

ENGINEERING RESEARCH INSTITUTE

UNIVERSITY OF MICHIGAN

ANN ARBOR, MICHIGAN

NUCLEAR RESEARCH AND DEVELOPMENT

PROGRESS REPORT

(For the Period April 3 to July 2, 1956)

Project 2505

Chrysler Corporation

July 15, 1956

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1.0 INTRODUCTION

This report is the second progress report issued under the contract between the Chrysler Corporation and the Engineering Research Institute on nuclear energy research. The first progress report (2505-2-P) was issued June 15, 1956 covering the period January 2 to April 2, 1956. This report covers the subsequent quarters work.

2.0 SUMMARY AND CONCLUSIONS

Fabrication of the loop and components, as discussed in the previous progress report, has been proceeding. The loop furnace is complete and has been installed inside the transite enclosure. The actual construction of the loop and components has been contracted to Alloy Fabricator Division of Continental Copper and Steel Industries, Perth Amboy, New Jersey, for delivery the second week of September. Contracts for fabrication of the cooling air duct work has been awarded with early delivery assured. There should be no delivery problems or delays in the remaining loop components.

A vacuum system composed of a mechanical fore pump and water cooled oil diffusion pump has been built and leak tested. This unit is equipped with a thermocouple vacuum gage and can be used in conjunction with a freon leak detector.

Leaks were found in the helium purification system which necessitated a partial dismantling and re-soldering of the joints. This system is now leak tight as far as it is fabricated at present. The heating coils for the titanium reactors have not been completed as yet pending arrival of new "cal-rod" heating units.

Thermodynamic data indicates that hydrogen firing will be largely ineffective at temperatures the loop can be safely withstand. This has necessitated some upward revisions in the degassing temperatures required. Additional heating coils and temperature controls will be installed on all loop components to enable degassing temperatures to be reached that are 50°F higher than maximum loop operating temperatures.

Most of the loop control instruments have been received and installed on the panel boards. Electrical wiring of the instruments and thermocouple connections is underway. The pressure transmitter at the electromagnetic pump inlet is being eliminated since it appears that the pump will operate satisfactorily without cavitation at the temperatures and pressures reached in the loop. The Moore pressure transmitters will apparently be the longest delivery items of all the instruments.

An instrument development program is highly desirable to develop satisfactory liquid level and interface indicators and controllers for molten metal systems. A program is outlined based upon two promising methods of measuring these variables. These methods involve ultrasonic sound devices and an oscillating probe that appear to have considerable promise. Construction of an instrument development facility is recommended to evaluate new concepts and to check out commercially available instruments.

Two carbon resistance furnaces, one large and one miniature have been completed. These furnaces will be used to prepare and test impregnated graphite and coatings on graphite as materials of construction for nuclear reactors using molten metal fuels. Equipment is under construction to supply a graphite crucible heated in such a furnace with a vaporized zirconium or titanium tetrachloride. The metal halide is

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decomposed and a metal carbide is formed which diffuses into the graphite making the structure impervious. Carbides of these two elements are inert to attack by a molten uranium fuel.

An induction furnace has been constructed and will be used to coat base metals with a metal coating that is inert to molten metal fuels. A vapor coating technique will be used to apply the metal coating.

Oxidation and temperature cycling tests on coated 2 1/4 Croloy specimens have shown that aluminum dip coatings, nickel braze, and chemically deposited nickel coating is satisfactory to protect 2 1/4 Croloy against air oxidation. Temperatures were cycled approximately 500 times from 1400 to 1000°F during this test. Tests on other coating materials are underway.

Analysis of bismuth for loop use shows considerably more impurities than indicated by the suppliers analysis. For reactor use, the quality of bismuth should be purer than the current lot.

Samples have been prepared and analyzed by two different laboratories. Agreement between "weighed in" quantities and analytical results was not obtained. Improvements in sample preparation and analytical procedures should result in close agreement in the future. Work is being done towards improving the analytical methods for determining more accurately the various components in molten fuel systems.

Methods have been examined for calculating critical sizes and fuel compositions in fast reactor systems. A modified transport equation is believed to be adequate for this computation. A digital computer calculation will be made by these methods in the near future.

Since the last quarterly report, 384 mandays have been spent on the loop, 209 on the materials program, and 54 on nuclear calculations.

3.0 LOOP STATUS

3.1 Loop Construction

3.1.1 The loop furnace has been completed and set inside the enclosure. Figure 1 shows the top of the furnace with the lid suspended just above the furnace enclosure. Four of the "Hot Rod" heating elements can be seen in place. The loop heating coil slides in place just under the heating elements. An emergency water cooling system, to prevent excessive heating of the loop heating coil in case of power failure, has been installed. The only remaining connections to be made to the loop proper are electrical bus connections to the heating elements. The transite enclosure wall around the furnace is visible on the side and back of the furnace. Figure 2 shows one wall and the entrance doorway to this enclosure. The heating coil slot into the loop furnace can be seen through the doorway. The ceiling panels have been left off this enclosure until the installation of the loop equipment is completed. The furnace transformer and saturable core reactors have been placed at the rear of the furnace and outside the transite enclosure.

The fabrication and assembly of the circulating loop and vessels has been contracted to the Alloy Fabricator Division of Continental Copper and Steel Industries, Perth Amboy, New Jersey. They have received the alloy material for fabrication of the equipment and have promised delivery of the assembled system by the second week of September. The system will be shipped on a supporting skid and filled with inert gas. On arrival at Willow Run, the system will be connected to an inert gas source to maintain the purge blanket. The end wall of the enclosure will be removed and the system slid into place and the support skid dismantled.

A high noise level made it necessary to mount the cooling blower in an outside shelter adjacent to the east wall of the building. The shelter lid is hinged to permit access for maintenance. The duct work for the cooling system is being contracted to the Ralph L. Davis Company, Ypsilanti, Michigan. The frame to support the duct work to and from the finned tube cooler has been completed. In addition, the portable heater to preheat the cooler has been built. The portable vacuum system has been built and has been checked for leaks. The apparatus as used is shown in Figure 3. The vacuum system including the mechanical and diffusion pumps and cold trap is mounted on the cart at left. A thermocouple vacuum gage and freon leak detector is shown on the cart on the right. The system is being used to leak check one of the stainless steel reaction tubes that is to be mounted in the helium purification system. The thermocouple type vacuum gage is to be used as a multiple point vacuum indicator. Unfortunately, the calibration



FIGURE I
LOOP FURNACE ENCLOSURE
AND HEATING ELEMENTS

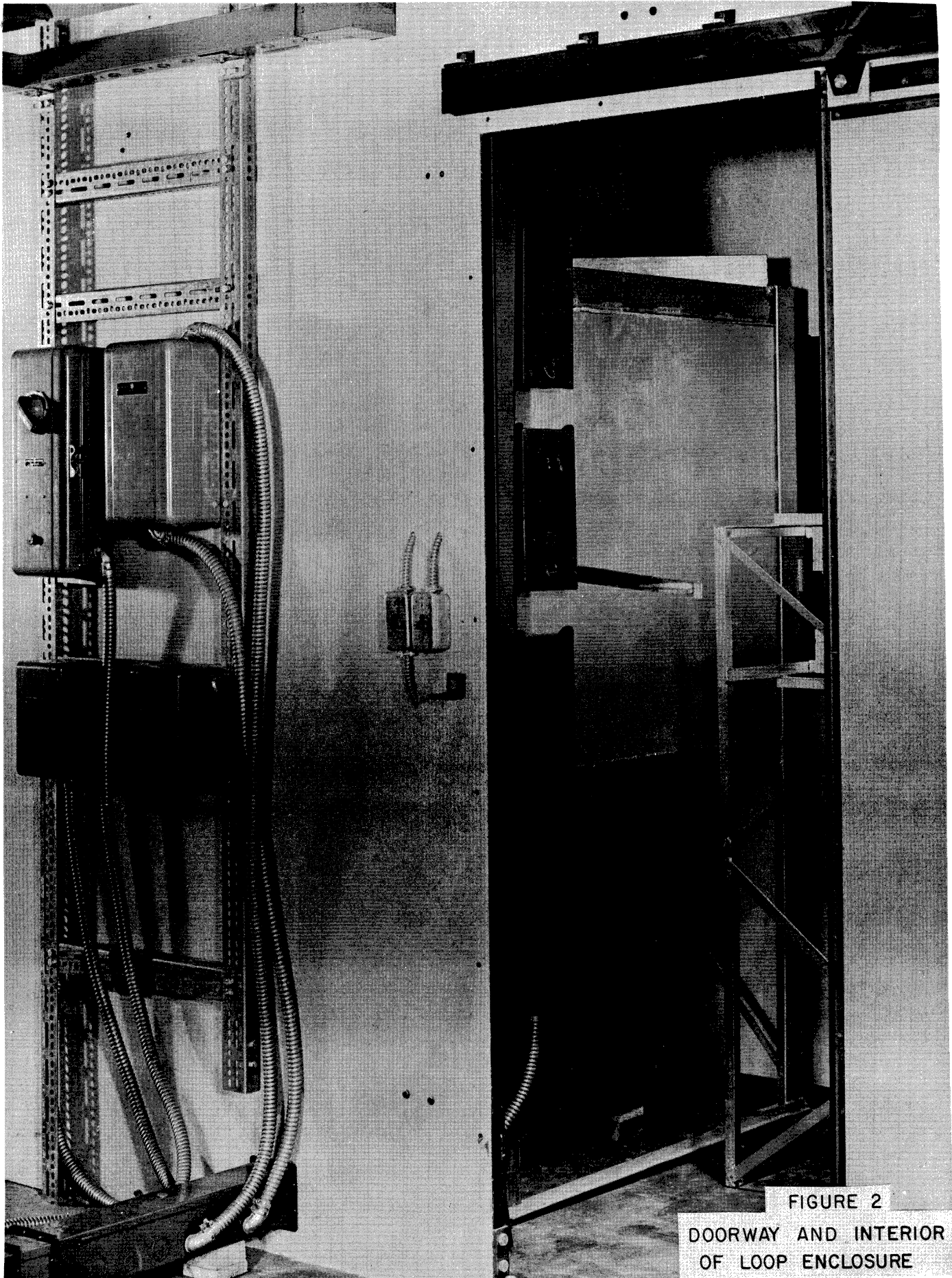


FIGURE 2
DOORWAY AND INTERIOR
OF LOOP ENCLOSURE

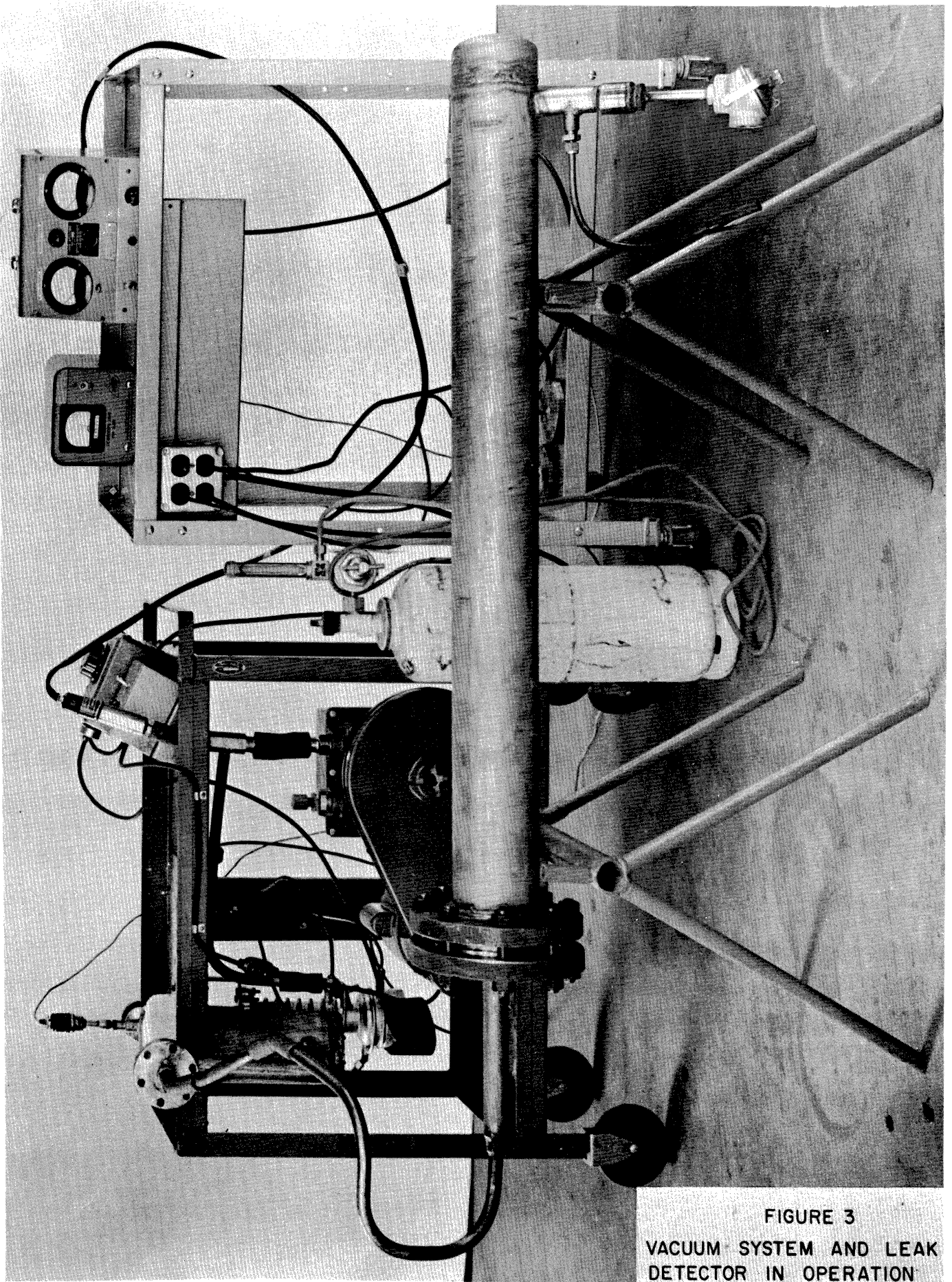


FIGURE 3
VACUUM SYSTEM AND LEAK
DETECTOR IN OPERATION

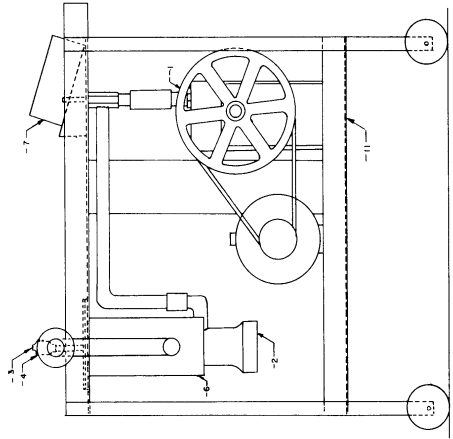
of the instrument changes when the sensing element is changed. For this reason, a calibration curve must be made with each sensing element to be used. A Stokes Machine Company, McLeod type gage has been ordered for use as a primary standard in running these calibrations. Several freon leak detectors were tried before satisfactory response and reproducible results could be achieved. The leak testing system is being checked against a University owned helium type detector to train personnel in the use and interpretation of results from the freon detector. Techniques in using this equipment are improving and it is believed that reliable results will be obtained in the future.

A more detailed picture of the vacuum system is given in Drawing 2505-91R-1008. This drawing shows how the component parts are mounted to obtain shortest possible piping connections.

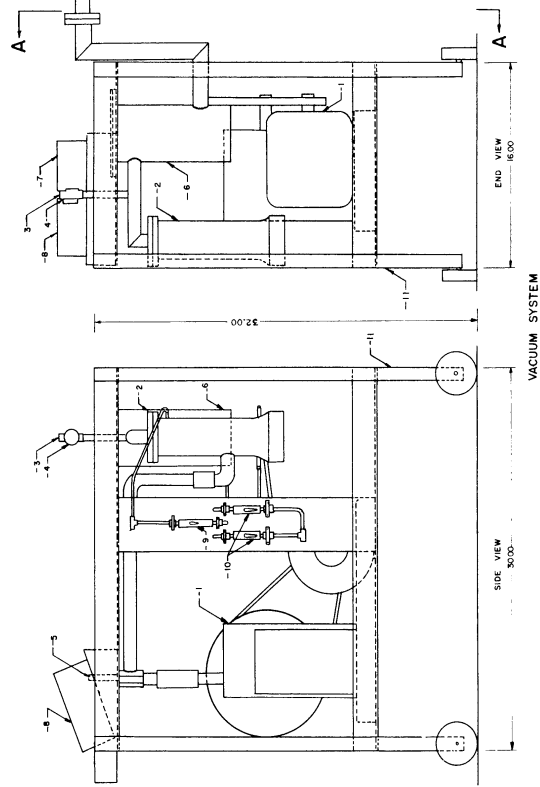
The helium purification system is shown in Figure 4. This figure shows the two purified helium storage tanks mounted on the side of the frame with the temperature control equipment for the titanium reaction tubes being shown at the bottom of the panel. Piping and valve manifolding together with the dryer and deoxo unit are mounted on the upper half of the panel. One of the titanium reaction tubes is shown without the heating coil and insulation at the rear of the panel. Helium purification testing apparatus will be mounted behind the plexiglass shield shown in the center of the panel. After assembly, subsequent testing revealed considerable leakage. A new assembly method has been devised so that all but two or three joints may be soldered on the bench with access to all sides of the joint. It will also be necessary to use more flux on the joints to make up the joint successfully. The Calrod heating coils for the reaction furnaces cracked and shorted-out on being silver soldered to the preheater tube. The stainless steel preheater tubes also cracked. The cracking was apparently due to the stress from cold bending the tubes prior to silver soldering. New Calrod units are on order and will be attached to the preheater tube with fine inconel wire. The helium system manifold is essentially complete and the largest task to finish will be the installation of the reaction tubes. The auxiliary panel board has not been started and is the main piece of equipment, apart from the loop proper, that is not nearing completion.

