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Report on

An Expendable [illegible]

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Navy Department

Report on

An Expendable 100 mc Radar Jammer

Naval Research Laboratory

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1. ABSTRACT

1.1 The radar Chick described herein is a small expendable pulse modulated radio transmitter, which was designed for jamming use against the 100 mc Japanese Search Radar. Experimental results showed jamming at saturation level on the Japanese radar screen at four miles with an antenna height of 15 inches above the surface of the water. When the transmitter was operated 60 feet above the water from the deck of an Escort Carrier, saturation jamming was possible at a distance of 17.5 miles, the greatest distance at which tests were made. When two or more Chick units were operated simultaneously, a rapidly changing random pattern on the screen was produced which was very effective in obliterating echo reception. The entire system consisting of transmitter, batteries and antenna, is housed in a parachute flare case.

2. INTRODUCTION

2.1 The problem assigned to NRL requested that radar barrage jammers be developed for use in the 100, 120, 375, and 575 mc bands. The 100 mc jammer was developed first, and the technique used in solving this problem was to be applied to the other frequencies.

2.2 In the original concept of the problem, the radar Chicks were to be dropped from aircraft and were to jam enemy radar receivers in the vicinity during their descent and possibly for a short time after landing. It was also desired to have the Chicks built into a Mark IV flare case which is 4-3/4 inches in diameter and 27 inches long. This would allow them to be launched from any plane without special installation. They were to be considered expendable, and the life was expected to be only a few hours.

3. RESULTS OF DEVELOPMENT AND TEST

3.1 Early tests using a 10 pound Chick in a Mark IV flare case showed the rate of descent, with the fifteen foot flare parachute, too rapid to be of any use for screening operations. The time of descent was three minutes for a height of 5000 feet. Because of the length of antenna required at 100 mc, it was necessary to secure the antennas to one end of the flare case and use the opposite end for the parachute exit. This placed the antenna on the bottom of the Chick as it descended and made it impossible to continue jamming after striking the water. In view of these limitations, the Chicks were generally conceded to be of very limited value when launched from aircraft because of the short jamming time.

3.2 The possibility of launching the Chicks in groups from submarines prior to an attack was proposed and tests were made to check their effectiveness. Since the Chicks would undoubtedly have to be built with a low antenna height to insure stability in the water, tests simulating these conditions were made. Two Chicks were installed in a rowboat with their

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antennas about fifteen inches above the water level. The rowboat was then towed about fifty feet behind a small motorboat to eliminate radio reflections as much as possible. Under these conditions, the Chick jammed the screen of the Japanese radar to saturation height at a distance of four miles. At six miles, the jamming was still about three times the normal noise level on the screen. Beating between the two Chicks was continuously visible on the screen of the cathode ray tube and made the identification of echoes very difficult. These tests were conducted against the Japanese search radar set at Chesapeake Bay Annex of NRL. This radar equipment, as installed, has an antenna height of 125 feet.

3.3 Later it was proposed to use the Chicks as a small economical jammer to screen landing operations by mounting them on landing craft and other small boats. Tests were made with these conditions approximately simulated. Three Chicks were mounted on poles 10 feet (one wavelength) above the flight deck of an Escort Aircraft Carrier effecting a total height of 60 feet above water. Chicks jammed the radar screen to saturation at the maximum distance of the test, 17-1/2 miles. At 10 miles, three jammers caused such violent beating that it was difficult to watch the screen for more than a minute or so at a time because of eye strain.

3.4 The radar Chick oscillator uses two 6C4 miniature tubes in a tuned plate, untuned grid circuit designed to cover the range of 90 to 120 mc. A self-quenching system is employed to key the grid circuit. Square waves at a repetition frequency of 200 kc and a duty cycle of approximately 50 percent are generated in the oscillator grid circuit by a three-section "pi" line which determines the repetition rate and the pulse length. A peak power of approximately 12 watts is obtained from the transmitter, with a bandwidth of approximately 400 kc.

