions; minimum tensile strength of spring materials; May: Properties of steel compositions, nonferrous metals and special alloys used as spring materials; effect of material on cost and performance of spring.

F. P. Zimmerli.
Metallurgy in the Mechanical Spring Industry. Il. diags., Metal Prog., v. 61, (1952), May p. 97-106; June p. 97-106; July p. 84 -88. The annual William Park Woodside Lecture given before the Detroit Chapter, ASM in October 1951.

Mitsuo Suzuki.
Present Status of Spring Materials for Communication Apparatus. Kinzoku (Metals), v. 20, n. 3, 1950, p. 29-34. Requirements of ferrous and non-ferrous materials for flat springs, and of piano wire for helical springs are discussed. For extended abstract, see Chem. Abstracts, v. 46, n. 4, p. 1418d.

Steel

S. Ammareller.
Die Federstaehle. Stahl u Eisen, v. 72, n. 9, Apr. 24, 1952, p. 475-88 (discussion), 488-9. Development, properties and applications of spring steels; requirements; tests on several steels for determining effects of surface finish, corrosion and cross section of specimen; manufacture of springs from steel bars or sections, cold rolled strip, drawn or drawn and ground steel bars or wire; heat treatment.

Anonymous 451.
Alloys vs. Straight Carbon Steel for Mechanical Springs. Mainspring, v. 14, Feb. 1952, 4 pages. Conditions necessary to make pretempered wire, and the reasons why some alloy steels do not lend themselves to this process. The patenting process and resulting mechanical properties.

Anonymous 452.
Stainless; Springs in Parachutes Replace Rubber. Iron Age, v. 169, April 24, 1952, p. 169.

Mitsuo Sakamoto and Kenji Ebashi.
Spring Characteristics of 18-8 Stainless Steel. Kinzoku (Metals), v. 20, n. 12, 1950, p. 39-41. The mechanical properties and fabrication of 18-8 stainless steel, the spring characteristics, and some consideration on use of 18-8 stainless steel springs are described. For full abstract see Chem. Abstracts, v. 46, n. 4, p. 1411f.

Sadao Koshiba.
Steel for Cutting Tools and Springs. Kinsoku (Metals), v. 20, n. 2, 1950, p. 77-80. Types of steel used for razor blades, agricultural cutlery, watch springs, phonograph springs, rail car springs and automobile springs are discussed. For full abstract see Chem. Abstracts, v. 46, n. 4, p. 1412b.

Testing

J. J. Ryan.
Characteristics of Dished-Plate (Belleville) Springs as Measured in Portable Recording Tensiometers. Am. Soc. Mech. Engrs.— Trans., v. 74, n. 4, May 1952, p. 431-7 (discussion) 437-8. Development of

tensiometers for maximum tension loads between 5000 and 16,000 lb. made possible determining load deflection characteristics of Belleville springs of same size and shape, except for variation in thickness; description of tensiometer; comparison of theoretical calculation with results of load deflection tests.

SUBJECT INDEX