- 3.1.2 Since it will be necessary to remove the end wall of the enclosure to install the bismuth system when it is received from the fabricator, the helium and vacuum connections will be moved to the opposite side of the enclosure from the control board. This new location will permit work to begin immediately on an auxiliary panel board to control the sampling process and the transfer of molten metal from sump and melt tanks to the circulating loop. The portable helium

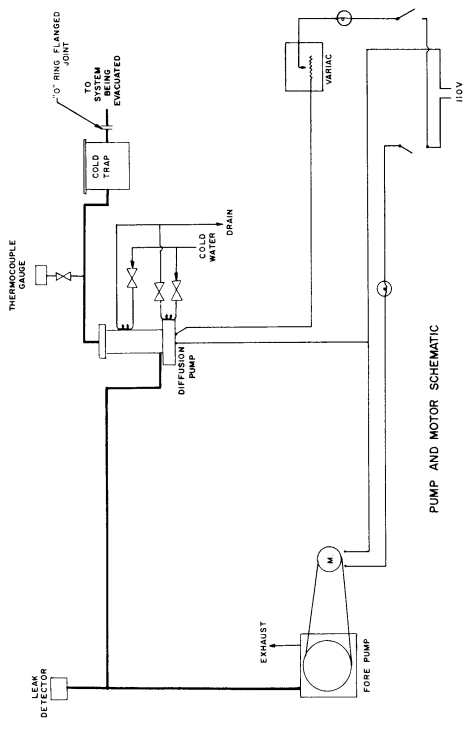
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A-A



VACUUM SYSTEM



PUMP AND MOTOR SCHEMATIC

11	PORTABLE STAND
10	WATER OUTLET CONTROL VALVE
9	WATER INLET CONTROL VALVE
8	CONTROL BOX
6	COLD TRAP
5	LEAKDETECTOR ELEMENT CONNECTION
4	THERMOCOUPLE GAUGE VALVE
3	THERMOCOUPLE GAUGE CONNECTION
2	DIFFUSION PUMP
1	FORE PUMP AND MOTOR
PT NO. DESCRIPTION	
Electronic Range Instrument	
United States of America	
PROJECT	
CLASSIFICATION	
PAGE NO. D-2505-9IR-1008	

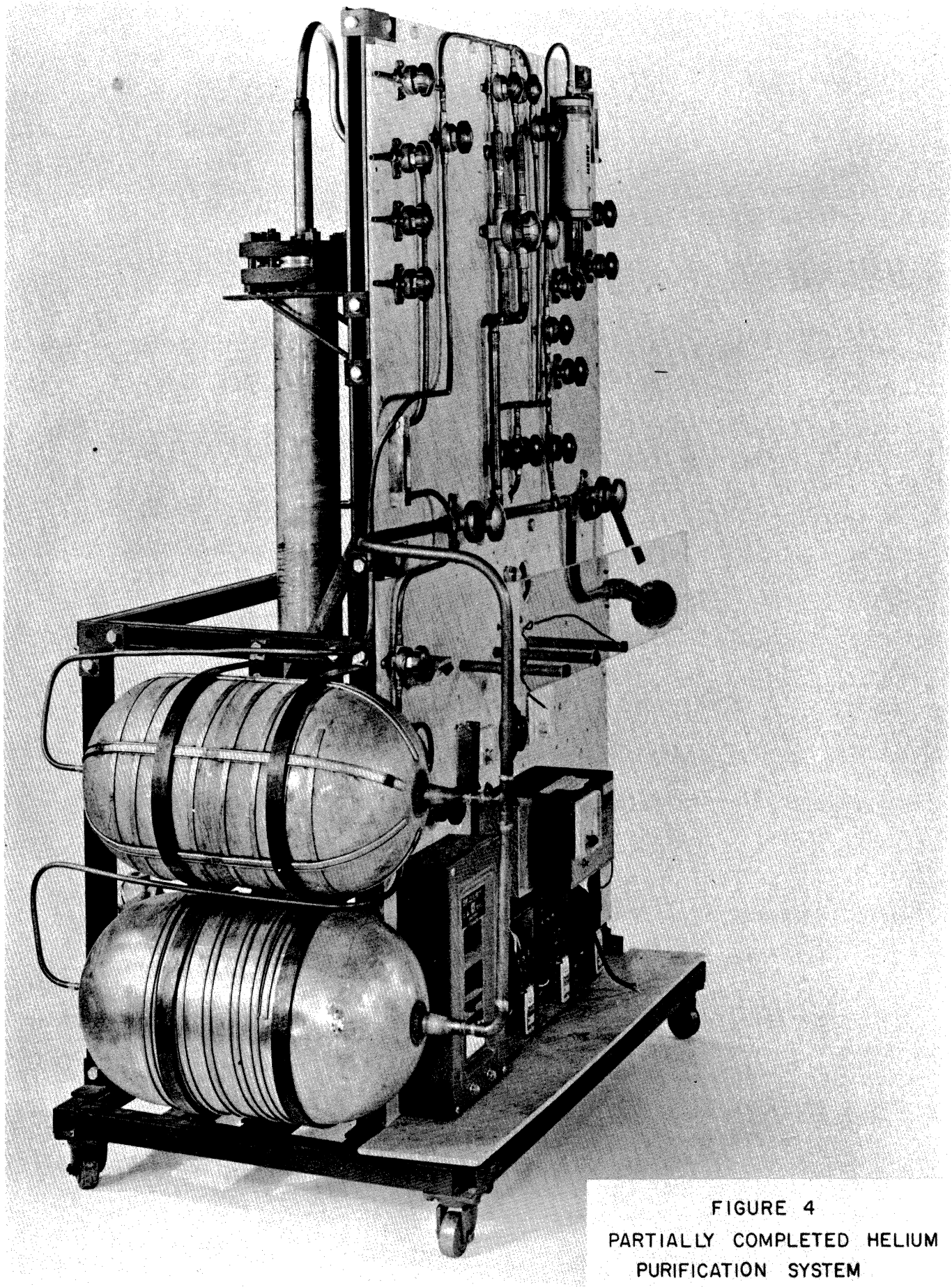


FIGURE 4
PARTIALLY COMPLETED HELIUM
PURIFICATION SYSTEM

purification system and the vacuum pumps will be located adjacent to the enclosure by the auxiliary panel board.

The inhibitors will be added to the melt tank after the bismuth has been melted to insure operation of the circulating loop with additives present at all times. The additions will be made through a ball valve and sliding seal mounted on the melt tank flange. The heating requirements for the melt and sump tank will be increased to 850°F to insure that the zirconium and magnesium will go into solution. Zirconium is soluble to the extent of 900 ppm in the presence of 1000 ppm of magnesium at this temperature according to Brookhaven National Laboratory. Approximately 250 ppm of zirconium will be required for corrosion inhibition.

The preheating requirements of the loop proper have been raised to 1300°F so that the loop will be out-gassed at least 50°F above the maximum operating temperature. Additional heating wire circuits will provide for this increase in temperature and a longer heat up time will be allowed for the preheater on the finned tube section. The ball valve on top of the sampler riser will be cooled by a water coil to protect it from the high temperatures reached while preheating the sampler. The valve has a rubber "O" ring body seal and a maximum temperature rating of approximately 200°F.

It was originally planned to "hydrogen fire" the loop before operation to remove oxygen diffused in the metal, however, this has been changed to out-gassing the system at a temperature higher than the probable operating temperature. The thermodynamics of the H_2 + metal oxide reaction indicate the proposed preheat temperature is not high enough to assure combination. The outgassing will be accomplished by connecting the loop to the vacuum header during preheat.

The manifold from the helium storage bottles to the purification system will be equipped with a pressure relief valve to prevent the helium pressure from being increased in excess of 50 psig; the loop design pressure.

3.1.3 Status of Procurement

Table V and VI in the appendix of this report summarizes the status of procurement on all requisitions prepared before July 1st. A number of items such as office supplies, and certain small parts are excluded from the tables.

The electrical equipment on order with the Westinghouse Electric Corporation, that is to be used for the electrical wiring revisions of Building #8 will probably not be delivered until the end of August. The loop fabrication, which is being done by Alloy Fabricators of Perth Amboy, New Jersey, will not be completed until around September 5th. These are the most critical items on the list and entail the greatest delay.

The major part of the tools and shop equipment which might be needed for construction work, fabrication of small parts, and maintenance or alterations have been received and are in operating condition at the present time.

3.2 Loop Instrumentation

The major efforts of the Instruments & Controls Group during the second quarter were directed towards the actual construction of the instrumentation system of the Bismuth Circulating loop. Some consideration has been given to the problem of determining which types of instruments should be developed by this group in order to meet the future demands of any projected liquid metal fuel reactor.

3.2.1 Design Changes

Only minor design changes have been made since the previous Quarterly Report.

3.2.1.1 E.M. Pump Inlet Pressure

The most significant change is the elimination of the pressure transmitter at the EM pump inlet. General Electric Company engineers have expressed the opinion that at the flow rates we propose to use, no cavitation is likely to result unless the system is under very high vacuum. Since this condition will exist only temporarily during the sampling operation when the Moore Transmitters are not operable (they are not suitable for vacuum operation), the extra transmitter has been eliminated. A pressure gage reading either sampler pressure or the loop pressure at the inlet of the flowmeter will be included on the main instrument panel for convenience of the operators.

3.2.1.2 Additional Auxiliary Heater Capacity

Recent information received from BNL indicates that the circulating loop should be raised to a much higher temperature (1200°F - 1300°F) than was originally planned (600°F) during initial out-gassing at high vacuum. In order to attain these temperatures, the capacity of the heaters used to preheat the loop must be greatly increased by wrapping additional heater wire on the loop. The additional heaters will be controlled by the same temperature controllers included in the original design but will not be equipped with variable voltage transformers. Sizing of the additional heaters has not been completed at this date.

3.2.2 Construction

All major items required for the installation of the control

system have been received with the exception of the Moore transmitters. Most items have also been checked for proper operation and calibration. The minor items not yet received will not delay installation of the system if they are received by their expected delivery dates.

Approximately three-fourths of the instruments and electrical conduit have now been installed. The electrical wiring and pneumatic tubing is scheduled to be installed at an early date. It is anticipated that the installation of all items not attached to the tanks, loop, etc. will be complete before September 1.

Construction status of the control panel is illustrated in Figure 5. The top panel of the first column of panels contains receiver gages indicating the sump tank liquid level and system pressure. Between the two pressure gages is a voltmeter to indicate the output voltage of the saturable reactor. This will be used to indicate when the taps on the Global transformer should be changed to compensate for Global aging.

The Global furnace temperature indicator-controller is located in the lower left corner of this panel. The finned tube cooler exit temperature recorder and associated controller are located one above the other in the lower right hand corner of the panel.

The middle panel of the first column contains all of the flow measurement and control equipment. The meters in the upper corners of this panel indicate the voltage and amperage of the current supplied to the electromagnetic pump thru the Powerstat variable voltage transformer located on the bottom of the panel. The receiver gage between the two meters indicates the flow rate of the liquid bismuth.

The thermocouple converter and voltage stabilizing transformer for the test section exit temperature controller are located on the rear of the lower panel of the first column.

The small panel located above the top panel of the second column contains the annunciator system which indicates by lighted panels the equipment that is not functioning correctly.

Located below the clock on the top panel of the second column is an auxiliary panel containing indicator lights to indicate which auxiliary heaters are energized. Below the row of indicator lights are located from left to right respectively, an elapsed time indicator connected to the electromagnetic pump, the startup control switch, push button for testing the lamps of the annunciator system and the annunciator alarm acknowledge button.

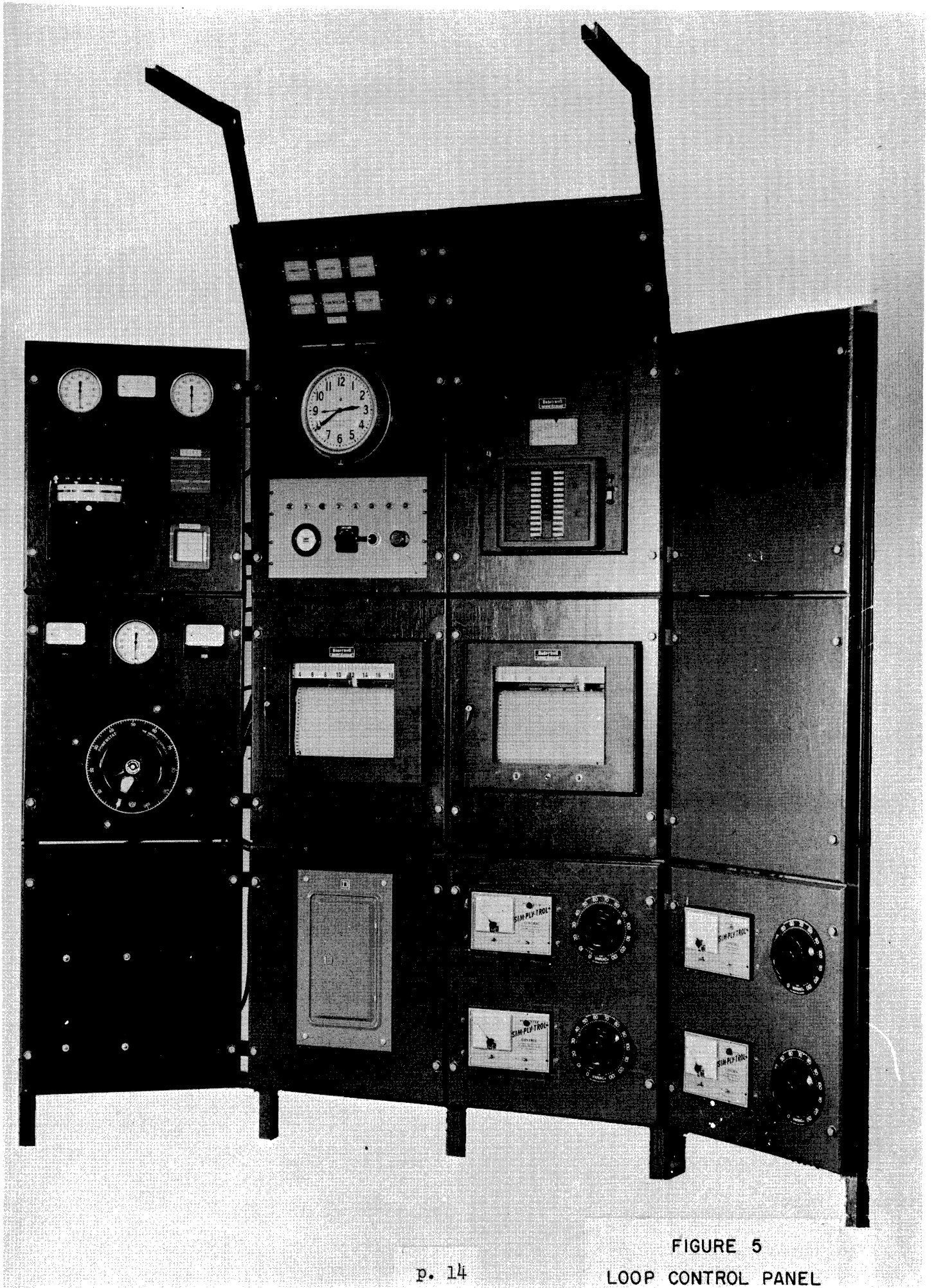


FIGURE 5
LOOP CONTROL PANEL

The middle panels of the second and third column contains a multipoint temperature recorder.

The lower panel of the second column contains the circuit breaker cabinet which controls the power to the various control and heater circuits of the loop.

A multi-point precision temperature indicator is located in the top panel of the third column.

The bottom panels of the third and fourth columns contain four temperature control systems, one each for the sump tank, melt tank, loop auxiliary heaters, finned cooler auxiliary heaters. Each system consists of a temperature controller and adjacent variable voltage transformer.

The top and middle panels of the fourth column are blank panels for future use.

3.2.3 Instrument Development

Instruments are now available which can do an acceptable job of controlling almost any process whose variables can be measured. The problem of obtaining accurate continuous measurements of process variables is often a difficult one even in conventional chemical processes operating at moderate pressures and temperatures. The high temperatures (1000-2000°F) involved in liquid metals systems cause measurements that are ordinarily relatively straightforward to become extremely difficult problems. In addition to the problem of temperature coefficients of the instrument calibration present in all instruments and particularly those operating at high temperatures, liquid bismuth systems present serious corrosion problems which very severely limit the choice of materials available for use in such systems. As a result, only a very few of the commercially available measuring instruments are suitable for liquid bismuth service at 1000 - 2000°F.

Most of the commercially available instruments for measuring flowrate, liquid level, and pressure utilize pneumatic transmission. It is the policy of the AEC Reactor Safeguards Committee that a minimum of pipes and tubes may penetrate the reactor shield. The quantity of air or other purge gas that may be vented inside of the reactor shield must be kept to an absolute minimum and decrease the possibility of radioactive material contaminating a working area. Electrical data transmission is the only system which meets these requirements.

As electrical data transmission of automatic control signals is relatively new to the process industries, only a few companies supply this type equipment. The choice of available

measuring equipment for use with liquid bismuth systems at 1000-2000°F is, therefore, very limited.

If the instruments are to be used in regions of high neutron and gamma fluxes, the problem becomes even more complicated as almost all of the transmitters using electrical data transmission systems use organic materials in their coil forms and insulation. As these materials are highly susceptible to radiation damage, most of the manufacturers will not commit themselves as to the long term reliability of their instruments under these conditions.

3.2.3.1 Measurements Required

Any liquid fuel reactor system will probably require that the following basic measurements be made somewhere in the bismuth system:

- 1) Temperature
- 2) Pressure
- 3) Liquid Level and Interface
- 4) Flow Rate

Temperature is the only measurement which can easily be measured with standard equipment such as thermocouples, recording and controlling potentiometers. Temperature is, therefore, of relatively little concern in this development program.