3.5 The artificial transmission line in the grid circuit serves to offset the disadvantages of using an RC combination (Fig. 2) for pulse control, by allowing a higher duty cycle and reducing the susceptibility of "lock in" from external signals. The conventional self-keying oscillator of Fig. 2 produces an oscillator grid voltage curve such as shown in Fig. 3. The resultant RF envelope is shown in Fig. 4. In the NRL Chick circuit of Fig. 1, the transmission line causes the grid voltage curve to assume the shape of Fig. 5 with a corresponding envelope as is shown in Fig. 6. In the RC type of circuit, a signal such as an external radar pulse occurring in the approximate period between A and B on Fig. 3 will cause the oscillator to key prematurely and hence will lock the jammer pulse in synchronism with the external signal. This "locking in" effect between radar transmitter and the jammer oscillator results in a stationary pattern on the screen of the radar indicator and may allow echoes to be seen between the jammer pulses. The grid voltage of the NRL circuit shown in Fig. 1 is held well below the starting bias value for a greater length of time for the same repetition rate as the RC circuit.

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As a result, the period between A and B in Fig. 5, during which the oscillator is susceptible to external influences, is materially reduced. These Chicks have been operated within a few feet of a high power radar transmitter and no leaking was apparent.

3.6 The antenna system for the Chick consists of two horizontal half-wave dipoles oriented at 90 degrees. The antenna rods are supported on the top cover of the case and are hinged in such a manner that they may be folded down along the case for convenience in stowing and launching.

3.7 Power requirements for the Chick are 6.3 volts at 0.3 amperes and 250 volts at 50 milliamperes. An experimental battery giving a life of one hour with a diameter of 4 inches and a length of 9 inches has been built, with a weight of 6 pounds. For some operational uses the magnesium-carbon sea water batteries designed by the Burgess Battery Company, could be used with a vibrator supply to secure a greater operating time. A life of 10 hours may be expected from a sea cell and power pack, occupying no more space than the dry cells used in this test. A small barrage type balloon has been suggested to secure additional antenna height for use when launched by submarine or on landing craft.

3.8 For maximum effectiveness, the Chicks can be put on frequency by the use of a narrow band panoramic receiver, provided that a small number are to be used. If large numbers are to be used, they can probably be preset and staggered in frequency to completely cover a given spectrum.

4. CONCLUSIONS

4.1 The radar Chick described in this report appears to perform in a very satisfactory manner when employed against the Japanese 100 mc radar in the tactical methods for which it was intended. Since each new problem of tactics may change the application of this Chick, some further development may be necessary to fulfill the tactical requirements.

