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ULTRASONICS APPLIED TO ELECTRODE REACTIONS

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OBJECT OF THE STUDY

The problem is the use of ultrasonics produced by magnetostriction as a means of studying phenomena at the interface between electrode and electrolyte.

RESEARCH DURING THE PERIOD

The panel-box assembly housing the measuring and electrolyzing circuits, referred to in the last report, was completed. The extensive series of tests required to verify its proper functioning showed that in spite of every effort being made to avoid the normal sources of trouble in such equipment, such as leakage and mutual interaction of the components of the measuring assembly as well as pickup from amplifier, oscilloscope, and other equipment in the building, certain difficulties remained.

Additional tests showed that one factor responsible was a hidden short-circuit in the current-regulating potentiometer. After this was eliminated, a portion of the difficulty still persisted, which was traced to a d-c potential fed back from the amplifier output through the ground into the panel-box assembly. After trial of numerous expedients, it appeared that the difficulty was eliminated by inserting a suitable capacitor in the ground lead of the assembly housing.

The new d-c amplifier, sent back to the makers for repairs, was returned. Even the first tests, however, indicated a gain much less than specified and in continued use it proved to be inadequate from the standpoint of constancy and the presence of excessive hum, while the older model loaned by the distributors as a temporary replacement always gave satisfactory performance.

To eliminate or at least minimize the effect of temperature flucuations in the amplifier, this instrument was housed in a suitable shield. Since hum was still present, all the electronic units, with the exception of

the magnetostriction oscillator, were assembled into one block to facilitate shielding of the whole. The necessary shield for this entire assembly was designed, purchased, and installed.

The difficulty due to hum still persisted with the new amplifier, which presumably had been put in first-class repair by the distributors. After extensive exploration of all conceivable external disturbances, it was finally concluded that the difficulty was inherent in the amplifier itself. This conclusion seemed at least partially justified in that in the new and supposedly improved instrument the a-c power supply is incorporated within the chassis, while in the older model it is a separate unit. With this possibility in mind, the distributor was contacted and requested to supply for trial one of the older models with the external power supply. After much delay this was received. Tests with this showed that the supposition was correct and that the hum difficulty was reduced to a point suitable for this work.

By means of photographic recordings it was possible to convince the supplier that the design of the new and supposedly improved instrument, incorporating the a-c power supply within the chassis, is actually defective. An exchange of instruments was accordingly effected at some additional cost to the Department.

Work was resumed on the magnetostriction oscillator and vibrating tube assembly. During previous use of these units it was concluded that certain changes in design would make them more effective in the extended project. At the same time certain safety features were incorporated.

In order to increase the effectiveness of the magnetic field due to the oscillator, a completely new and more efficient yoke for the vibrating tube (cathode of the electrolysis cell) was designed and constructed. Also a new a-c coil was made, using special wire to reduce losses.

An unfortunate accident with the magnetostriction oscillator necessitated replacement of the plate transformer. Since it seemed likely that the old transformer was somewhat deficient in capacity, it was replaced with a larger and more rugged unit. The larger size of the new transformer necessitated some changes in layout in order to incorporate it in the housing.

The measurements required in connection with this research involve a complex sequence of mechanical and electrical operations. In order to make the results significant and reproducible, it is essential that these operations be precisely controlled as to incidence and duration. The earlier work has indicated that the desired precision can be attained only if the various steps are made automatic. With this objective, a considerable number of switching elements have been designed to ensure that from beginning to end of an experiment, terminating in the securing of a permanent photographic record of events,

each step shall be controlled automatically. Some of these elements have been completed, while others are under construction. Among the former is an electrically operated shutter release for the camera. Another is a timing mechanism consisting of a series of adjustable cams, each operating a microswitch controlling one of the operations; all the cams are mounted on a common shaft driven by a synchronous motor. As a part of the complete sequence, it is necessary to activate the spot on the oscillograph screen automatically to a sufficient intensity for the photographic record. An existing multivibrator has been adapted for this purpose.

While the oscilloscope purchased for the project incorporates an automatic sweep which will be useful for short cycles, it is much too fast in operation for most of the events to be recorded. Consequently it has been necessary to design an external sweep for use in most of the experiments.