The situation with respect to pressure transmitters suitable for use in high temperature liquid metals is not nearly as satisfactory as for temperature. Most measurements can be made with commercially available transmitters, however, the price of the transmitter will be high. Manufacturers of such equipment are General Electric Company (pneumatic), Callery Chemical Company (electric), and Moore Products Company (pneumatic).

To date, the above transmitters have been produced only of 18-8 stainless steels and Inconel for sodium and NaK service. Moore Products Company is currently committed to supply several of their transmitters of 400 series stainless steel at an early date for trials in bismuth. There is no obvious reason why the others cannot be similarly altered if the occasion warrants.

Commercially available instruments suitable for measuring liquid and interface level in high temperature liquid bismuth systems are almost nonexistent. The situation is somewhat better for sodium and NaK systems where non-magnetic materials of construction are suitable. Visits to several instrument companies indicated that all are aware

of the problem, however, relatively few are actively pursuing any definite development program. Callery Chemical Company appears to be the closest to a satisfactory solution, but are not willing to release many details at this time. Their design uses a modification of their pressure transmitter to measure the bouyant force on a displacement member immersed in the liquid metal.

Several conventional liquid level transmitters of the float type can be used in liquid bismuth service if their bearing and measuring heads can be located on extensions to the tank such that they can be kept cool (below $\sim 400^{\circ}\text{F}$) and isolated from any surging or splashing of bismuth. (This is not feasible with sodium and NaK systems because the high vapor pressure of sodium permits sodium vapor to condense on cold surfaces). Most of these transmitters require 4" to 6" - 150# flanges for mounting so will result in large heat losses to any tank they are mounted on. The flanges could be easily modified however.

Of the numerous methods of measuring liquid level, the following appear to be promising:

- a) Ultrasonic
- b) Oscillating probe

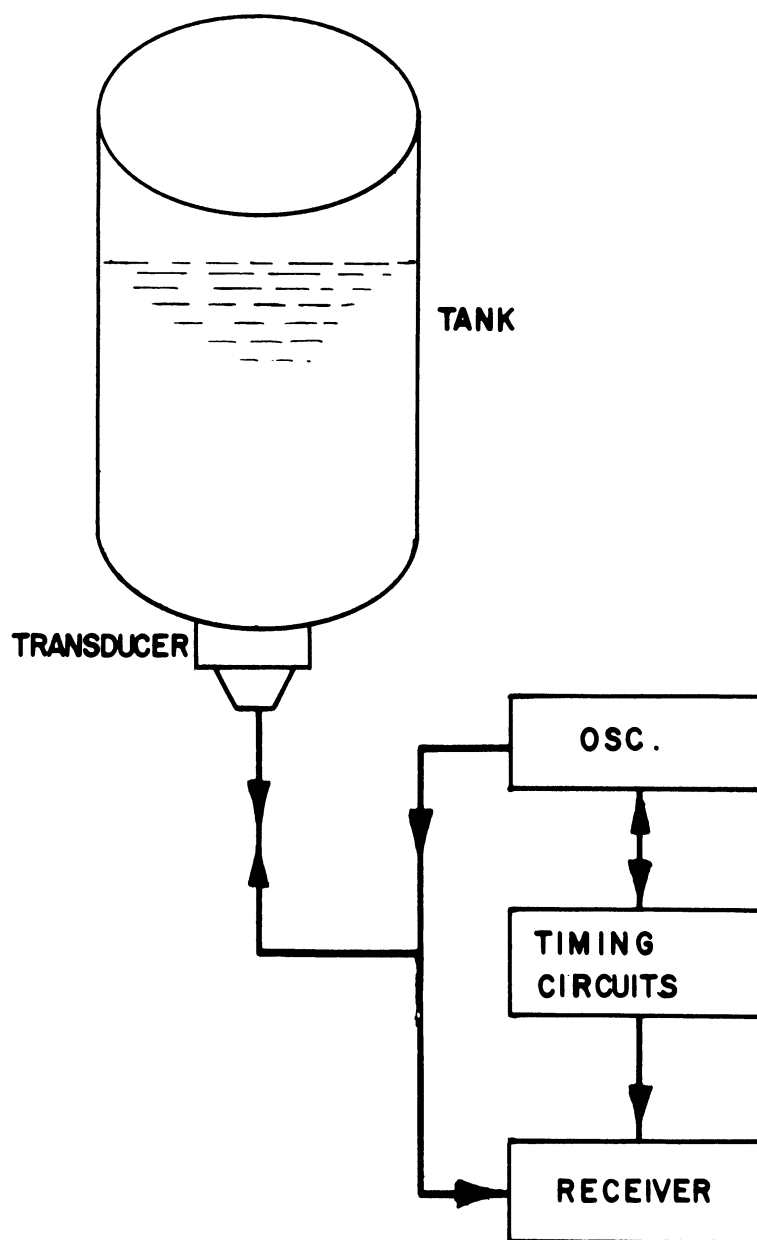
The ultrasonic type of level measuring instrument consists of a pulsed electronic ultrasonic oscillator, transducer, receiver, and suitable timing circuits, arranged as in Figure 6. The pulses of power from the oscillator are projected into the liquid through the bottom of the tank. The echoes of these pules reflected back from the surface of the liquid are then received by the transducer and transmitted to the receiver. The time interval between the transmitted pulse and the returning echo is measured by the timing circuits. This time interval is a function of the liquid level in the tank.

Equipment of this type is currently manufactured by the Bogue Electric Company, however, their transducers are rated only to 130°C . It may be possible to insert a thermal spacer between the transducer and the tank and so isolate the transducer from the high temperatures. This possibility is now being explored with the Bogue Electric Company. Because the velocity of sound is high, this type of instrument is most suitable in situations where the change in liquid level to be measured is of the order of several feet.

FIGURE 6

ULTRA SONIC LIQUID LEVEL INDICATOR

REF. BOGUE ELECTRIC CO. BULLETIN S-68B pg. 3



The oscillating probe type of instrument is shown by Figure 7.

The 1-10 cps. sine wave generator supplies an air pressure signal to the bellows which in turn causes the probe to oscillate about its pivot point. The amplitude of the probe oscillation, A , is detected by the linear variable transformer whose output signal is amplified, rectified and measured by the amplifier and meter. As indicated in Figure 7, if the probe is driven at some fixed frequency ω_1 , variations in the liquid level of the tank will vary the amplitude of the oscillation of the probe. Since bending of the probe itself will also affect the amplitude of the oscillations, this type instrument is probably most suitable for ranges of liquid level change from 6-18 inches. No commercial instruments of this type are currently available. It is estimated that a prototype model can be built for about \$100 worth of materials.

Little thought has been given to interface level measurement at this time, however, it would appear that additional timing circuits in the ultrasonic type level indicator should be able to measure the liquid levels of two liquids in contact at an interface.

Two types of flowmeters appear to be satisfactory for use with liquid metals.

- a) Differential Pressure Type
- b) Electro-Magnetic Type

The differential type of meter uses conventional orifice plates, flow nozzles or venturis of the proper material to withstand service conditions. The major expense involved in this measurement is the two pressure transmitters required for measuring the drop across the primary element. No differential pressure measuring devices are available for liquid metals service at elevated temperatures. This type of meter can, therefore, be utilized with no additional development cost. As mentioned earlier, the cost of the pressure transmitters is high.

Electro-magnetic type flowmeters consist of a piece of pipe, preferably non-magnetic, with a magnetic field passing through the pipe perpendicular to the pipe axis. Electrodes are welded to the pipe diametrically opposite one another and perpendicular to the magnetic field. Under these conditions any good electrical conductor flowing in the pipe will

FIGURE 7
OSCILLATING PROBE LIQUID LEVEL INDICATOR

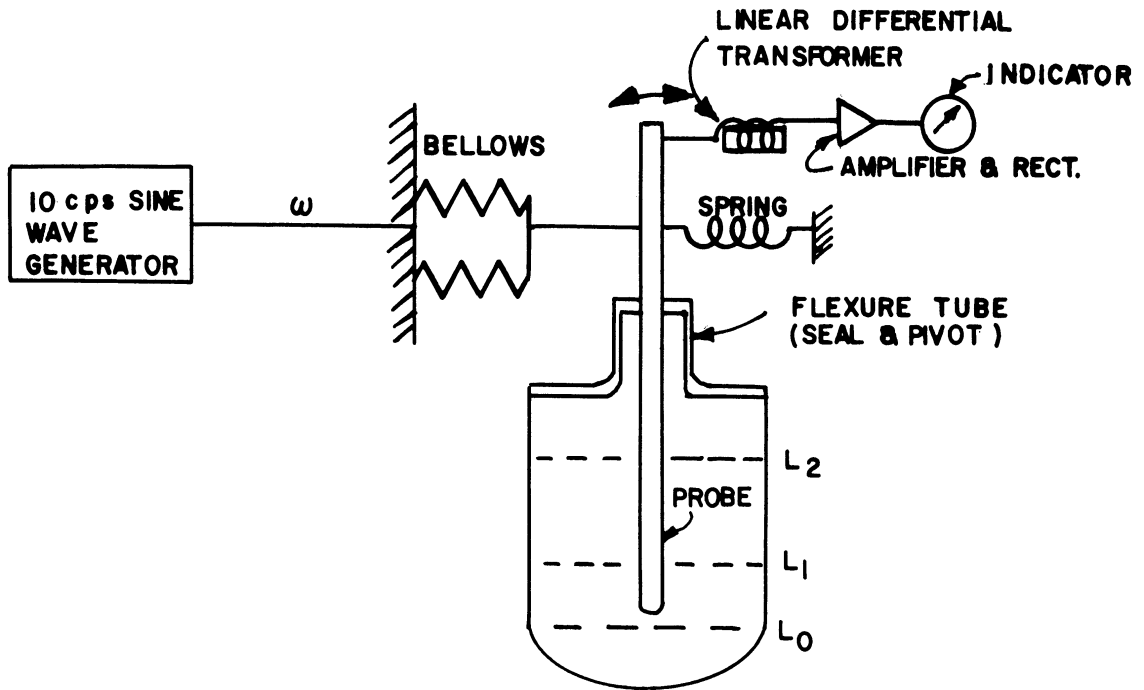


FIGURE 7 a
SCHEMATIC

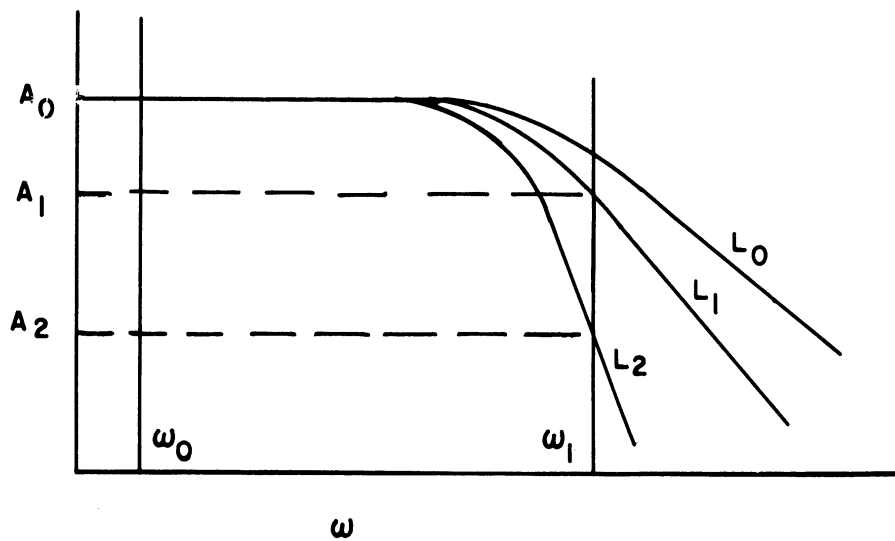


FIGURE 7 b
SYSTEM FREQUENCY RESPONSE

cause an EMF, proportional to the flowrate, to be induced in the electrodes. This meter is simple and requires only a conventional potentiometer to indicate or record the flow rate. Its cost is reasonable, \$500 for a 1/2" meter made of 18-8 stainless steels from either General Electric Company or Callery Chemical Company. These meters have been used quite extensively in sodium and NaK service to 1500°F and have proven to be quite satisfactory.

Relatively few of these meters have been used in liquid bismuth service as 18-8 stainless steels are not satisfactory. At the present time, no non-magnetic materials are suitable for liquid bismuth service so that if this type meter is used, a much larger magnet is required to produce the magnetic field required inside of a magnetic pipe to give a workable EMF output from the meter.

In order to reduce the extramagnet requirements, the General Electric Company proposes to use flow cells constructed of 347 stainless steel lined with 0.010 thickness of 2 1/4 chrome - 1 molybdenum steel, however, none have been built to date.

3.2.4 Instrument Development Facilities

The initial testing of any instruments developed can best be done using mercury at room temperatures. This will require a minimum amount of equipment although the value of the mercury used will be high since 10-20 lbs. will probably be required. However, one can reasonably expect that most of this mercury will be available for other uses after re-purification at the conclusion of the test program.

Before being installed in high temperature service, any proposed instrument should be tested under conditions approaching those expected in service. For this a special test facility will be required, the design of which will depend upon the instruments to be tested. A general purpose test facility can be built which would be usable for testing almost any possible instrument. This facility would be similar to the one mentioned in the previous progress report.

The path to be followed depends in part upon the urgency of the over-all program. If the time available for development will be limited, then construction of a general test facility should be initiated at once. However, if time is not critical, then a test facility for one or two specific instruments can probably be constructed at considerably less cost than a general purpose facility.

4.0 MATERIALS PROGRAM

As discussed in the earlier progress report, one objective of this program is to investigate impregnated graphites as molten metal containing material. This is to be done by impregnating normally porous graphite with materials such as ZrC, TiC, or ThC by a vapor deposition technique. Another approach is to coat a base metal having desirable oxidation resistance and strength at high temperatures with a metal inert to attack by molten reactor fuels. The coating material in this case being Ta, Mo, Nb, V, or W. These programs have been proceeding as planned.

4.1 Graphitic Materials

4.1.1 Preparation of Diffused Materials

The graphite resistance tube furnace for use in preparation of these materials has been completed and the power supply installed. This furnace is illustrated in Figure 8. The drawings and detailed description of this furnace was given in the previous progress report. Figure 8 shows the water cooling line connections at the top and bottom connection blocks and the saturable core reactor power supply behind the furnace. One of the large connecting cables can be seen lying on the floor just under the furnace. Coating vapors will be introduced into this furnace through the 1/4 inch pipe connection at the lower end of the resistance tube. Nitrogen is introduced through the copper tube manifold shown at the top of the furnace. This gas purges air from the thermofax insulation to prevent combustion and protect the outside of the resistance tube. Helium, Argon, or hydrogen will be used to purge N₂ and air from the inside of the resistance tube.

The equipment to be used in the impregnation of graphite consists of a vaporizer, a vapor line and a graphite crucible. This equipment is shown in Figure 9. The metal halide of interest will be vaporized and transferred through a heated line to a graphite crucible. The crucible being placed in the center of the resistance tube.

Initial tests are to be made with titanium tetrachloride. Liquid TiCl₄ will be fed from a burette into a pyrex flask. The flask will be operated dry so that successive readings of the burette give the flow rate of TiCl₄. A mercury filled thermometer will measure the flask temperature. This temperature will be maintained by connecting the heating mantle leads to a bimetallic type temperature control switch. The bimetallic element will be in contact with the vapor.

An inert gas such as argon or helium will be used as purge to protect a U-tube pressure gage on the flask, and also to purge the system before start-up.