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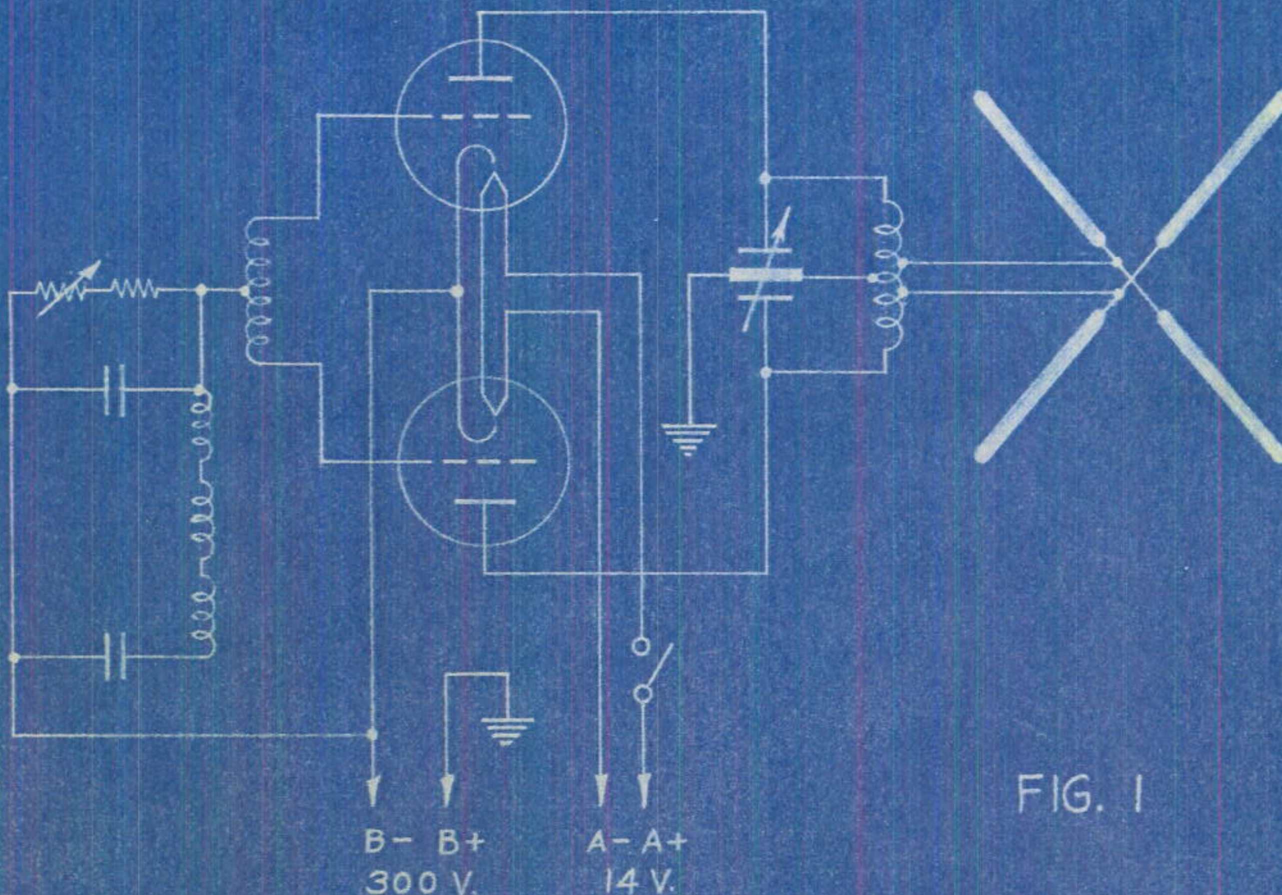

FIG. 1

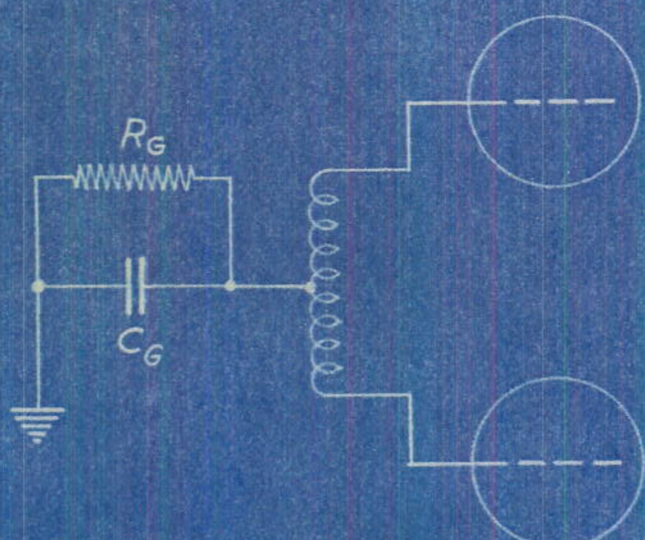

FIG. 2

PLATE I

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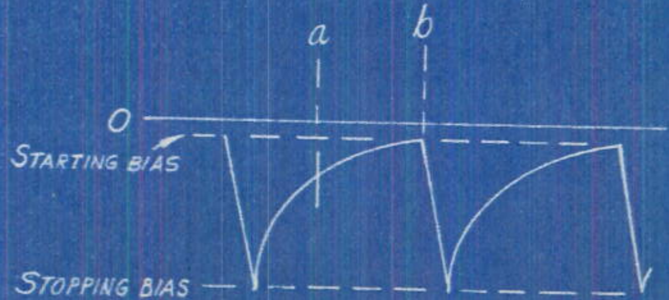

