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TECHNICAL REPORT No. 396-45

GERMAN INDUCTION MINE UNITS

September 1945

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GERMAN INDUCTION MINE UNITS

SUMMARY

This report contains information on German Induction Magnetic Mine Units. No induction units were used by the Germans during this war. However, the British success with induction mines led to considerable German experimentation, and the results of these experiments is shown herein.

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GERMAN INDUCTION MINE UNITS

1. Introduction.

(a) At the time the Germans first started experiments with magnetic mines in 1923, they realized that they would never have a sufficient supply of Nickel to make induction mines. Therefore, all energy was devoted to the development of dip-needle type mine units. They reasoned that although there was Nickel available, mining would take secondary priority with respect to other weapons and the aircraft industry. This is undoubtedly the reason why only needle-type mines were laid operationally in any large number. However, when the Germans recovered the first British induction mines they were stimulated to experimentation with similar circuits and coils. Although it appears that some 200 experimental BMA mine were laid, the Nickel shortage prevented a serious induction mining effort. At some further advanced points in the war they actually intended to use British coil-rods and other British components recovered from mines dropped on land to lay against the British. This, however, never took place.

(b) Although there is no documentary information on induction mines, samples of the BMA I, II, III and J-1 were found and shipped to U. S. Navy Ordnance Investigation Laboratory. The information contained herein has been obtained through interrogation of prisoners of war and field examination of equipment captured.

2. General.

Due to the shortages of Nickel, Cobalt and Copper, several schemes of substitution were used. The shortage of Nickel seriously impeded the production of coil-rods and Krupp was given the job of producing coil-rods of high-permeability transformer steel, which were to be wound with Aluminum windings. To overcome the loss of permeability due to Nickel shortage, there were to be more than one coil-rod, to make up the loss in sensitivity. These coils were to be arranged in a circle, parallel to the axis of the mine and cast into the explosive. The cylindrical portion of the BMA case into which they were placed was to be of non-magnetic steel. Most BMA mine-cases found were fitted with tubes for two (2) coil-rods. However, others have been found with six (6) and some with eight (8). Approximately 200 such cases were manufactured, most of which were used for experiments. As a result of

2. General (Cont'd.)

these unsuccessful experiments. some work was done on "amplified-induction" units, which were to be fitted to the aluminum-cased LMB mine. These experiments were not pursued exhaustively and no satisfactory unit resulted. The circuits described below are entirely SVK development (Navy). The Luftwaffe was more favored by the German High Command and was allocated a small amount of Nickel for induction mine production. Two induction combination units were completely developed and ready for production at the end of the war in Europe. These were the AJ (D) 102, developed by Dr. Ing. Rudolf Hell, and the JDA 105, developed by Dr. Werner of AEG. These will be reported separately in Technical Reports Nos. 418-45 and 419-45.

3. BMA II

The BMA II mine was designed for laying without parachute from an altitude of 2500 meters, or from S-boats. The induction coils were wound with aluminum wire and the resistance of one coil was approximately 15 Ohms. The self-inductance of the coil-system is reported to be 25 Henry. Each coil-rod was covered with rubber (Oppanol), and the main charge poured into the mine-case around it. The BMA II mine case is very similar in design to the BM 1000.

4. BMA III

The BMA III mine was similar in design to the BMA II, except that it was an experimental one-coil mine (mounted on the axis) with Nickel specially allocated for the work. The mine was designed to be laid safely from 3000 meter altitude. The coil was wound with copper wire on a Mu-Metal core 150 cm. long and 2.5 cm. diameter. The sensitivity of this system was 5 - 10 mg., as opposed to approx. 25 mg. for the BMA II. However, due to a shortage of materials the development was stopped.

5. J - 1

The J-1 unit is an attempt to copy one of the simple British systems. It is a one-look, random direction device with a 12-place P.D.M. and detonation-protection. It may be fitted to the BMA II or BMA III mines and consists simply of the necessary induction coil (s), a sensitive relay, 12-place P.D.M., UES (hydrostatic clock), a vibration-actuated anticountermining switch, and resistors and a

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5. J - 1 (Cont'd.)

condenser. The circuit is shown in Figure 1. When the hydrostatic clock runs off, u_1 and u_2 close. A few minutes later u_3 closes and the circuit is fully armed. If coil S detects a magnetic signal, it energizes the coil of relay J through R_1 and R_2. When J closes contact, the battery produces a self-holding current for J through S. The ZK II mechanism is actuated and runs off, during which process the holding current is broken before the cycle is complete. When the ZK II switches over, it switches in the detonator and the protection circuit. A final firing actuation will produce a large surge through the detonator to charge condenser C. The mine then fires. If a detonation occurs when the ZK II has switched over to put the detonator into the circuit, the result is that vibration-switch K makes contact before the relay (J) can close. Closing of K immediately charges C fully so that when J does make contact, the resultant surge through the detonator to charge C is too weak to fire the detonator and self-holding of the relay does not take place. It is reported that this blocking condition lasts for approx. 1 minute, but this is very doubtful since the constants of R_3 and C are not large enough.

6. JV

The JV is an attempt to develop an amplified induction mine unit. JV = Jnduktion Verstärker (Induction Amplifier). This was attempted purely due to the shortage of critical materials: Nickel and Copper. Two types were experimented with. One for use as a plain induction unit for use in the LMB mine and the other for use in combination with a unit component operating on another influence in the LMB mine. The coil was wound on a soft-iron core of 2.5 cm. diameter and 60 cm. length, and consisted of two coils in series totalling 60,000 turns of 0.03 mm. copper wire. In the JV circuit shown in Fig. 2, the medium and high frequencies are by-passed by condenser C_1. The circuit is designed to respond only to very low frequencies, (approx. 1/30 - 1/50 cps). Some experimentation was also carried on with a similar three-stage amplifier, arranged in such a way, that after the induction system had been amplified and operated, it would be switched out and the amplifier used as a low-frequency amplifier ("Klotz-verstärker") for a low-frequency detector. Development work on this system was stopped as it was considered too difficult a problem to work out a satisfactory protection system against nearby detonations.

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Prepared by:

W. C. HOLMES,
Lieut., USNR.

R. J. FRANZ,
Lieut., USNR.

C. J. OLENIACZ,
Lieut., USNR.

H. G. VOGEL,
Lieut., USNR.