The vapor line will be glass tubing wrapped with nichrome

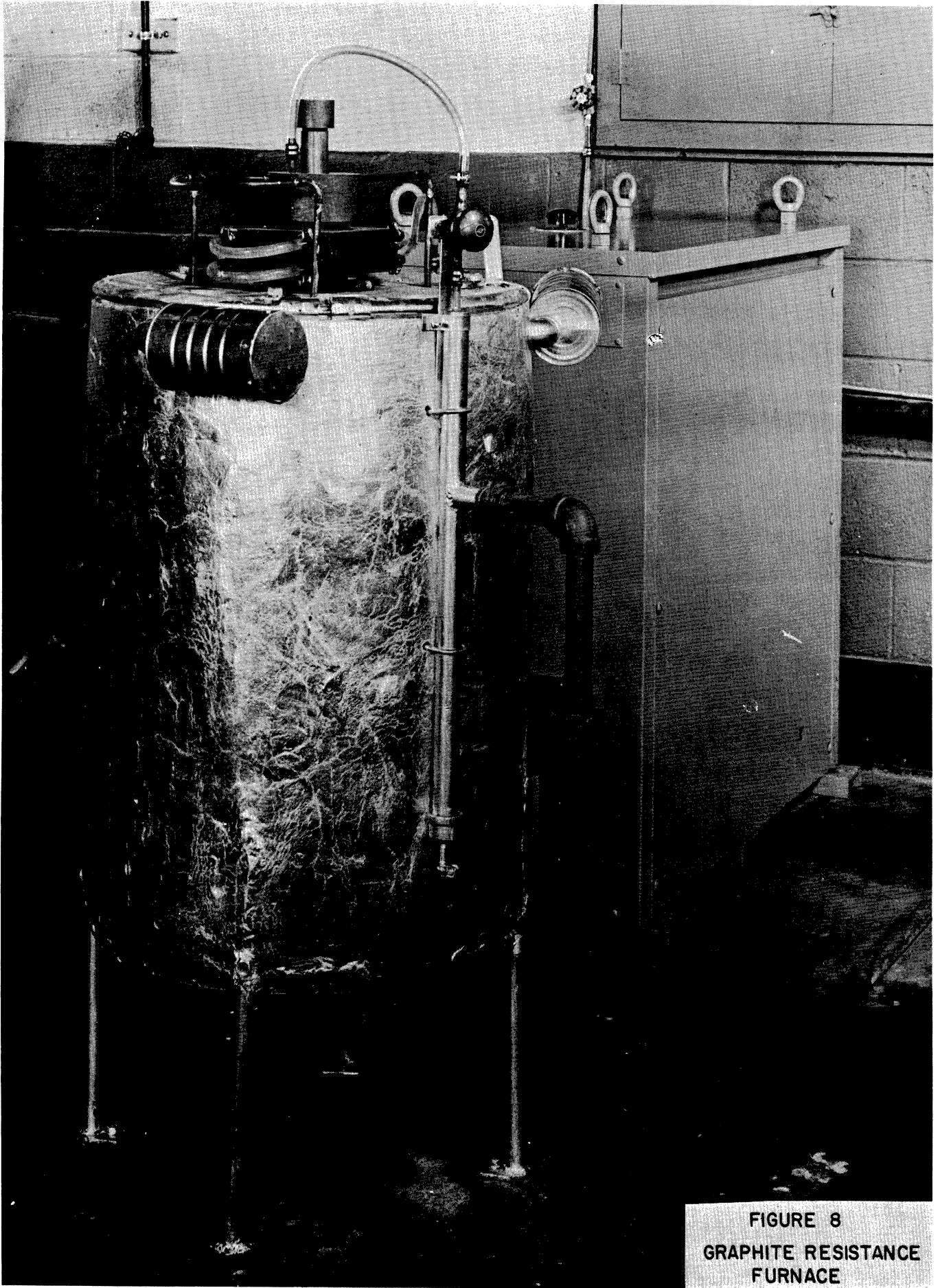


FIGURE 8
GRAPHITE RESISTANCE
FURNACE

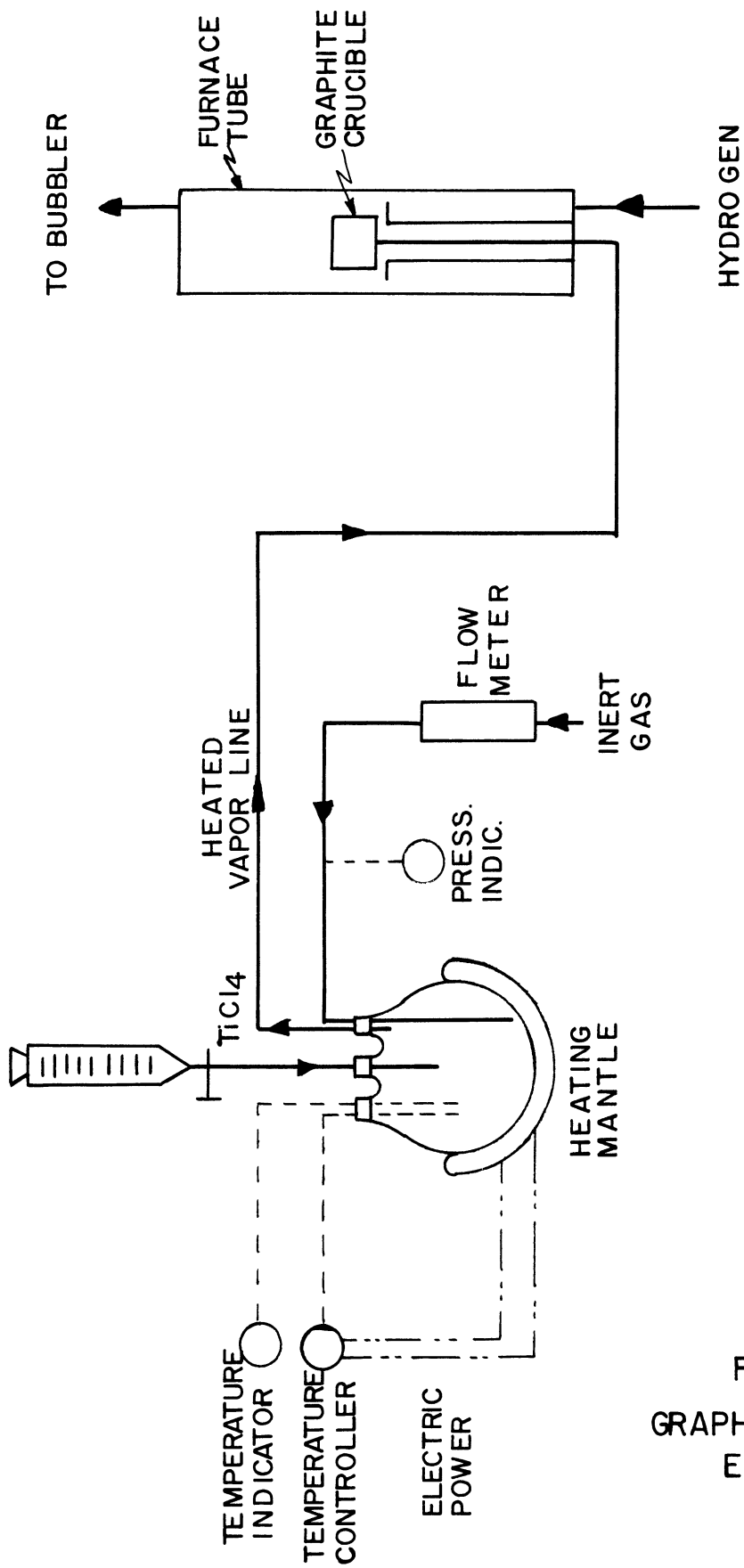


FIGURE 8
 GRAPHITE IMPREGNATION
 EQUIPMENT

heating wire and insulation. Thermostats will maintain the correct temperature in the line and flask. Graphite tubing will extend up into the furnace connecting the crucible to the vapor line.

This apparatus will be altered to carry out similar tests with $ZrCl_4$ and $TrCl_4$. Since these compounds are solids which sublime, the vaporizer will be charged with sufficient material for an entire run. The flow rate of vapor can then be computed assuming equilibrium is maintained between the inert purge gas and the sublimed vapor.

4.1.2 Special Graphites

High density graphites ($\rho = 1.9 \text{ g./cc}$) have been obtained from Graphite Specialty Corporation and from National Carbon, however, the density of these graphites appear to decrease from the outside in. Rods of graphite from the two sources were turned down by various amounts in the lathe and the porosity examined microscopically. A definite increase in porosity could be seen with both materials as the diameter was decreased. It would appear then that to use these graphites as reactor container materials would require a complete fabrication first followed by a series of impregnations and re-graphitizations to decrease the porosity. This may be impractical for applications where large fabricated pieces are required.

Future research is justifiable on pure graphites to determine if a uniform density throughout can be obtained.

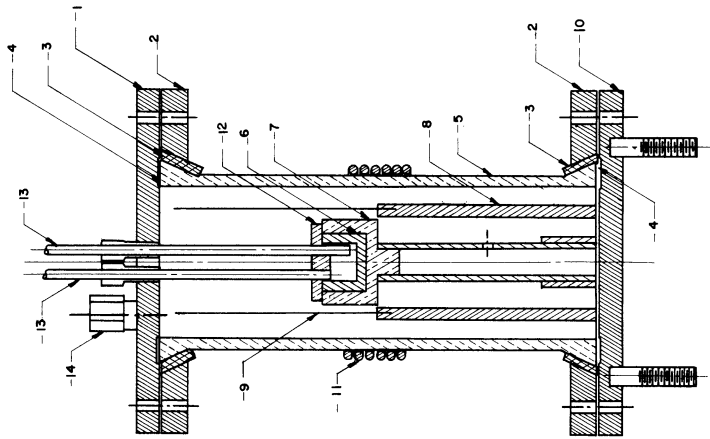
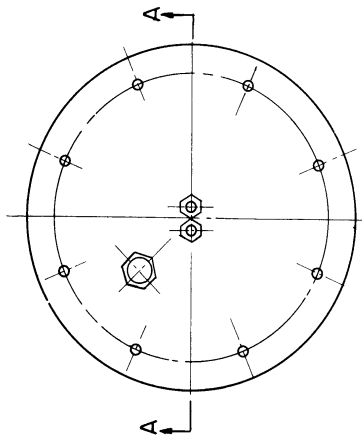
4.2 Coated Metal Materials

As pointed out in the previous progress report, a bimetallic material made by a vapor coating technique may have considerable promise as a reactor material of construction.

4.2.1 Techniques Employed

The metal coating is to be applied to base materials such as inconel or 300 series stainless steels by a hydrogen reduction of metal halides at high temperatures. No satisfactory source of the desired metal halides could be located so these materials are being prepared. The metal halides to be used are $MoCl_5$, $TaCl_5$, $NbCl_5$, VCl_5 , and WCl_5 . These compounds are prepared by passing dry Cl_2 over the metal powders at temperatures of 500 to 800°F. The desired compound either vaporizes or sublimes and is collected in a cold zone of the reactor tube.

Metal halide and hydrogen will be passed into the crucible to be coated. At the temperatures to be used, the metal halide is reduced to metal and deposited on the crucible walls. The furnace in which this reaction is to be carried out is shown in drawing 2505-89R-1034. This furnace consists



A-A

ITEM NO.	DESCRIPTION
14	VACUUM CONNECTION
13	GAS PURGE
12	CRUCIBLE COVER
11	INDUCTION COIL
10	BOTTOM FLANGE AND SUPPORT
9	MOLYBDENUM FOIL RADIATION SHIELD
8	MOLYBDENUM FOIL HOLDER
7	GRAPHITE CRUCIBLE HOLDER
6	GRAPHITE CRUCIBLE
5	PYREX PIPE - 4" O.D. HEAVY WALL 1/2" LONG
4	TEFLON GASKET
3	ABESTOS INSERT
2	PYREX PIPE FLANGE
1	TOP FLANGE
	PTING

2505-89R-1034

INDUCTION FURNACE ASSY

of a vertical 4" nominal diameter 12" long standard pyrex pipe, with both ends blank-flanged. An induction coil with 8 turns made of 1/4" diameter copper tubing is fitted on the pipe with provision to circulate water in the coil. A ceramic receptor-holder within the furnace chamber supports a 2 1/4" diameter x 1 1/2" high graphite receptor which can receive a specimen cup 1 1/2" in diameter. A molybdenum foil reflector supported on a 2 1/2" nominal diameter graphite pipe is provided to reduce radiation losses. Swagelok male connectors are soldered on the top flange of the furnace to provide inlet and outlet passages for the feed and reaction products for a vacuum connection. The induction coil will be connected to a 6KW, AJAX-Northrup, 10,000 cps, sealed gap type, converter. Two 1/4" diameter glazed ceramic tubes through the Swagelok male connectors connect to the specimen crucible through the crucible lid. The plating atmosphere composed of hydrogen as carrier gas and a metal chloride is fed through one of the ceramic tubes and vented out through the other into a bubbler acting as a flame arrester. The furnace assembled in the protective cubicle is shown in Figure 10.

In the first series of experiments, crucibles made out of stainless steel 304, and Inconel will be vapor plated with zirconium, tantalum, niobium, vanadium and tungsten chlorides. The vapor plated specimen will be tested for uniformity of deposition and adherence to the surface and resistance to spalling under repeated temperature cycling.

In the next series of experiments, it is proposed to study the diffusion characteristics of liquid metals in vapor plated crucibles. Also, the structure of deposits on metal surface and the mechanical properties of vapor plated specimen will be studied.

4.3 Vacuum Melting and Testing

As the test specimens are prepared either by vapor deposition or metallic films on base metals or diffusion of inert materials into a graphite base, it will be necessary to test these materials. It was deemed advisable to construct a separate furnace to carry out these tests so that the induction and resistance furnace can be utilized more efficiently. A miniature resistance furnace was designed and built utilizing the same power source as the large resistance furnace. This testing furnace was built at a very nominal cost since most of the materials required were already available. It is capable of operation either under vacuum or inert gas atmosphere, and can attain any temperature that will be required for testing purposes. An assembly drawing of this furnace is shown in Drawing 2505-89R-1050. The electrode cooling coil on this furnace is designed to act as a spring to give good electrical contact with the graphite resistance tube as well as allowing for thermal expansion.

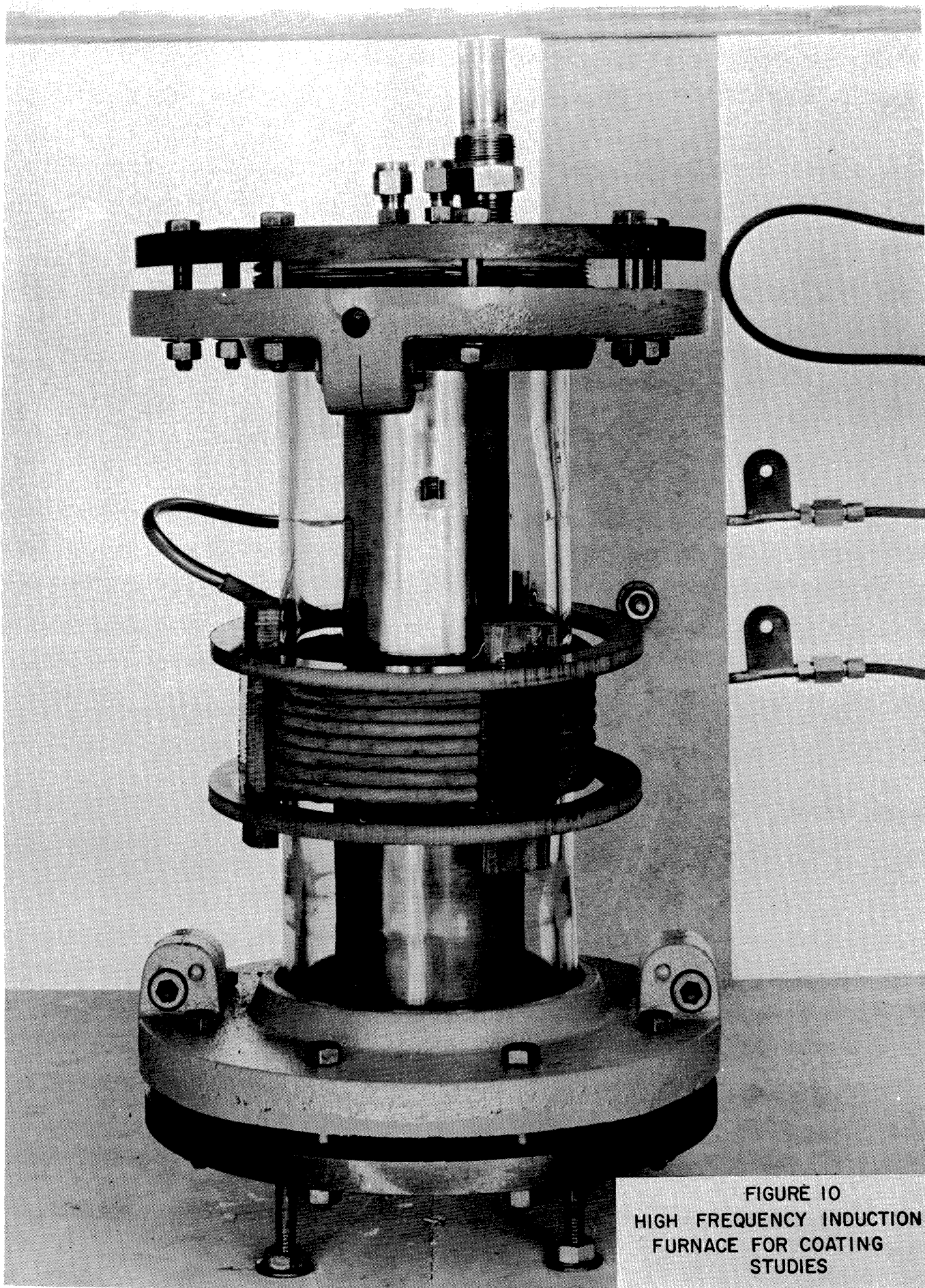
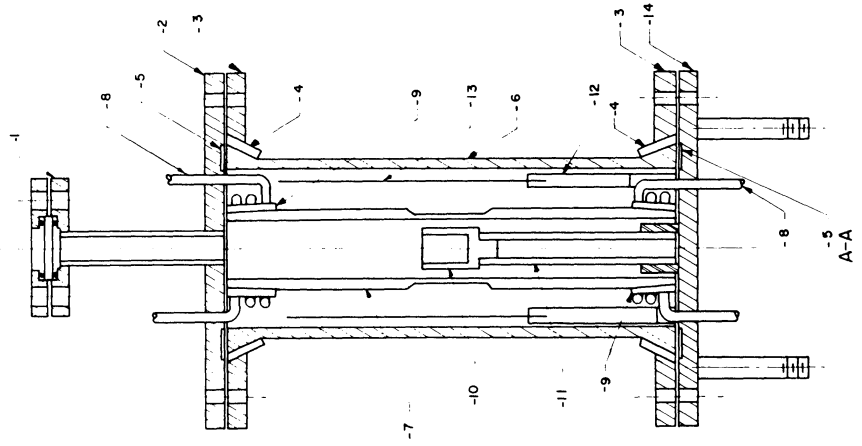
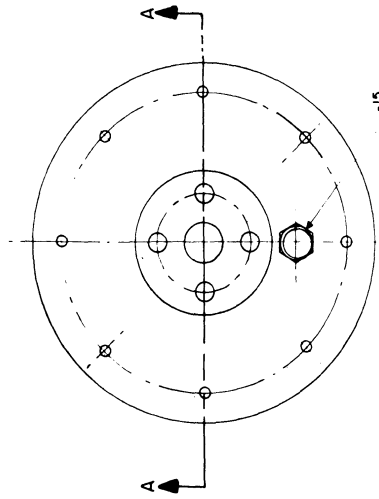


FIGURE 10
HIGH FREQUENCY INDUCTION
FURNACE FOR COATING
STUDIES



15	VACUUM CONNECTION
14	BOTTOM FLANGE AND SUPPORT
13	MOLYBDENUM FOIL RADIATION SHIELD
12	MOLYBDENUM FOIL HOLDER
11	GRAPHITE CRUCIBLE HOLDER
10	GRAPHITE CRUCIBLE
9	ELECTRODE END CAP
8	ELECTRODE COOLING COIL
7	GRAPHITE ELECTRODE
6	PYREX PIPE - 4" O D HEAVY WALL X 12" LONG
5	TEFLON GASKET
4	ASBESTOS INSERT
3	PYREX PIPE FLANGE
2	TOP FLANGE
1	SIGHT GLASS ASSY
P.T. NO.	DESCRIPTION

2505-89R-1050

MINIATURE CARBON FURNACE ASSY.