FIG. 3

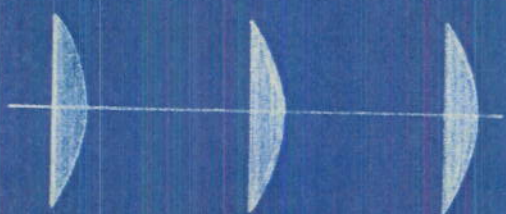

FIG. 4

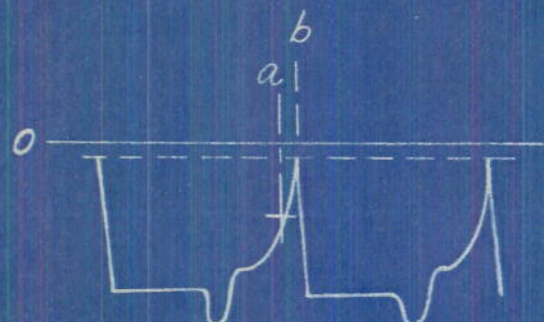

FIG. 5

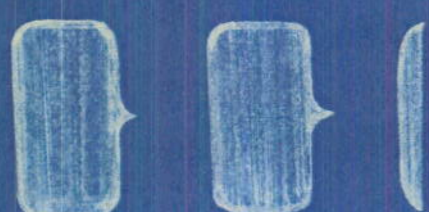

FIG. 6