A photograph of the assembled miniature resistance furnace is shown in Figure 11. This photograph was taken with the furnace mounted in the protective enclosure. The cable, vacuum, and thermocouple connection were not complete at this time.

Crucibles prepared by the various techniques already discussed and containing a uranium charge will be placed inside this furnace and the whole heated to test the inertness of the crucible to uranium attack. Also, this furnace could be used to determine the effects of temperature cycling on coatings and base materials.

4.4 Oxidation Resistant Coatings on 2 1/2 Croloy

This test program was initiated to determine which type of protective coating would protect a steel such as 2 1/4 chrome - 1 molybdenum steel from attack by air at elevated temperatures. Since the coating must withstand the effects of cyclic temperature changes, a small furnace was constructed and equipped with a mechanism to insert and remove samples on a preset cycle. In operation, the samples are inserted and heated for 15 minutes followed by removal and cooling for 15 minutes. Cooling is accomplished by blowing room air over the samples with a small fan. The samples cool to very nearly 100°F regardless of the temperature to which they have been heated. A normal temperature cycle is from 100°F to 1400°F and back to 100°F.

The temperature of the furnace is controlled by an expansion type circuit breaker which is adjusted manually to cut off at the desired operating level.

Thermocouples are placed inside each sample and the thermocouple leads are connected to a multipoint temperature indicator-recorder, which maintains a record of the cyclic temperature change for each sample.

This furnace is illustrated in Figure 12. The electrical heating elements are inclosed in insulated box, control and timing equipment is mounted on the panel. An air cylinder that removes and re-inserts the specimens into the furnace is shown mounted at the top of the framework. The specimens themselves can be seen clipped to the ends of the vertical rods just below the air cylinder.

Shop grease and organic materials is removed from the specimens with acetone and dried in air. Tongs are used to handle the samples after washing.

All samples are uniformly 1 inch in length but vary in diameter since some suppliers provided samples before size requirements were set. Results of these tests indicate that diffused aluminum, nickel braze and nickel plate are adequate coatings for the service being considered. The appearance of the diffused aluminum was unchanged after test except for a red tinge in the color of the coating. The nickel plate changed from a bright smooth finish to a dull gray, and the nickel braze changed from a smooth bright

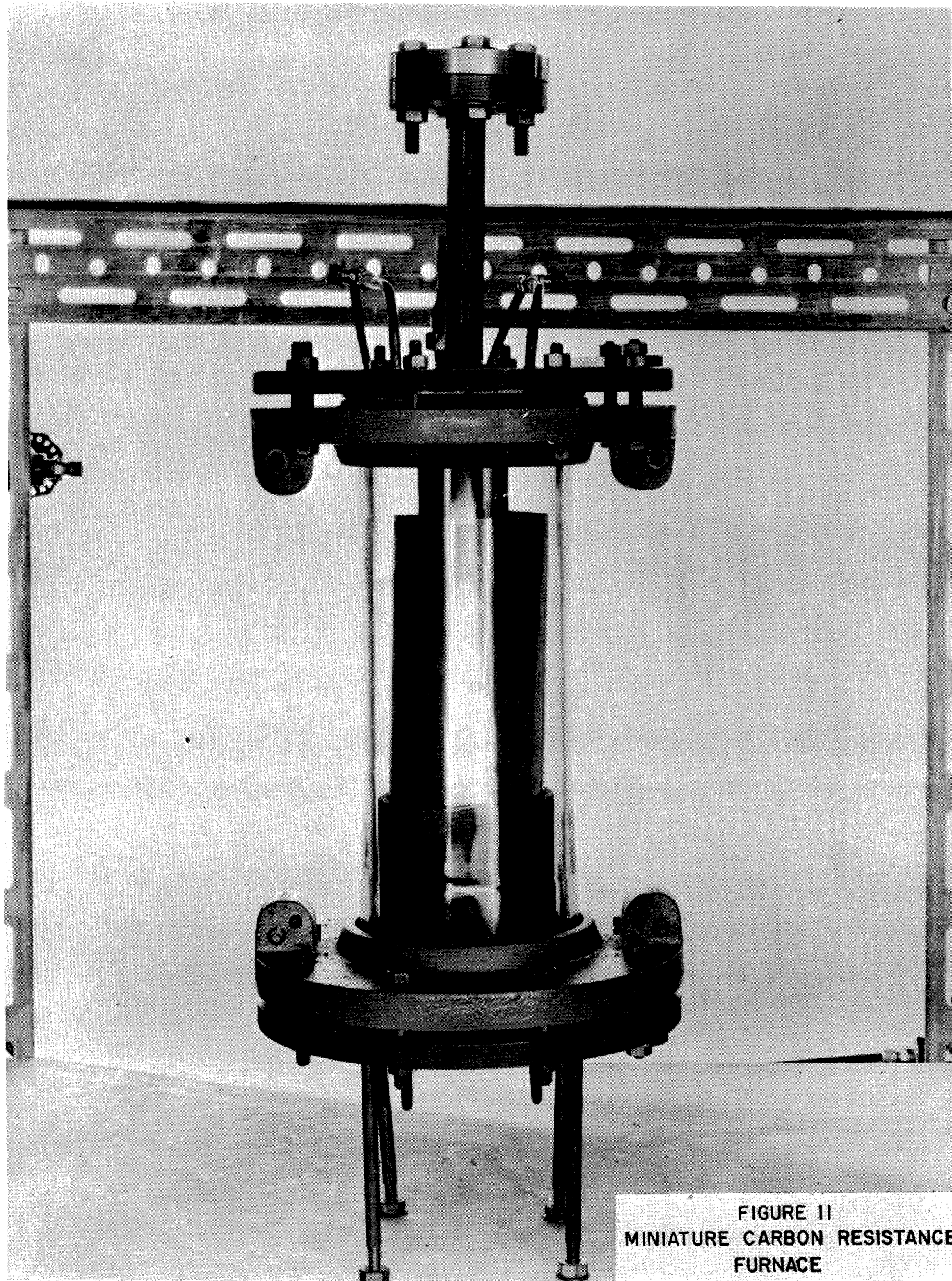


FIGURE II
MINIATURE CARBON RESISTANCE
FURNACE

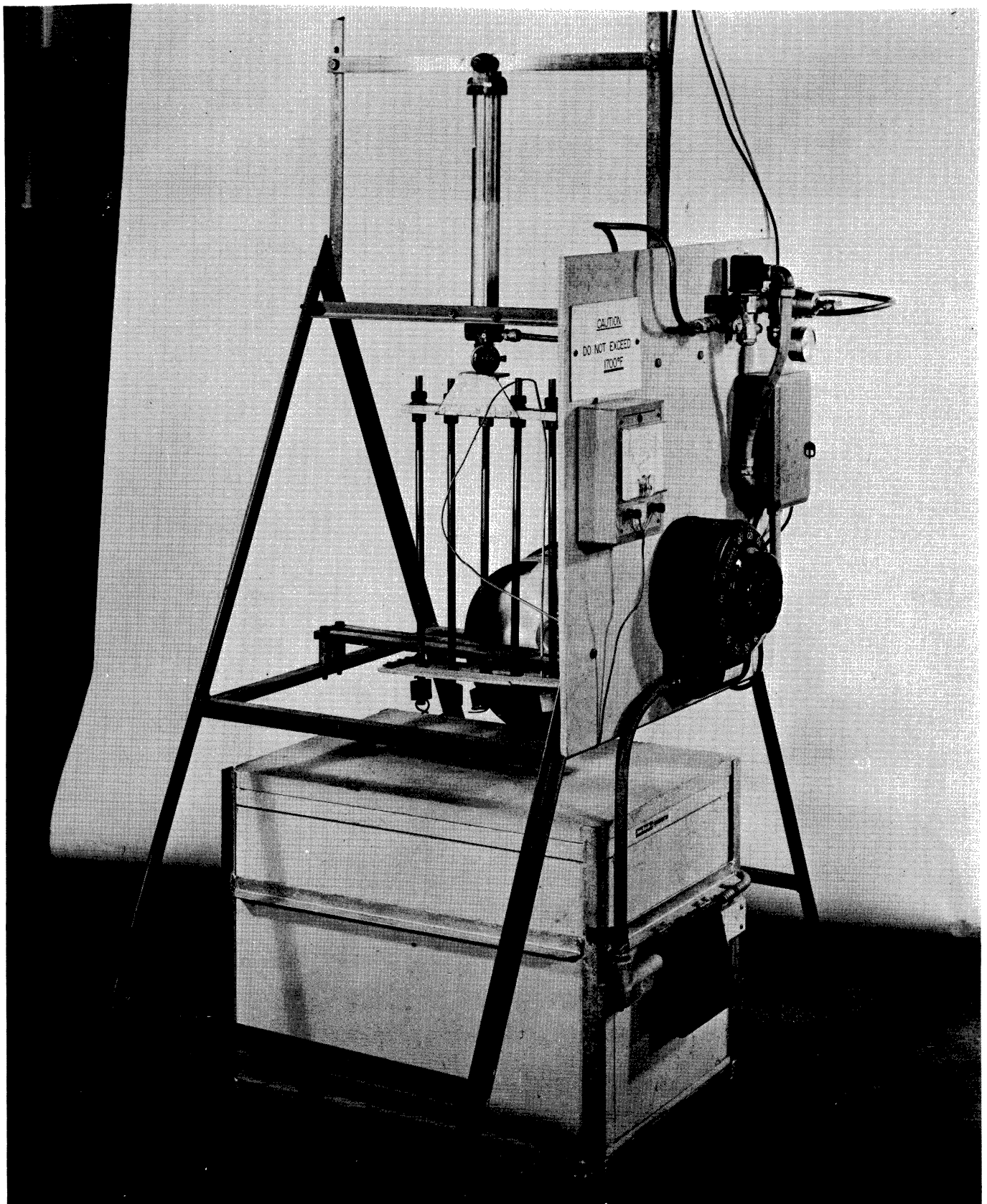


FIGURE 12
MATERIALS TESTING FURNACE

finish to a rough black. In none of these was there any appearance of attack on the base metal. Some specimens after testing are shown in Figure 13.

A special ceramic submitted by Toledo Porcelain Enamel Company was successful in protecting the metal but the coating itself broke down. Small nodules increased in size as the test continued, leaving what appeared to be bare metal exposed in adjacent areas. However, the exposed areas did not scale or flake-off.

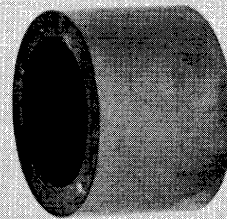
Of the RoKide ceramics, only the RoKide Z shows promise. One sample tested at 1350°F did not fail. All others failed by cracking. The coating came off in large flakes with a layer of the base metal bonded to it. Results on all the materials tested to date are summarized in Table I.

Further tests will be made on the diffused aluminum, nickel braze and nickel plate to establish their service life. Also, additional samples of the Toledo Porcelain Enamel Company ceramic have been requested.

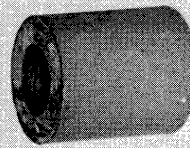
First tests on many of the coatings have not been made. Table II lists the suppliers and coating materials that have yet to be tested.

FIGURE 13
 TEST RESULTS ON OXIDATION
 RESISTANCE COATINGS
 APPLIED TO 2 1/4 CROLOY
 (TEST CONDITIONS GIVEN IN
 TABLE 11)

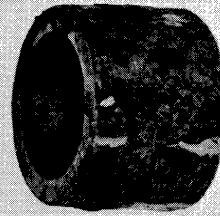
NICKEL PLATE



DIFFUSED ALUMINUM



BARE CROLOY



NICKEL BRAZE

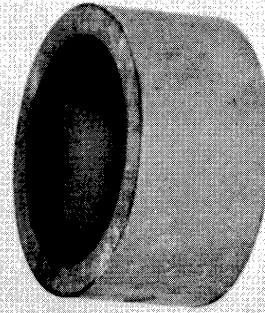


Table I

Summary of Results on Testing of Oxidation Resistant Coatings

Coating Material	Supplier	Sample	Max. Temp. Of	No. of Cycles	Failed	
					Yes	No
1) Diffused Aluminum	Arthur Tickle Co.	1	1400	538	X	X
		2	1400	538	X	X
2) Nickel Braze Croloy	Griscom-Russell Co.	1	1450	570	X	X
		2	1400	570	X	X
3) RoKide A (Alumina)	Norton Co.	1	1450	41	X	X
		2	1350	46	X	X
4) RoKide ZS (ZrO ₂ -S ₁ O ₂)	Norton Co.	1	1375	3	X	X
		2	1375	3	X	X
5) RoKide Z (ZrO ₂)	Norton Co.	1	1400	210	X	X
		2	1350	537	X	X
6) Chemically Plated Nickel	General America Transportation Co.	1	1300	524	X	X
		2	1400	524	X	X
7) Ceramic	Toledo Porcelain Enamel Co.	1	1375	525	X***	X***
8) Silicone Heat Resisting Aluminum Paint EX-5190	American Asbestos Products Co.	*1	1350	51	X	X
		**2	1400	103	X	X
		3	1400	150	X	X

* One coat, dipped, dried 4 hours.

** Two coats, dipped, dried 18 hours each coat.

*** Coating blistered but did not appreciably fail.

Samples were heated over a 15 minute period to the temperatures indicated and convectively cooled for 15 minutes to 100°F.

Table II

Oxidation Resistant Coating Materials to be Tested

<u>Supplier</u>	<u>Coatings</u>
Bettinger Corporation	Alcermet SL - 139W
Chromalloy Corporation	Diffused Chromium
Dow Corning Corporation	Aluminum Paints: XP-310 XP-412 XP-4695
Markal Company	Paints: SR SR-2
Niphos Process Sales Corporation	97% Nickel - 3% Phosphorus
Solar Aircraft	S-1033 Diffused Aluminum S-1177 Aluminum-Ceramic
Metal Cladding Inc.	Metcollizing Process: #11 Aluminum Oxide over Diffused Aluminum #33 Aluminum-Chromium- Nickel Alloy #45 Same as #33 except - 50% thicker Metallizing Eng. Co. Process: # 12C } # 12F } Alloys of Nickel Chromium, Boron # 14C } and Silicon # 15C } # 16C } # 17C }

5.0 ANALYTICAL RESULTS

The analytical work on project 2505 is being done by Dr. P. J. Elving and co-workers of the University Chemistry Department. Results reported here are abstracted from memorandums from Prof. Elving to the project supervisors.

5.1 Bismuth Metal Analysis

Three samples of bismuth metal have been submitted for analysis and are given below.

B-1 Advance sample of pig bismuth submitted by American Smelting and Refining prior to delivery of the bismuth now on hand for the loop.

B-2 Sample of bismuth from American Smelting and Refining which is to be used in the loop.

B-3 Bismuth sample supplied by Belmont Smelting and Refining Works.

Sample B-1 was analyzed with the following results:

1. Antimony: The antimony 2311 Angstrom line shows itself at 100 p.p.m. added antimony but not at 10 p.p.m. As much as 100 p.p.m. antimony might therefore be present in the original bismuth without detection.
2. Boron: The lines at 2497 and 2498 show about same intensity for 1 p.p.m. added boron and for the unspiked sample. There is weak indication of these lines in a reagent blank. Boron is probably present in the bismuth at less than 10 p.p.m. The possibility that boron is being picked up from glassware should be checked (this will be done by preparing and storing solutions in quartz).
3. Cadmium: The cadmium 2265 and 2288 lines show at 10 p.p.m. added cadmium but not 1 p.p.m. or in the sample itself. Cadmium, if present at all, is probably at less than 10 p.p.m.
4. Copper: The 3247 and 3274 copper lines show at 1 p.p.m. added copper and in the sample. The lines of 10 p.p.m. copper are only slightly stronger. Copper is present and possibly in amounts as much as 20 p.p.m.
5. Iron: The 2599 iron line shows about the same intensity for 1 p.p.m. added iron and for the sample. There is also an indication of iron in the blank. Iron is probably present at less than 10 p.p.m.
6. Lead: The 2247, 2614 and 2802 lead lines are present at 100 p.p.m. added lead but not at 10 p.p.m. From indications obtained from analysis of chips of the bismuth pig sample, lead is probably present and possibly is as high as 100 p.p.m.

7. Silver: The silver 3280 and 3382 lines show at 10 p.p.m. added silver but are masked at 1 p.p.m. silver and in the sample by the cyanogen band lines. Chip analysis showed at least a trace of silver. As much as 10 p.p.m. silver might be present.
8. Zinc: The zinc 3302 and 3345 lines show at 100 p.p.m. added zinc but are masked by cyanogen band lines at lower concentrations. As much as 100 p.p.m. zinc might be present without detection.

As a comparison of our results with the analysis given by American Smelting and Refining, table III is included.

Table III
Comparison of Determined Bismuth
Impurities with Suppliers Analysis

<u>Element</u>	Present Study, Maximum Limit %	American Smelting and Refining Co.	
		<u>Specifications</u> %	<u>Sensitivity</u> %
1. Antimony	0.01	0.0001	*
2. Boron	0.001		
3. Cadmium	0.001		*
4. Copper	0.002	0.0001	0.0001
5. Iron	0.001	0.0005	0.0001
6. Lead	0.01	0.0001	0.0001
7. Silver	0.001	0.0001	0.0001
8. Zinc	0.01	0.0005	*

*Sensitivity to these elements is inferior to the 0.0001% shown for the other elements.

It is evident that the impurities given by the supplier may be low by a significant amount. These impurities, while high will probably not interfere with the loop research, but may be excessive for actual use as a reactor fuel diluent.

Comparison of analytical results between samples B-1 and B-2 showed no significant difference. With B-2 showing somewhat higher iron content than B-1.

Sample B-3 showed very strong indications of lead with this element being present possibly as high as 1000 ppm. B-3 also showed strong tin lines, and contained more iron than sample B-2.

Iron present in B-2 and B-3, as high as 100 ppm, may have been introduced in the process of milling the bismuth metal, although the

bismuth chips were magnetically cleaned before use.

All three solution samples indicated traces of boron in the range of 10 ppm. The uniform presence of boron in all three bismuth samples is probably due to attack on the Pyrex beakers by the nitric acid used to dissolve the metals.

5.2 Preparation and Analysis of Metallic Samples

Weighed charges of bismuth, uranium, and magnesium were placed in a de-gassed graphite crucible with crucible and contents then placed inside a pyrex tube. The tube contents were then evacuated to a pressure less than 1 micron and placed in an electrically heated furnace. The samples were cooked in the furnace for a period of not less than four hours with the furnace temperature being controlled at 550°F. Tube and contents were cooled, under vacuum, then the tube was broken and the graphite crucible removed. The crucible was broken to remove the metal button and the button then submitted for analysis. The fragments of glass container and graphite crucible were saved for future examination.

It was noticed during the melting under vacuum that some volatilization occurred and a black ring was deposited on the glass tube above the graphite crucible. The crucible and glass tube fragments were then submitted for analysis to determine if any of the sample had permeated the graphite and what the volatile material on the glass might be. Two of the metallic samples were submitted to the Chrysler analytical group and two to Dr. Elving's group. Results from the two groups are given in table IV.

Table IV

Comparison of Analytical
Data with Sample Composition

Sample (Run) No.	Prepared Composition Component Weight ppm	Analytical Data Reported				
		Univ. of Michigan ^a Weight ppm		Chrysler Corp. Weight ppm		
1	Bi					
	U	988				
	Zr	350		500		
	Mg	250		300		
2	Bi					
	U	1300				
	Zr	370		250		
	Mg	260		300		
3		<u>Sectioned Sample</u>			<u>Composite</u>	
		<u>Top</u>	<u>Top</u>	<u>Bottom</u>		
		<u>Side</u>	<u>Center</u>	<u>Center</u>		
	Bi					
	U	1045	820	720	740	800
	Zr	390	319	355	315	
Mg	290	127	205	117		
4	Bi		<u>Composite</u>			
	U	1000		950		
	Zr	350		187		
	Mg	265		200		

^aThe analytical data on uranium have a precision of +5% (relative) or better; those on magnesium and zirconium have a precision of +10% (relative) or better.

Sample 3 was sectioned to determine the extent of metal migration during cooling. The evidence indicates that uranium migrates to the outside of a cooling sample while zirconium and magnesium migrates inward. This phenomenon can be explained if uranium forms bismuthides and zirconium and magnesium do not.

The graphite crucible in which sample B-1 was prepared was pulverized and extracted with nitric acid for a period of 8 hours. The resulting solution was concentrated and analyzed. No zirconium was found, bismuth lines are very light and magnesium lines were only slightly greater than the blank. The results indicated no significant penetration of the melt into the graphite.

The vapor deposits on the glass were analyzed and found to consist mostly of magnesium, with some bismuth; no zirconium was found. The results indicate that the more volatile magnesium deposited above the crucible, as would be expected.

Samples being prepared after B-4 were melted in a 5 psig atmosphere of helium to avoid the volatilization of magnesium. No deposits on the glass above the crucible were noted when an inert gas blanket was maintained above the melt. All future samples will be prepared using the inert blanket. No analytical results are available as yet from samples submitted after B-4.

5.3 Method Development

5.3.1 Removal of Bismuth

Studies on the electrodeposition of bismuth have been in progress in hope of developing a rapid procedure for removing bismuth from samples in order facilitate the subsequent determination of minor constituents. This work has been stopped since it was felt that we had achieved results which were as satisfactory as could be obtained without much more extensive work and that further work was unwarranted until we had a chance to discuss the matter with the people at Chrysler or elsewhere. A short report on this work is being prepared and will be submitted.

5.3.2 Emission Spectroscopy

Some uncertainties were believed to exist in the composition of the original calibration standards. Fresh standard solutions have been prepared and new calibration curves obtained for the determination of magnesium and zirconium in the bismuth matrix. These new results showed an almost two-fold shift in the zirconium values; the magnesium values were generally satisfactory. The emission spectrographic analyses are now based on the calibration by 2 pairs of lines for the magnesium and 3 pairs of lines for the zirconium. The precision of the determination of magnesium and zirconium in a bismuth matrix for the range of about 50 to 400 ppm Mg or Zr, is believed to be $\pm 10\%$ (relative) or better based on the

calibration curves. A report on the method used may be prepared if you or the Chrysler people think such a report will be helpful to the Chrysler group as a basis for discussion on our proposed visit to them.

5.3.3 Determination of Uranium

The direct titrimetric determination of uranium in bismuth has given satisfactory results and can be expected to be a satisfactory method for uranium provided that interfering elements are not present. A report on this method, which is considered to have a precision $\pm 5\%$ or better, is also in preparation.

We shall start work on two spectrophotometric methods for the determination of uranium which seem to have considerable promise as moderately rapid procedures for the determination of uranium with reasonable precision (one part in 25 to perhaps one part in 100) in the presence of a fair variety of other elements. These methods include the dibenzoyl methane (1,3-diphenyl-1,3-propane-dione) procedure as adapted by the Brookhaven National Laboratory for the determination of uranium in a bismuth matrix and the TBP (tri-*n*-butyl phosphate) procedure developed at the Chemical Processing Plant at Idaho Falls for the determination of uranium in a variety of types of samples.

5.3.4 Oxygen Determination

The work on the determination of oxygen in metallic bismuth has not progressed beyond the fabrication and setting up of the necessary apparatus, since the use of our manpower on other of our efforts seemed more justified.

6.0 NUCLEAR CALCULATIONS

Calculations on thermal neutrons as given in the previous progress report indicated that thermal reactor size and weights would be quite large. Consequently, it was decided to investigate intermediate and fast reactor sizes.

Calculation of reactor sizes and fuel compositions for intermediate neutron energies have progressed to a point where solution can be obtained by computer techniques. Ten groups of neutron energies are involved for a right cylindrical geometry in a reflected reactor. These calculations were brought up to a point where a computer group could program the problem and arrive at a solution. No further work will be done on an intermediate reactor until the probable neutron spectra of the core can be definitely defined and the core composition fixed.

Preliminary calculations indicate that for cores containing none or very little of the light elements that most of the neutron energies will be outside the intermediate region. For these high energies, the diffusion theory no longer holds and the transport equation must be used. An approach similar to ours has been outlined in LA-1891, "Solution of the Transport Equation by Sn Approximations", by B. G. Carlson. This report discusses a digital computer solution of the transport equation for multi-groups of neutrons. We are now preparing an adaption of the above approach to fit the cylindrical geometries we are interested in.

It is planned to program the fast reactor calculations and run through one iteration on a digital. At that time, the results can be examined to determine the correctness of the original assumptions and check the program for possible errors. If the results are in order after the first iteration, repeated iterations will be made until the desired accuracy is achieved. It is believed possible to simplify the calculations considerably once a complete solution is available to serve as a reference in checking further simplifying assumptions.

7.0 MANPOWER EXPENDITURES

Following is a tabulation of the mandays on the three phases of this contract. A normal 8 hour working day is assumed.

	<u>Mandays</u>
Loop	384
Materials	209
Nuclear Calculations	<u>54</u>
Total	647

8.0 APPENDIX

Table V gives the procurement status for March as this material was not included in the previous progress report. Table VI gives the procurement status for the months April to June inclusive. Expendable items are not included in the listings.

**TABLE V
MATERIAL STATUS REPORT**

ORDER NO.	QUANTITY	DESCRIPTION	MANUFACTURER	DATES (1956)					REMARKS	S L C
				REQUISIT. TO CHRYSLER	CHRYSLER APPROVAL RECEIVED	REQUISIT. TO PURCHASING	ORDER TO VENDOR	PROMISED DELIVERY		
1	1	Ammuniation Horn 115v	Cincinnati Time Recorder Company	3/1	3/8	3/9	3/15	*3/26	163008	\$18.50
2	6	Thermostats	General Electric Company	3/1	3/8	3/9	3/15	*5/31	163005	\$80.00
3	100'	Stainless Steel Tubing	Allegany Ludiam Company		Cancelled		Cancelled		163004	--
4	6	Bags Thermax, Carbon Black	R. T. Vanderbilt Company	**	**	3/2	3/26	*3/16	162181	\$42.00
5	1	D. C. Voltmeter	Allied Radio Company	3/2	3/14	3/15	3/22	*3/29	164196	\$10.60
6	1	25 kva Transformer	Sorgel Electric Company	3/2	3/27	3/28	4/12	*7/25	167720	\$995.00
7	9	General Electric Relays and Clocks	General Electric Company	3/2	3/8	3/9	3/26	*5/16	164774	\$125.00
8	6	Tap-A-Line Electrical Outlets	Miles Kimball Company	**	**	3/5	3/9	*3/21	162180	\$15.00
9	3	Pressure Regulators	Moore Products Company	3/5	3/8	3/9	3/15	*5/7	163003	\$60.00
10	5#	Natural Uranium Turnings	Mallinkrodt Company	**	**	3/5	3/13		162241	\$75.00
11	--	Miscellaneous Tube Fittings	Crawford Fitting Company	**	**	3/6	3/8	*5/4	162016	\$95.00
12	--	Tube Fittings	Crawford Fitting Company	**	**	3/6	3/13	*4/23	162572	\$50.00
13	--	Furnace, Crucible and Aux.	Eberbach and Sons	3/6	3/14	3/15	3/22	*4/30	164198	\$85.00
14	--	Aluminum, Zinc and Silver Metal	Eberbach and Sons	**	**	3/6	3/13	*4/6	162573	\$33.00
15	3	Sheets Transite	Plant Department	**	**	**	3/6	*3/19		\$45.00
16	--	Miscellaneous Rubber Products	Automotive Rubber Company	3/6	3/14	3/15	3/22	*5/14	164197	\$95.00
17	--	Machine Tender and Shovel Truck	Palmer-Shile Company	3/6	3/14	3/16	3/22	*3/28	164200	\$59.00
18	2	Commercial Clocks	Johnston and Company	3/6	3/8	3/10	3/15	*4/31	172334	\$24.00
19	--	Polyethylene Equipment	Dyna-Lab. Corporation	3/6	3/8	3/10	3/15	*3/27	163001	\$89.50
20	--	Valves, Diaphragm Type	Imperial Brass Company	3/7	3/14	3/16	4/2	*4/23	165418	\$236.46
21	--	Stopwatch and Holder	Eberbach and Sons	3/7	3/14	3/16	3/22	*3/30	164204	\$24.00
22	--	Micro-switches	Minneapolis Honeywell Company	3/7	3/14	3/16	4/10	*4/20 (157524)	167071	\$368.00
23	1	Water Cooled Condenser	Minneapolis Honeywell Company	3/7	3/14	3/16	3/22	*5/2	164203	\$60.00

*Item required.

**Expendable item Chrysler approval not required.

**TABLE V (cont.)
MATERIAL STATUS REPORT**

ORDER NO.	QUANTITY	DESCRIPTION	MANUFACTURER	DATES (1956)					REMARKS	SL. NO.	
				REQUISIT TO CHRYSLER	CHRYSLER APPROVAL RECEIVED	REQUISIT. TO PURCHASING	ORDER TO VENDOR	PROMISED DELIVERY			
24	--	HR Steel Angles and Plates	Ryerson Company	**	**	3/7	3/27	Stock	*3/23	163268	\$100.00
25	--	HR Steel Angles and Plates	Central Steel Company	**	**	3/7	3/23	Stock	*3/23	163269	\$15.00
26	1	Sim-Ply-Trol Thermocouple	Assembly Products Company	3/9	3/14	3/16	4/2	4/16	*5/2	165417	\$228.00
27	1	3/4" #3221 Packless Valve	Robertshaw-Fulton Controls Company	3/9	3/14	3/16	3/22	Stock	*5/23	164262	\$245.00
28	8	4 Wheel Trolley Ass'y w/p-1000	Unistrut	3/9	3/14	3/16	3/22	Stock	*3/25	164202	\$52.50
29	500'	#20 AWG Resistance Wire	Lewis Engineering Company	**	**	3/9	3/15	Stock	*4/2	162898	\$95.00
30	100#	A-1 Grade Sponge Titanium	E. I. DuPont De Nemours and Company	**	**	3/9	3/27	4/7	*4/11	164873	\$345.00
31	3	General Purpose Relay's	General Electric Company	**	**	3/9	3/15	Stock	*4/9	163022	\$33.00
32	--	Miscellaneous Tube and Pipe Fittings	Crawford Fittings Company	**	**	3/9	3/15		*5/4	163033	\$84.00
33	300'	3/8 O.D. x .032 Copper Tubing	Chas. A. Strelinger Company	**	**	3/9	3/5	Stock	*3/29	162897	\$50.00
34	1	Nuclear Chicago Model Counter Rate Met.	Nuclear Instrument and Chemical Corporation	3/13	4/4	4/5	4/11	4/17	*4/13	166805	\$275.00
35	--	Pipe - Miscellaneous	Service Steel Corporation	**	**	3/13	3/22	4/10	*3/29	163234	\$675.00
36	2	Stainless Steel Plates	Ryerson and Son	**	**	3/13	3/23	3/15	*3/23	163237	
37	--	Miscellaneous Couplings, Flanges, Gaskets	Harry W. Taylor, c/o Sargant Company	**	**	3/13	4/2	Stock	*4/24		\$707.00
38	1	Stainless Steel Sink	Cobb and Zimmer Company	3/13	4/4	4/5	4/20	5/20	*5/25	166607	\$179.50
39	1	Stainless Steel Drum	Schnitzer Alloy Company	3/13	4/4	4/5	4/11	Stock	*5/14	167274	\$91.50
40	2	Stainless Steel Pails	Schnitzer Alloy Company	3/14	4/4	4/5	4/16	Stock	*4/27	167859	\$55.80
41	4	Variac - V - 5	General Radio Company	3/14	4/4	4/5	4/16	Stock	*5/8	167864	\$95.00
42	10	Thermocouple Protection Tubes	Fisher Scientific Company	**	**	3/14	3/20	Stock	*3/29	163590	\$24.00
43	--	Misc. Filler Rod, Welding Rod, Glass	Welding Equipment and Supply Company	**	**	3/15	3/20	3/20	*3/20	163586	\$87.00
44	--	Packless Valve and Accessories	Carmen Adams, Inc.	**	**	3/15	3/22	6/4	*7/3	164208	\$56.00
45	1	Wheelco Potentiometer	Boyer Campbell Company	3/20	4/4	4/5	4/11	5/2	*4/19	164390	\$280.00
46	1	Stainless Steel Drum	Schnitzer Alloy Company	3/15	4/4	4/5	4/16		*5/2	167838	\$97.86
47	1	D. C. Coil	Detroit Coil Company	**	**	3/15	3/22	Stock	*4/10	164220	\$14.00

*Item required.
**Expendable item Chrysler approval not required.

TABLE V (cont.)
MATERIAL STATUS REPORT

ORDER NO.	QUANTITY	DESCRIPTION	MANUFACTURER	DATES (1956)					REMARKS	S. I. C. CODE	
				REQUISIT TO CHRYSLER APPROVAL	CHRYSLER RECEIVED	REQUISIT TO PURCHASING	ORDER TO VENDOR	PROMISED DELIVERY			
48	4	Enclosed Electrical Wiring Boxes	Hoffman Engineering Company	**	**	3/15	3/20	Stock	*4/3	163588	\$20.00
49	--	Swagelok Pipe Connections	Crawford Fittings Company	**	**	3/15	3/23	Stock	*5/4	164474	\$115.00
50	--	Stainless Steel Beakers	Schritzer Alloy Company	3/16	4/4	4/5	4/12	Stock	*5/8	167714	\$61.75
51	1	D. C. Power - 6-12 Volt	Allied Radio Company	3/16	3/20	3/22	3/23	Stock	*4/2	164477	\$40.00
52	--	Temperature Control System	Swarbout Company	3/16	4/4	4/5	4/10	6/15	*7/16	167067	\$820.00
53	1	Grad-U-Motor Damper	Minneapolis Honeywell Company	3/16	4/4	4/5	4/4	Stock	*5/?		\$39.00
54	36	Thermocouple Connector Blocks	General Electric Company	**	**	3/16	3/22	Stock	*4/17	164293	\$31.00
55	2	Stainless Steel Wire Baskets	Schritzer Alloy Products Company	3/20	4/4	4/5	3/12	Stock	*5/31	168060	\$75.00
56	--	Graphite Rods	Graphite Specialties Company	**	**	3/20	3/21	Stock	*3/27	163221	\$90.00
57	1	Voltmeter, Expanded, Scale	Electric-Mec. Association	Cancelled	Cancelled		Cancelled	Cancelled			
58	6	Flow Controllers	Moore Products Company	**	**	3/20	3/22	Stock	*4/5	164296	\$61.00
59	6	Pressure Gages, 2" Dial	Smith Instrument and Equipment Company	**	**	3/20	3/22	Stock	*4/9	164299	\$17.50
60	6	Pressure Regulators	Watts Regulator Company	**	**	3/20	3/22	Stock	*4/6	164298	\$24.00
61	10	Screw Tee, S.S. Type 304	Van Pelt Corporation, Service Steel Division	**	**	3/20	3/22	Stock	*3/26	163209	\$50.00
62	10	Pressure Gages	Minneapolis Honeywell Company	**	**	3/20	3/23	Stock	*4/9	164460	\$22.00
63	--	Miscellaneous Valves	Copper and Brass Sales Company	**	**	3/20	3/23	5/20	*6/5	167409	\$87.00
64	--	Miscellaneous Pipe Fittings	Taylor Manufacturing Company	Cancelled	Cancelled		Cancelled	Cancelled			
65	4	Globe Valves	The Crane Company	**	**	3/20	3/23	Stock	*3/29	164461	\$10.00
66	--	Stainless Steel Electrodes	Welding Equipment and Supply Company	**	**	3/20	3/20	Stock	*4/2	163226	\$69.00
67	3	Bags "Thermax"	R. T. Vanderbuilt, Inc.	**	**	3/20	3/23	Stock	*4/3	164465	\$21.00
68	3	Fisher Back Pressure Valve	Fisher Governor Company	3/20	4/4	4/5	4/11	Stock	*5/2	167257	\$93.00
69	1	Temperature Switch - Burling	Byrl R. Hill Company	3/20	4/4	4/5	4/11	Stock	*4/23	167275	\$68.00
70	--	Miscellaneous Unistrut Members	Unistrut Corporation	**	**	3/21	3/23	Stock	*4/26	164469	\$63.00

*Item required.