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PLATE 2

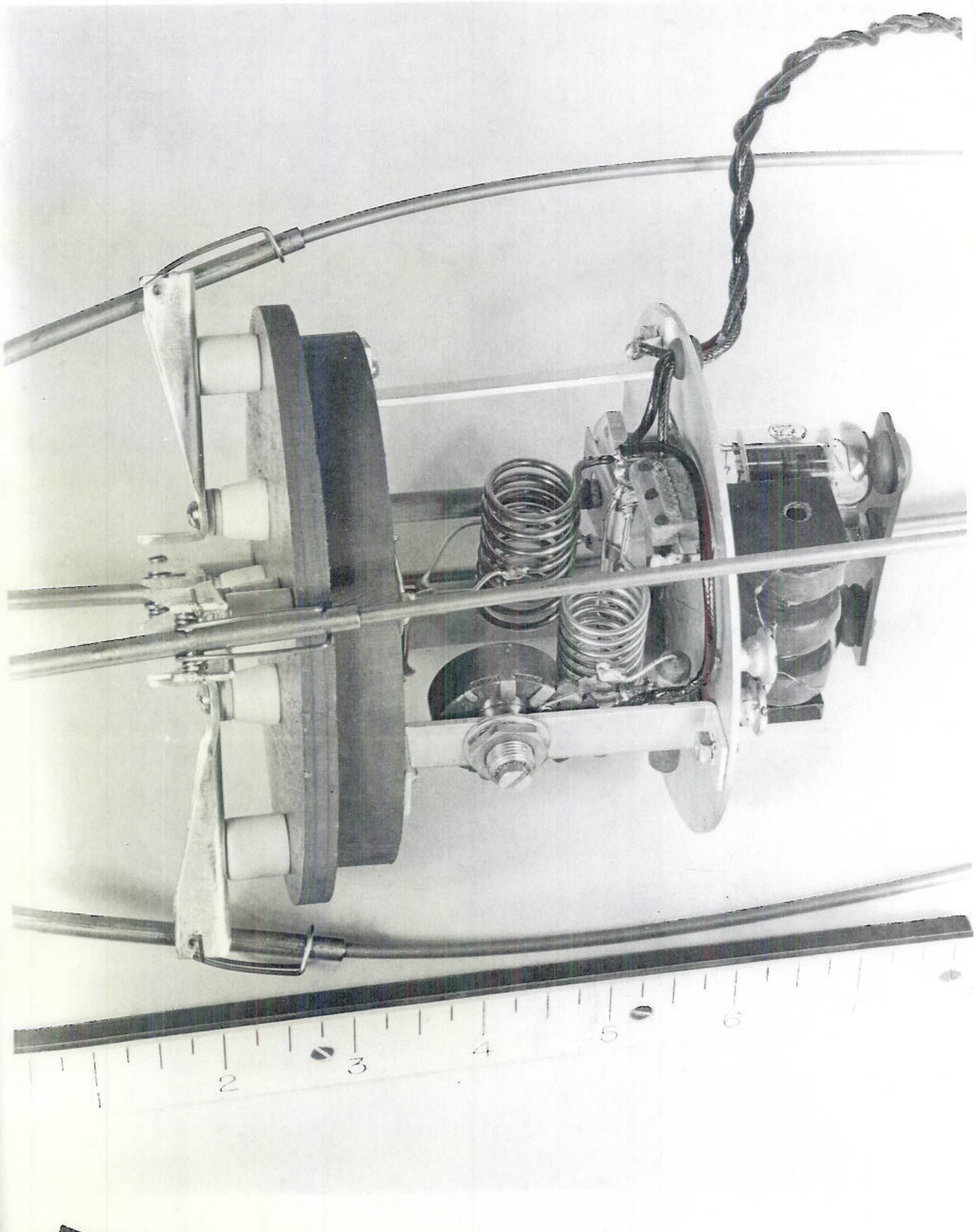

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PLATE 3

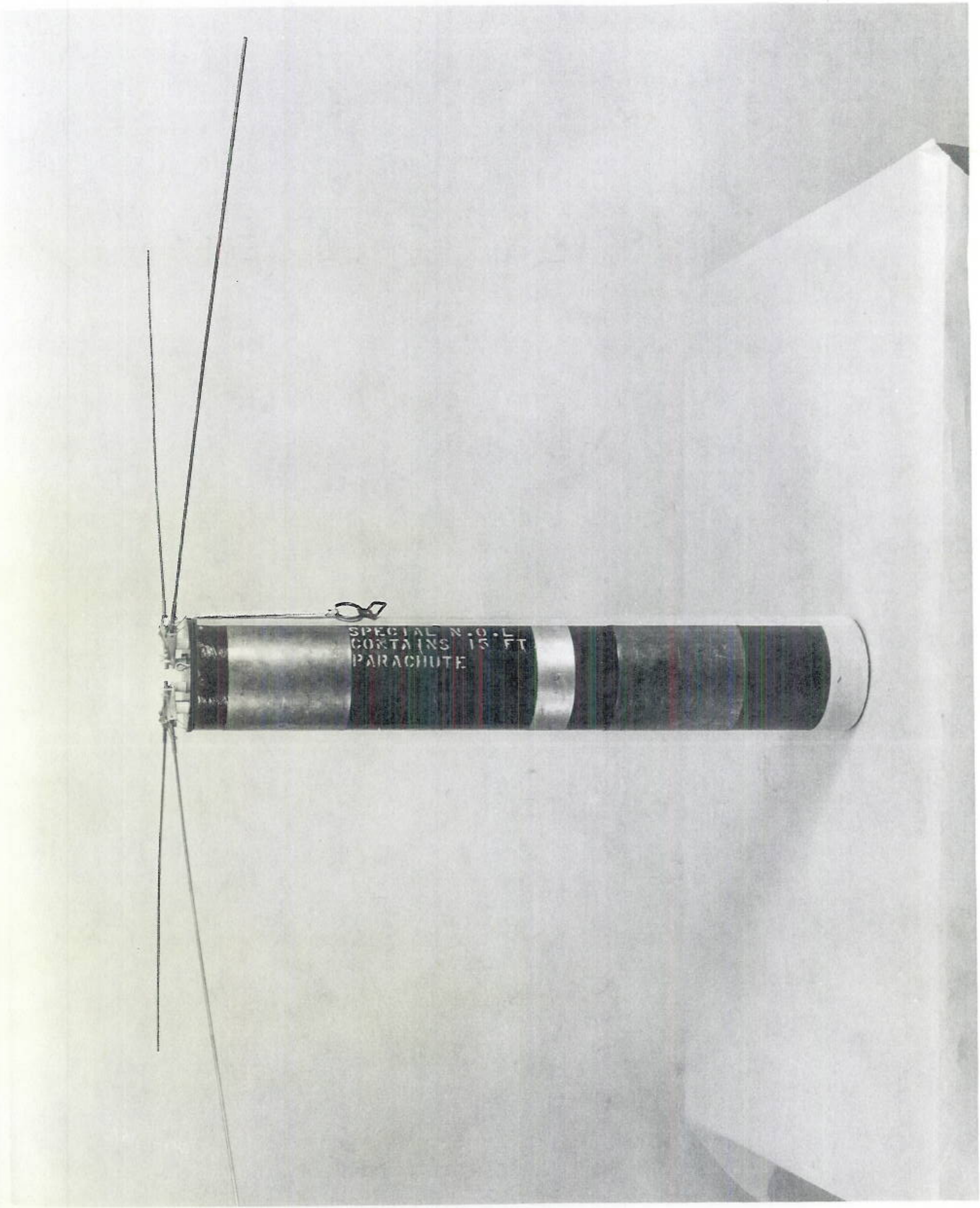