**Expendable item Chrysler approval not required.

TABLE V (cont)
MATERIAL STATUS REPORT

ORDER NO	QUANTITY	DESCRIPTION	MANUFACTURER	DATES (1956)				REMARKS	\$		
				REQUISIT. TO CHRYSLER	CHRYSLER APPROVAL RECEIVED	REQUISIT. TO PURCHASING	ORDER TO VENDOR			PROMISED DELIVERY	
71	--	Miscellaneous Electrical Equipment	Allied Radio Company	3/21	4/4	4/5	4/11	Stock	*5/7	167255	\$51.00
72	--	Pyrometer and Thermocouple	Assembly Products Company	3/21	4/4	4/5	4/11	Stock	*5/2	167256	\$22.50
73	--	Minneapolis Honeywell Pressure Table	Minneapolis Honeywell Company	3/21	4/4	4/5	4/11	Stock	*4/20	167310	\$160.00
74	--	Valve Lubricant	Foxboro Company	**	**	3/21	3/23	Stock	*4/20	164470	\$7.00
75	--	Miscellaneous Steel, Centerless Ground	R. T. Ryerson and Son	**	**	3/21	3/22	Stock	*3/23	163252	\$45.00
76	--	Candelabra Lamps and Pilot Lt. Assembly	Wedemeyer Electronic Supply Company	**	**	3/21	3/27	Stock	*4/15	165180	\$3.30
77	--	Misc. Wire - Glassbraided and Plastic	Alpha Wire Company	**	**	3/21	3/23	Stock	*4/2	164471	\$25.00
78	--	Helicord Air Gage and Dials	E. J. Becker and Company	3/21	4/4	4/5	4/18	Rec'd	*4/?	168087	\$132.00
79	1	Thick Plexiglass Sheet	Cadillac Plastic Company	**	**	3/30	4/5	Stock	*4/13	166576	\$24.00
80	1	Brooks Purge-Meter	Brooks Rotameter Company	3/30	4/4	4/5	4/11	Stock	*4/26	167276	\$15.00
81	2	Electric Bell 4", and Hydrometer	W. M. Welch Company	**	**	3/30	4/5		*4/17	166575	\$5.50
82	--	Swagelok Fittings and Capillary Tubing	H. E. Lennon and Son (Crawford)	**	**	3/30	4/6	5/1	*5/10	166705	\$136.78
83	--	Voltmeter, Ammeter, "Insuline"	Wedemeyer Electronic Supply Company	3/26	4/4	4/5	4/11	Stock	*4/16	167273	\$21.00
84	--	Taylor Pressure Transmitter	Taylor Instrument Company	3/20	4/4	4/5	4/10	Stock	*4/11	167069	\$920.00
85	--	Steel Work Bench	Burkel Equipment Company	3/28	4/4	4/5	4/13	Stock	*5/2	167757	\$66.25
86	2	Time Delay Relay, Inst.	Allied Radio Company	3/27	4/4	4/5	4/12	Stock	*4/19	167708	\$60.00
87	1	Type HW-10 Cable and Hose Assy.	Welding Equipment Company	Cancelled	Cancelled			Cancelled			

*Item required.

**Expendable item Chrysler approval not required.

TABLE VI
MATERIAL STATUS REPORT

ORDER NO.	QUANTITY	DESCRIPTION	MANUFACTURER	DATES (1956)						REMARKS	\$ 500
				REQUISIT. TO CHRYSLER	CHRYSLER APPROVAL RECEIVED	REQUISIT. TO PURCHASING	ORDER TO VENDOR	ORDER TO VENDOR	PROMISED DELIVERY		
1	--	Miscellaneous Fittings - Clips	George L. Johnston Company	**	**	4/2	4/10	4/10	Stock	166950	\$35.00
2	--	Thermocouple Wire and Insulators	Minneapolis Honeywell Company	**	**	4/2	4/12	4/12	Stock	166972	\$28.30
3	--	Miscellaneous Fitting-Fees-Adaptors	Michigan Chandelier Company	**	**	4/2	4/10	4/10	Stock	166971	\$77.17
4	--	Miscellaneous - Square-D	Ann Arbor Electrosales Company	4/2	4/4	4/23	4/30	4/30	Stock	169902	\$77.10
5	--	Miscellaneous - Tools	Montgomery Wards Company	**	**	4/2	4/10	4/10	Stock	167068	\$1,169.57
6	600	32 B.W.G. SS 316 Wire	Schnitzer Alloy Products Company	Cancelled	Cancelled	Cancelled	Cancelled	Cancelled			
7	1	Portable Type Shop Desk	Burkel Equipment Company	**	**	4/2	4/10	4/10	Stock	167073	\$42.00
8	1	LT 200 Cylinder Hand Truck	Welding Equipment and Supply Company	**	**	4/2	4/5	4/5	Stock	166582	\$35.00
9	--	Wrenches and Steel Rule	Chas. A. Strelinger Company	**	**	4/2	4/5	4/5	Stock	166577	\$39.60
10	1	Stainless Steel - Type 304	J. T. Ryerson & Son, Inc.	**	**	4/3	4/3	4/3	4/5	164974	\$50.00
11	1	Rockwood Cold Forged Steel Union Type	Murray W. Sales Company	**	**	4/3	4/10	4/10	4/24	166960	\$3.20
12	12	P-1068 Angles Greenamel	Unistrut Detroit Service Company	**	**	4/3	4/10	4/10	4/24	166962	\$10.00
13	--	Miscellaneous Ferrules - Unions - Fittings	Crawford Fitting Company	**	**	4/3	4/11	4/11	Stock	167251	\$65.00
14	--	Weld Pipe Caps 4" Sch and 1" Sch	Harry W. Taylor Company	**	**	4/3	4/11	4/11	Stock	167250	\$33.00
15	1	Cable and Hose Assy. HW-4	Linde Air Products Company	Cancelled	Cancelled	Cancelled	Cancelled	Cancelled			
16	--	Thermocouple Gage Tube and Connectors	Consolidated Electrodynamics Corporation	**	**	4/4	4/11	4/11	Stock	167263	\$56.00
17	--	Miscellaneous - Screws - Nuts - Washers	Buhl Sons Company	**	**	4/5	4/11	4/11	Stock	167248	\$9.10
18	--	Miscellaneous Unistrut Assy's	Unistrut Corporation	**	**	4/5	4/11	4/11	Stock	167311	\$106.66
19	4	Weather Lead Hoses	Great Lakes Rubber Company	**	**	4/6	4/11	4/11	Stock	167261	\$10.00
20	1 ea	Relay Rack Panel - Aluminum Mini-boy	Wedemeyer Electronic Supply Company	**	**	4/6	4/19	4/19	Stock	168504	\$6.11
21	--	Miscellaneous - Regulators - Connections	Victor Equipment Co., c/o Welding Equip.	**	**	4/6	4/11	4/11	Stock	167260	\$96.00
22	2 ea	Twistdrill's High-Speed-Straight Shank	Buhl Sons Company	**	**	4/9	4/16	4/16	Stock	167831	\$19.40
23	--	Miscellaneous-Fees-Crosses-Pipe	Crane Company	**	**	4/9	4/12	4/12	Stock	167707	\$8.50

*Item required.
**Expendable item Chrysler approval not required.

**TABLE VI (cont.)
MATERIAL STATUS REPORT**

ORDER NO.	QUANTITY	DESCRIPTION	MANUFACTURER	DATES (1956)				REMARKS	COSTS
				REQUISIT. TO CHRYSLER	CHRYSLER APPROVAL RECEIVED	ORDER TO PURCHASING	PROMISED DELIVERY		
24	1 pc.	3/8" I.P.S. x Sch. 40 SS-304 Pipe (17-24')	Service Steel Division	**	**	4/9	4/6	164992	\$40.00
25	--	Valves and Connections - Miscellaneous	Hoke, Inc. c/o H. E. Lennon and Son	**	**	4/9	4/16	167833	\$30.00
26	1	Wattmeter- Dynamo Meter Type	Wademyer Electronic Company	4/9	4/11	4/23	4/30	169911	\$28.00
27	1	Current Transformer	General Electric Company	4/9	4/11	4/23	4/30	169913	\$20.00
28	--	Miscellaneous - Thinner - Glyptal Resin	General Electric Company	**	**	4/9	4/12	167716	No charge
29	4 ea	Bearings Type 1 No. 8N8 and No 5N7	Detroit Ball Bearing Company	**	**	4/9	4/12	167717	\$8.00
30	4 #	Inconel Wire	Steel Sales Company	**	**	4/12	4/13	166844	\$10.00
31	2	Micro Switch #BZ-ZRL-PI	Micro-Switch Company	**	**	4/12	4/18	168066	\$3.56
32	--	Miscellaneous Unistrut - Nuts - Bolts	Unistrut Corporation	**	**	4/12	4/12	166836	\$29.91
33	--	Miscellaneous - Hacksaw Blades - Rules	Royall, Inc.	**	**	4/12	4/12	K-6906	\$36.80
34	--	Miscellaneous - Greenlee Punch - Wire	Allied Radio Company	**	**	4/13	4/19	168906	\$10.56
35	--	Miscellaneous - Stainless Steel Tanks	A. C. Tank Company	**	**	4/16	4/20	168615	\$36.95
36	--	Hose Connections - Welding Masks	Welding Equipment and Supply Company	**	**	4/17	4/17	166872	
37	4'	Nickel Tubing	Roberts, C. A., Company	**	**	4/17	4/23	168736	\$7.50
38	4'	1" O.D. x S.S. 303 Rod	J. T. Ryerson and Son	**	**	4/18	4/18	166899	\$12.00
39	--	Misc. - Adapters - Couplings - Clamps	The Chas. A. Strelinger Company	**	**	4/19	4/19	168410	\$60.00
40	--	Misc. - Caps - Tee - Elbow	Taylor, Harry W. Company	**	**	4/19	4/19	166879	\$54.00
41	1	Circuit Breaker XO-115	Ann Arbor Electro Sales Company	**	**	4/24	4/24	168432	\$2.20
42	1	Automatic Drain Trap	Worthington Corporation	**	**	4/24	4/24	168434	\$25.00
43	--	Miscellaneous - Screws	Royall, Inc.	**	**	4/24	4/24	K-8012	\$3.00
44	6	Cuno Micro-Klean Filters and Elements	J. N. Fauver Company, Inc.	**	**	4/25	4/30	169914	\$41.04
45	2 ea	Unimpregnated Graphite	National Carbon Company	**	**	4/24	5/28	173977	\$186.50
46	--	Miscellaneous - Tubes - Pipes - Caps	National Carbon Company	**	**	4/24	5/7	171119	\$282.15

*Item required.
**Expendable item Chrysler approval not required.

**TABLE VI (cont.)
MATERIAL STATUS REPORT**

ORDER NO.	QUANTITY	DESCRIPTION	MANUFACTURER	DATES (1956)					REMARKS	SLCS
				REQUISIT. TO CHRYSLER	CHRYSLER APPROVAL RECEIVED	REQUISIT. TO PURCHASING	ORDER TO VENDOR	PROMISED DELIVERY		
47	--	Miscellaneous - Flow Controllers	Moore Products Company			Cancelled By Chrysler			\$560.00	
48	--	Misc. - Differential Pressure Transmitters	Taylor Instrument Co. and Foxboro Co.	4/26		Cancelled By Chrysler			\$250.00	
49	1	2" Pem Strip Chart Recorder	Foxboro Co., Taylor Inst. Co., Mpls.Honeywell	4/26		Cancelled By Chrysler			\$115.00	
50	1	Research Controls Minim Flow Valve	Research Control Company	4/26		Cancelled By Chrysler			\$350.00	
51	1	Foxboro Model (?) Controller	Foxboro Company	4/26	**	Cancelled By Chrysler	4/30	168445	\$50.00	
52	1	Avco Series 1200 A.C. Valve	Associated Valve and Engineering Company	**	**	Cancelled By Chrysler	4/26	Stock		
53	--	Misc. - Pipe - Nuts - Flanges	Taylor Supply Co., Sawmill Tubular Products	4/26		Cancelled By Chrysler			\$80.00	
54	--	Misc. - Valves - Coil	Federal Pipe & Supply, Industrial Pipe Co. Automatic Switch Company	4/26		Cancelled By Chrysler			\$110.00	
55	--	Misc. - Screws - Nuts - Flanges	Allmetal Screw Products Company, Inc.	**	**	Cancelled By Chrysler	5/3	Stock	\$9.90	
56	--	Misc. - Series Relay - Cabinets	Allied Radio Company	**	**	Cancelled By Chrysler	5/7	Stock	\$27.00	
57	1 ea.	Foxboro Flow Slide Rule & Flow Meter Handbook	Foxboro Company	**	**	Cancelled By Chrysler	5/7	Stock	\$42.54	
58	--	Misc. - Valves - Couplings - Elbow	Taylor Supply Company	**	**	Cancelled By Chrysler	5/7	Stock		
59	1 ea.	Temperature Indicator	Assy. Prod. Co., Thermo Elect. Co., Inc. Wheelco Inst. Div.	4/27		Cancelled By Chrysler			\$264.00	
60	2 ea	Simply-trol Thermocouple Pyrometer	Assy. Products Inc.	4/27		Cancelled By Chrysler			\$20.00	
61	2	1 - 3/4 O.D. Bar, Type 416 Stainless	Globe Trading Company	**	**	Cancelled By Chrysler	4/30	Stock	\$10.00	
62	1	2 Unit Hot Plate	Hessenauer	**	**	Cancelled By Chrysler	4/19	4/19	\$39.00	
63	1	Grad U Motor Model M09008	Minneapolis Honeywell Company	**	**	Cancelled By Chrysler	4/16	Stock	\$7.20	
64	--	Miscellaneous	Sears, Roebuck and Company	Pickup	4/20	Cancelled By Chrysler	4/20	4/20	\$19.00	
65	1	8' Stepladder	Royal Inc.	**	**	Cancelled By Chrysler	4/20	4/20	\$6.60	
66	4	Sill Cocks	Rutzel and Company	**	**	Cancelled By Chrysler	4/20	4/20	\$35.00	
67	--	Tube Bushing	General Electric Company	**	**	Cancelled By Chrysler	4/20	Stock	\$8.10	
68	--	Tapes	Schlenker Hardware	**	**	Cancelled By Chrysler	4/24	4/24	\$15.30	
69	--	Hacksaw Blades, etc.	Sears, Roebuck and Company	**	**	Cancelled By Chrysler	4/2	4/19	\$3.00	
70	--	Porcelain Protection Tube	Sears, Roebuck and Company	**	**	Cancelled By Chrysler	4/20	Stock		

*Item required.

**Expendable item Chrysler approval not required.

**TABLE VI (cont.)
MATERIAL STATUS REPORT**

ORDER NO.	QUANTITY	DESCRIPTION	MANUFACTURER	DATES (1956)				REMARKS	C O S	
				REQUISIT. TO CHRYSLER	CHRYSLER APPROVAL RECEIVED	REQUISIT. TO PURCHASING	ORDER TO VENDOR			PROMISED DELIVERY
1	1 ea	Grease Gum - Grease - Screw Driver	Sears, Roebuck & Company	**		5/7	5/8	5/8	170439	\$4.75
2	--	Angle Valve All4877 Mueller	J. Geo Fischer & Sons Inc.	**		5/2	5/2	5/9	170431	\$20.00
3	--	Misc. - Lamps, Switch-Grommet, etc.	Allied Radio Company	**		5/3	5/14	5/21	172082	\$4.48
4	--	Misc. - Silver Solder and Flux	Welding Equipment and Supply Company	**		5/3	5/7	5/10	170441	\$5.00
5	1 ea	600 MCM Jumper - 500 MCM Jumper	Uniflex Cable Div., United Metalcraft Company	5/3/56		5/3	5/8	6/8	171357	\$49.50
6	1 ea	Individual Push Button Elements	Cutler Hammer Company	**		5/4	5/14	5/21	172083	\$7.00
7	1 bar	Stainless Steel Rod	Joseph T. Ryerson & Son, Inc.	**		5/4	5/4	5/8	170430	\$25.00
8	--	Misc. - Screw Bushing-Reducers	Service Steel Company	**		5/4	5/4	5/10	170432	\$10.00
9	--	Misc. - Potentiometer - Resistor - Socket	Allied Corporation	**		5/7	5/17	5/23	172497	\$5.80
10	5	Mallory Type "A" Battery	F. R. Mallory & Company	**		5/7	5/14	5/28	172079	\$8.00
11	--	Misc. - Silver Solder - Handy Flux	Welding Equipment & Supply Company	Cancelled			Cancelled	Cancelled	Cancelled	
12	--	Misc. - Saddlers Punches - Hacksaw Blades	Buhl Sons Company	**		5/8	5/8	Stock	5/17, 5/24	\$23.20
13	1	Converter	Ajax Electrothermic Corporation	5/8	5/9	5/8	6/15	7/20	8/17	\$2200
14	--	Misc. - Connectors & Inserts-Elbows	H. E. Lennon, Sons	**		5/8	5/8	5/10	5/10	\$30.00
15	--	Misc. - Breakers - Load Center	Ann Arbor Electro Sales	5/9		5/9	Cancelled	Cancelled	By Chrysler	\$25.00
16	--	Misc. - Variac's	General Radio Company	5/9		5/9	Cancelled	Cancelled	By Chrysler	\$149.00
17	3	Contactors	General Electric Company	5/9		5/9	Cancelled	Cancelled	By Chrysler	\$90.00
18	4	Pressure Regulator	Watts Regulator Company	5/9		5/9	Cancelled	Cancelled	By Chrysler	\$20.00
19	6 ft.	S.S. Tubing	Ryerson Steel Company	**		5/10	5/21	6/1	6/1	\$21.00
20	1	Elapsed Time Meter	Allied Radio Company	5/10		5/10	5/21	5/28	5/28	\$15.60
21	1500'	Thermocouple Wire	General Electric, Mpls. Honeywell Regulator Co	5/10		5/10	5/28	6/28	6/25	\$95.00
22	1	Teflon	U.S. Gasket Co., c/o Kicer Supply Company	**		5/10	5/10	6/7	6/7	\$15.00
23	--	Misc. & Replacements Shafts (Variacs)	General Radio Company	**		5/15	5/24	7/10	7/10	\$8.00

*Item required.