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PLATE 4

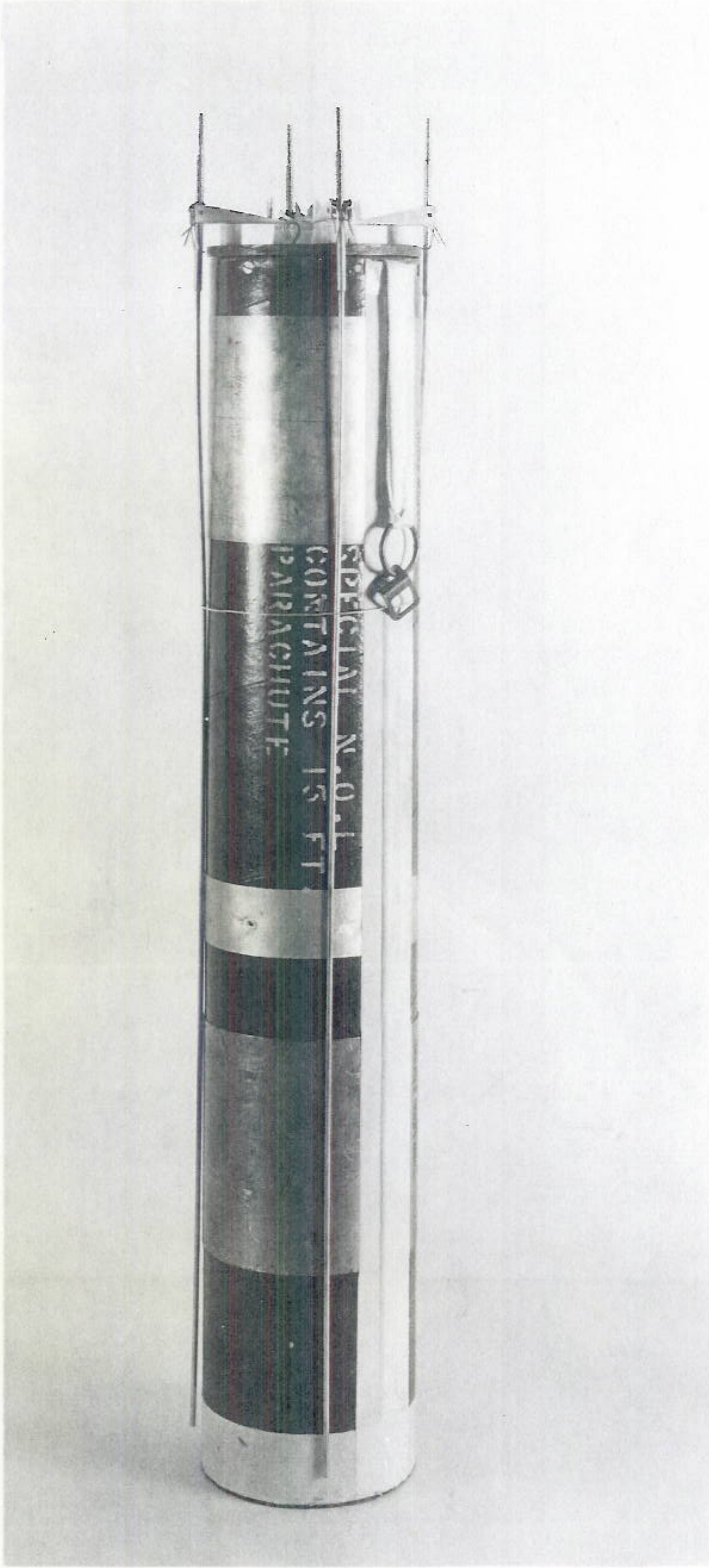

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 PLATE 5