**Expendable item Chrysler approval not required.

**TABLE VI (cont.)
MATERIAL STATUS REPORT**

ORDER NO.	QUANTITY	DESCRIPTION	MANUFACTURER	DATES (1956)				REMARKS	COST
				REQUISIT. TO CHRYSLER	CHRYSLER APPROVAL RECEIVED	REQUISIT. TO PURCHASE	ORDER TO VENDOR		
24	--	Wire Revisions	Plant Stores	5/16		5/16	Cancelled		\$175.00
25	10	Graphite Rods	United Carbon Products Company	**		5/16	5/16	*5/16	172302 \$65.00
26	1	Purge Meter	Process Controls Company	5/16		5/16	5/25	*6/25	174046 \$16.00
27	--	Misc. - Tubing	McDanel Refractory Porcelain Company	**		5/16	5/24	*6/18	173604 \$21.56
28	--	Misc. - Pipe	Corning Glass Works Company	**		5/16	5/24	*6/11	173614 \$40.80
29	2	Graphite Pipe	National Carbon Company	**		5/16	5/24	*6/15	173607 \$5.00
30	20	Doré Teflon O-Ring Packing	John L. Doré Company	**		5/16	5/24	*6/11	173606 \$6.00
31	1	Molybdenum Sheet 0.005" Thickness	The Rembar Company	**		5/16	5/24	*6/1	173605 \$8.25
32	2	Misc. - Rectangular Base - Clamps	Eberbach & Son Company	**		5/16	5/24	*6/1, 6/8	173603 \$18.20
33	2	Rustproof Aluminum Wall Lower	Sears, Roebuck & Company	**		5/16	5/28	*6/14	173975 \$12.49
34	5	No - Drip Tape	Buhl Sons Company	**		5/17	5/28	*6/7	173973 \$8.45
35	47	Clips, Insulators & Wiring	Allied Radio Company	**		5/17	5/25	*6/4	173962 \$4.76
36	1	Lugs, Scriber Studs	Allied Radio Company	**		5/17	5/25	*6/1	173958 \$23.40
37	--	Fittings, Valves, Couplings, etc.	Copper & Brass Sales Company	5/17		5/17	5/25	*6/25	173961 \$80.95
38	--	Steel Angles	Kasle Steel Corporation	**		5/21		*5/23	172335 \$60.00
39	1	Chassis	Wedemeyer Company	Cancelled		5/21	Cancelled		174065 \$3.50
40	19	Nipples	Keystone Manufacturing Company	5/22		5/22	5/25	*6/4	174048 \$26.30
41	1	Freon Gas 25#	J. Geo Fischer & Sons Inc.	**		5/24	5/24	*5/30	174545 \$17.50
42	1	Guide to Instrument Literature	Supt. of Documents	**		5/28	6/6	*7/17	175633 \$1.00
43	5	Saw Blades & Rules	Schlenker Hardware Company	**		5/29	5/29	*5/29	K8268 \$7.80
44	1	Teflon Sheet 3' x 3' x 1/16"	Kicer Supply Company	**		5/3	5/14	*6/7	172097 \$81.00
45	74	Ells', Tee's, Clamps, etc.	J. Geo Fischer & Sons Inc.	**		5/16	5/16	*5/16	172308 \$25.00
46	15	Brady Cards	Cadillac Elect. Supply Company	**		5/16	5/16	*6/4	173974 \$2.25

*Item required
**Expendable item Chrysler approval not required.

TABLE VI (cont.)
MATERIAL STATUS REPORT

ORDER NO.	QUANTITY	DESCRIPTION	MANUFACTURER	DATES (1956)				REMARKS	COSTS	
				REQUISIT: TO CHRYSLER APPROVAL TO CHRYSLER RECEIVED	CHRYSLER APPROVAL	REQUISIT: TO PURCHASING	ORDER TO VENDOR			PROMISED DELIVERY
47	2	Adapter Flange	Corning Glass Works Company	**		5/23	5/31	*6/5	172390	\$12.00
48	2	Clocks	Johnston and Company	5/25	3/28	5/25	5/31	*5/31	172334	\$24.00
49	--	Screws, Washers	Strelinger Company	**		5/17	5/17	*5/22	172317	\$36.00
50	2	Grinding Wheel	Sears, Roebuck and Company	**		5/21	5/21	*5/23	172321	\$4.00
51	2	Boxes for Terminals	Ann Arbor Electrosales Company	**		5/31	5/31	*7/25	174218	\$9.00
52	--	Ledgers and Tags	General Stores and Mayer-Shairer Company	**		5/10		*6/13	K8338	\$15.00
53	--	Screws and Bolts	Royall Inc.	**		5/8	5/16	*5/24, 7/11	172495	\$6.00

*Item required.
**Expendable item Chrysler approval not required.

**TABLE VI (cont.)
MATERIAL STATUS REPORT**

ORDER NO.	QUANTITY	DESCRIPTION	MANUFACTURER	DATES (1956)					REMARKS	\$ L 00	
				REQUISIT. TO CHRYSLER	CHRYSLER APPROVAL RECEIVED	REQUISIT. TO PURCHASING	ORDER TO VENDOR	PROMISED DELIVERY			
1	--	Miscellaneous Tools	Sears, Roebuck and Company	**		6/1	6/5	Stock	*6/22, 6/25	175639	\$60.70
2	2	Rheostat and Resistor	Wedemeyer Company	**		6/1	6/7	6/28	*6/28	175859	\$15.00
3	--	Steel Channel and Rods	Joseph T. Ryerson & Son, Inc.	**		6/4	6/4	6/7	*6/7	174235	\$18.22
4	--	Aluminum & Steel Bars	Kasle Steel	**		6/4	6/4	Stock	*6/5, 6/6, 6/11	174233	\$100.00
5	2	(ANL-5107) by Alvin Glassner	Office of Technical Services	**			Cancelled				
6	1	Bismuth-piping Layout	Alloy Fabricators	6/5		6/6	6/12	9/12	*7/12	177103	\$6165.00
7	3 ea.	Brown Inst. Co. 8 point Terminal Board	Minneapolis Honeywell Company	**		6/6	6/14	Stock	Received		\$8.00
8	2 ea.	Angle Iron Plate	General Stores	**		6/6	6/6	Stock	*6/6	K8316	\$33.98
9	--	Pliers, Terminals, Clamps	Wedemeyer Electronic Supply Company	**		6/6	6/6	Stock	*6/22	177180	\$15.00
10	1	Colorless Transparent "Plexiglass" Sheet	Cadillac Plastic Company	**		6/6	6/14	6/22		177179	\$80.00
11	12ea.	Flange Steel Plate Pieces	Copco Steel Engineering Company	**		6/6	6/14	6/22	*6/22	177858	\$2.00
12	25'	2 Conductor Shielded Microphone Cable	Wedemeyer Electronic Supply Company	**		6/6	6/6	6/6	*6/6	174258	\$35.00
13	15	Miscellaneous Tools	Schlenker Hardware Company	**		6/8	6/15	7/2	*7/2	177850	\$4.75
14	1	Brazing Manual	Rheinhold Publishing Company	**		6/8	6/15	Stock	*6/28	177859	\$4.00
15	1	Removable Top Chassis	Harold H. Powell Company	**		6/8	6/8	6/11	*6/11	174289	\$6.00
16	--	Locking Pins for Breakers	Electro Sales Company	**		6/8	6/8	Stock	*8/20	177138	\$111.00
17	--	Molybdenum-Tantalum-Niobium Powder	Fansteel Metallurgical Corporation	**		6/8	6/13	Stock	*7/18		\$38.46
18	2	Crouse Hinds Receptacles	General Electric	6/1	6/4	6/5	6/12	Stock	*7/18	176177	\$22.83
19	2	Crouse Hinds Receptacles and Plugs	General Electric	6/1	6/4	6/5	6/12	Stock		180191	\$558.00
20	--	Electrical Equipment - Materials Program	Westinghouse Electric	6/1	6/4	6/5	7/16	8/16		180191	\$731.00
21	--	Electrical Equipment - Bismuth Loop Test	Westinghouse Electric	6/1	6/4	6/5	7/16	8/16		180191	\$731.00
22	--	Electrical Equipment - Materials Program	Westinghouse Electric	6/1	6/4	6/5	7/16	8/16		180191	\$731.00
23	--	Screws, Nuts, Bolts, Washers	The Chas. A. Strelinger Company	**		6/11	6/19	6/26	*6/26	178105	\$12.50

*Item required.

**Expendable item Chrysler approval not required.

**TABLE VI (cont.)
MATERIAL STATUS REPORT**

ORDER NO.	QUANTITY	DESCRIPTION	MANUFACTURER	DATES (1956)					REMARKS	S I S C	
				REQUISIT. TO CHRYSLER	CHRYSLER APPROVAL RECEIVED	REQUISIT. TO PURCHASING	ORDER TO VENDOR	PROMISED DELIVERY			
24	1	Rockwood Ball Type Valve	Rockwood Sprinkler Company	**		6/11	6/15	6/26	*6/26	177897	\$16.00
25	9	No 10981 12" Dominion Fans	W. W. Grainger, Inc.	Director Charge		6/12	6/25	Stock	*8/2	178937	\$121.05
26	1 ea.	Couplings 3/8" 1/4" Pipe 3"	Crane Company	**		6/12	6/12	7/5	*7/5	177503	\$15.00
27	6 ea.	Teflon Type 'T' Gasket	Fischer Scientific Company	**		6/12	6/19	6/29	*6/29	178108	\$3.00
28	4	National "O" Ring	Detroit Ball Bearing Company	**		6/12	6/19	6/22	*6/22	178106	\$4.00
29	5 ft.	Nickel Tubing	C. A. Roberts Company	**		6/12	6/12	6/20	*6/20	177506	\$5.00
30	100'	Copper Tubing	General Stores	**		6/12		Received			\$10.00
31	1	Croloy	Babcock and Wilcox Company	**		6/12	6/21	6/29	*6/29	177511	No charge
32	1	Saw Blades and Pocket Rules	Shaefer Hardware Company	**		6/12	6/12	6/12	*6/12	177512	\$15.00
33	200	Thermocouple Insulators	Barber-Colman Company	**		6/12	6/19	7/2	*7/2	178107	\$5.00
34	1	Bottle Argon	Plant Stores	**		6/13		Stock	Received		\$36.00
35	10'	Steel Bar	Casco Steel Company	**		6/13	6/13	6/14	*6/14	177532	\$4.00
36	18	Toggle Switches and Potentiometers	Medemeyer Company	**		6/13		Stock	*6/13, 6/14	R8341	\$7.50
37	4 am.	Transites	Plant Stores	**		6/13		Received			\$40.00
38	9	Tough Pipe	Fischer Scientific Company	**		6/13	6/21	7/5	*7/5	178384	\$71.60
39	11	Unimpregnated Graphite	National Carbon Company	**		6/14	6/21	7/17	*7/17	178383	\$26.00
40	100'	Copper Tubing	General Stores	**		6/14		Received			\$10.00
41	1	Salt Tablet Dispenser	Mine Safety Appliances Company	**		6/18	6/22	Stock	*7/24	179083	\$15.00
42	2	Temp. Control and Mounting Flange	Burling Instrument Company	**		6/18	6/27	7/14	*7/14	179716	\$84.75
43	1	Resistor, Switches, Test Leads	Allied Radio	**		6/15	6/22	Stock	*7/24	179085	\$34.42
44	1	Miscellaneous Tools	Allied Radio	**		6/15	6/22	Stock	*7/24	179085	\$25.24
45	32	Little Fuses	Allied Radio	**		6/15	6/22	Stock	*7/24	179085	\$2.46
46	1	Elbow	Service Steel Division	**		6/18	6/26	7/3	*7/3	179318	\$3.00

*Item required.
**Expendable item Chrysler approval not required.

TABLE VI (cont.)
MATERIAL STATUS REPORT

ORDER NO.	QUANTITY	DESCRIPTION	MANUFACTURER	DATES (1956)					REMARKS	U L C O	
				REQUISIT. TO CHRYSLER	CHRYSLER APPROVAL RECEIVED	REQUISIT. TO PURCHASING	ORDER TO VENDOR	PROMISED DELIVERY			
47	5	Resistors	Simpson Electric Company	**		6/18	6/22	7/12	*7/12	179084	\$1.00
48	6	Engraving	Instrument Shop	**		6/18		7/20	*7/20		
49	2	Neoprene Sheetting	Detroit Rubber Company	**		6/14	6/14	7/16	*7/16	177547	\$18.00
50	10	Dry Ice	Ypsilanti Dairy	**		6/18	6/18	6/18	*6/18	177554	\$1.00
51	2	Gas Mask, Oxygen Mask	Wiard Surplus Store	**		6/15	6/15	6/15	*6/15	177560	\$2.75
52	12	National O-Rings	Detroit Ball Bearing Company	**		Cancelled					
53	14	Wire Cables, Cable Sash, Single Block	Sears, Roebuck and Company	**		6/18	6/26	7/12	*7/12	179317	\$5.97
54	1	Teflon Rod	Kicer Supply Company	**		6/19	6/27	7/2	*7/2	179727	\$15.00
55	1	Chlorine Gas	Mathieson Company, Inc.	**		6/19	6/19	7/22	*7/22	177581	\$28.25
56	2	Ceiling and Exhaust Fan	W. W. Grainger Company	**		6/19	7/3	7/10	*7/10	177028	\$36.80
57	1	Flexiglas Sheet	Cadillac Plastic Company	**		6/19	6/27	7/10	*7/10	179728	\$20.00
58	10	Magnetic Contactors, Fish Tape	Ann Arbor Electro Sales	**		6/20	6/20	6/22	*6/22	178711	\$14.50
59	112	Gaskets	Consolidated Electro Dynamics Corporation	**		6/20	6/20	6/22	*6/22	169618	
60	30	Male Connectors and Elbows	Lennon & Company	**		6/20	6/27	Stock	*7/19	179726	\$30.00
61	1	Dexion Slotted Angle Cutter	Acme Steel Company	**		6/20	6/20	6/22	*6/22	178705	\$45.75
62	75'	Fiberglass Tubing	Bentley Harris Mfg. Company	**		6/20	6/20	6/26	*6/26	178708	\$11.00
63	96	O-Rings	Detroit Ball Bearing Company	**		6/21	6/18	6/22	*6/22	177574	\$11.30
64	500'	Resistance Wire	Lewis Engineering Company	**		6/22	7/3	Stock	*7/23	180229	\$119.50
65	2	Oxygen Regulator, Connect. Tube, Fitting	Wiard Surplus Store	**		6/22	6/22	6/22	*6/22	178739	\$8.75
66	1	GPH Recirculating - Pump No. 1P260	W. W. Grainger, Inc.	**		6/22	7/3	7/10	*7/9	180234	\$9.80
67	2	Safety Cans	Plant Stores	**		6/25			Received		\$12.00
68	31	Electrical Pipe Fittings	Ann Arbor Electro Sales	**		6/25	6/22	Stock	*8/9	174300	\$30.00
69	2	Thermocouple Assembly	Leeds Northrup, G.E. Co., Bristol Co.	**		6/25	7/5	Stock	Cancelled	180212	\$25.00

*Item required.

**Expendable item Chrysler approval not required.

TABLE VI (cont.)
MATERIAL STATUS REPORT

ORDER NO.	QUANTITY	DESCRIPTION	MANUFACTURER	DATES (1956)					REMARKS	\$	
				REQUISIT. TO CHRYSLER APPROVAL	CHRYSLER RECEIVED	REQUISIT. TO PURCHASING	ORDER TO VENDOR	PROMISED DELIVERY			
70	1	Variac Model	General Radio Company	6/25		6/25	7/10	Stock	*7/24	181075	\$40.00
71	4 gross	Screws and Nuts	Banal Corp., Steel Sales, Continental Screw Co.	**		6/26	7/3	7/11	*7/11	180223	\$9.10
72	1	"Review of Scientific Instruments"		**		6/26	Order	Received			\$8.00
73	26	Heating Elements, Clamps	Norton Company	**	**	6/25	7/11	7/25	*7/25	178786	\$120.00
74	1	Cylinder Argon	Plant Stores	**		6/27		Stock	Received		\$36.30
75	16	Sockets - Resistors	Wedemeyer Company	**		6/27	6/27	6/27	*6/27	K8473	\$3.00
76	6	"O" Rings	Detroit Ball Bearing Company	**		6/27	6/27	7/2	*7/2	178778	\$3.00
77	1	Handjack for Pressure Gages	Becker Company	6/27		6/27	6/27	Stock	*8/13	178767	\$2.50
78	1	Rosin Core Solder	Wedemeyer Company	**		6/29	7/10	7/13	*7/13	181024	\$1.00
79	25	Fittings	Andrew Company	**		6/29	7/23	8/1		182991	\$16.00

*Item required.

**Expendable item Chrysler approval not required.

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