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U. S. NAVAL TECHNICAL MISSION TO JAPAN
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SAN FRANCISCO, CALIFORNIA

14 February 1946

RESTRICTED

From: Chief, Naval Technical Mission to Japan.
To : Chief of Naval Operations.

Subject: Target Report - Japanese Fuse-Setting Equipment.

Reference: (a)"Intelligence Targets Japan" (DNI) of 4 Sept. 1945.

1. Subject report, covering Target O-48(N) of Fascicle O-1 of reference (a), is submitted herewith.

2. The investigation of the target and the preparation of the report were accomplished by Commander (E) A. J. Stewart, RN.

C. G. GRIMES
Captain, USN

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O-48(N)

JAPANESE FUSE-SETTING EQUIPMENT

"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945

FASCICLE O-1, TARGET O-48(N)

FEBRUARY 1946

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

ORDNANCE TARGETS

JAPANESE FUSE-SETTING EQUIPMENT

The Japanese Navy used only one type of automatic fuse-setting machine. It was designed in 1933 and later modified to its present form. It is fitted to the breech face of the gun and the fuse is set when the round is in the loading tray being transferred to the loading position. This enables a dead time of only two seconds to be used in the computer. The machine is a very simple mechanism and, compared with most other fuse-setting machines, is light and compact. The over-all error in fuse setting is about 0.09 to 0.41 seconds of fuse time. Experiments were being carried out at the end of the war to reduce this error by use of a fuse having a plain white metal fuse-setting ring, but these experiments were not satisfactorily completed in time to use the new type of fuse. Some documents, giving details of the factors affecting the accuracy of these machines, have been collected but not yet translated. The figures given above are, therefore, liable to amendment. Had the Japanese been able to improve the accuracy of these machines they would undoubtedly have had as far back as 1934, an automatic fuse-setting machine superior to any mechanical fuse-setting machine in use by the Allies up to the end of the war.

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REFERENCES

Location of Target:

Naval Ordnance Dept., Kure Navy Yard

CV KATSURAGI, and DD HANAZUKI and NATSUZUKI

Japanese Personnel Assisting in Gathering Documents:

Comdr. ICHINAI, IJN Naval Technical Headquarters, TOKYO.

Japanese Personnel Interviewed:

Capt. DATE IJN, Naval Technical Headquarters, TOKYO

Comdr. ICHINAI, IJN

M. KOGA, Engineer in the Ordnance Dept. of Kure Navy Yard

INTRODUCTION

The object of the investigations was to discover what types of automatic fuse-setting machines were being used by the Imperial Japanese Navy, and to obtain details of those of interest and of any projected new designs. It was also desired to determine the "dead time" set in the computers for each type of fuse-setting machine.

The required information was obtained during the course of investigation on all types of guns and mounts, by visual inspection, and by interrogations. The majority of the information contained in this report was obtained, after visual inspection of the machines, from discussion with Captain DATE, who was mainly responsible for designing the most up-to-date machine in use.

THE REPORT

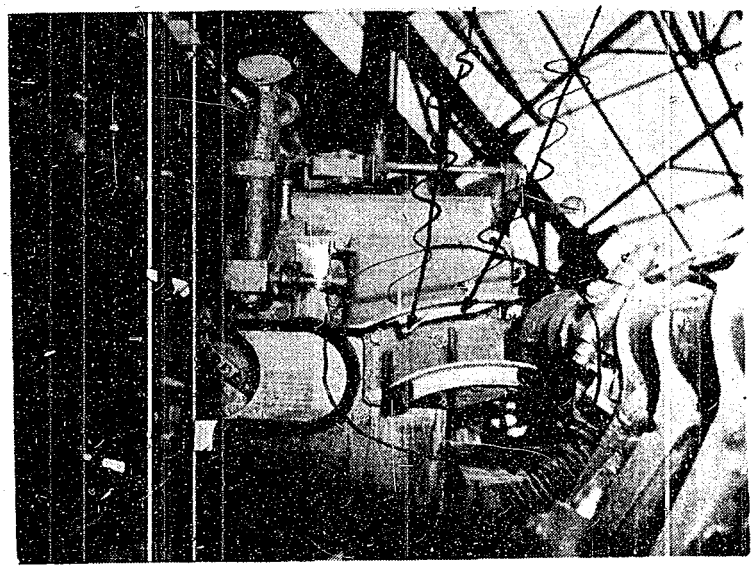


Figure 1

FUSE-SETTING MACHINE (RIGHT HAND)
FITTED ON 12.7cm MARK V EXPERIMENTAL MOUNT

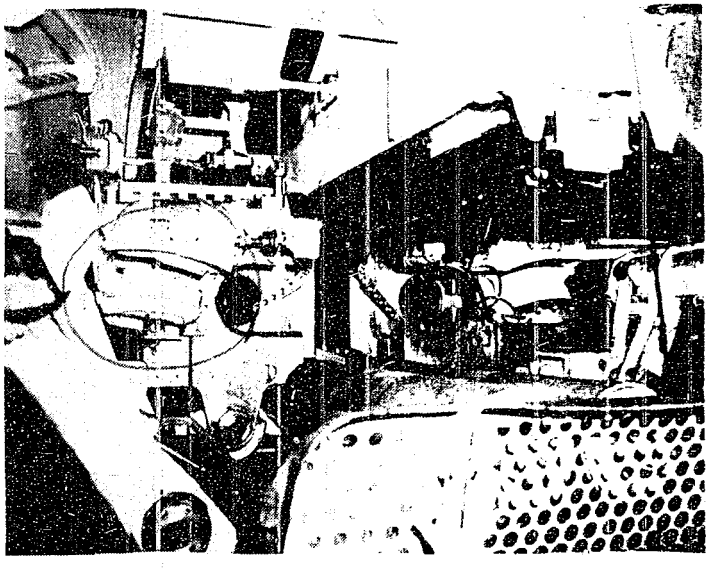


Figure 2

FUSE-SETTING MACHINE (LEFT HAND)
FITTED ON 10cm TYPE 58 TWIN "GUN"

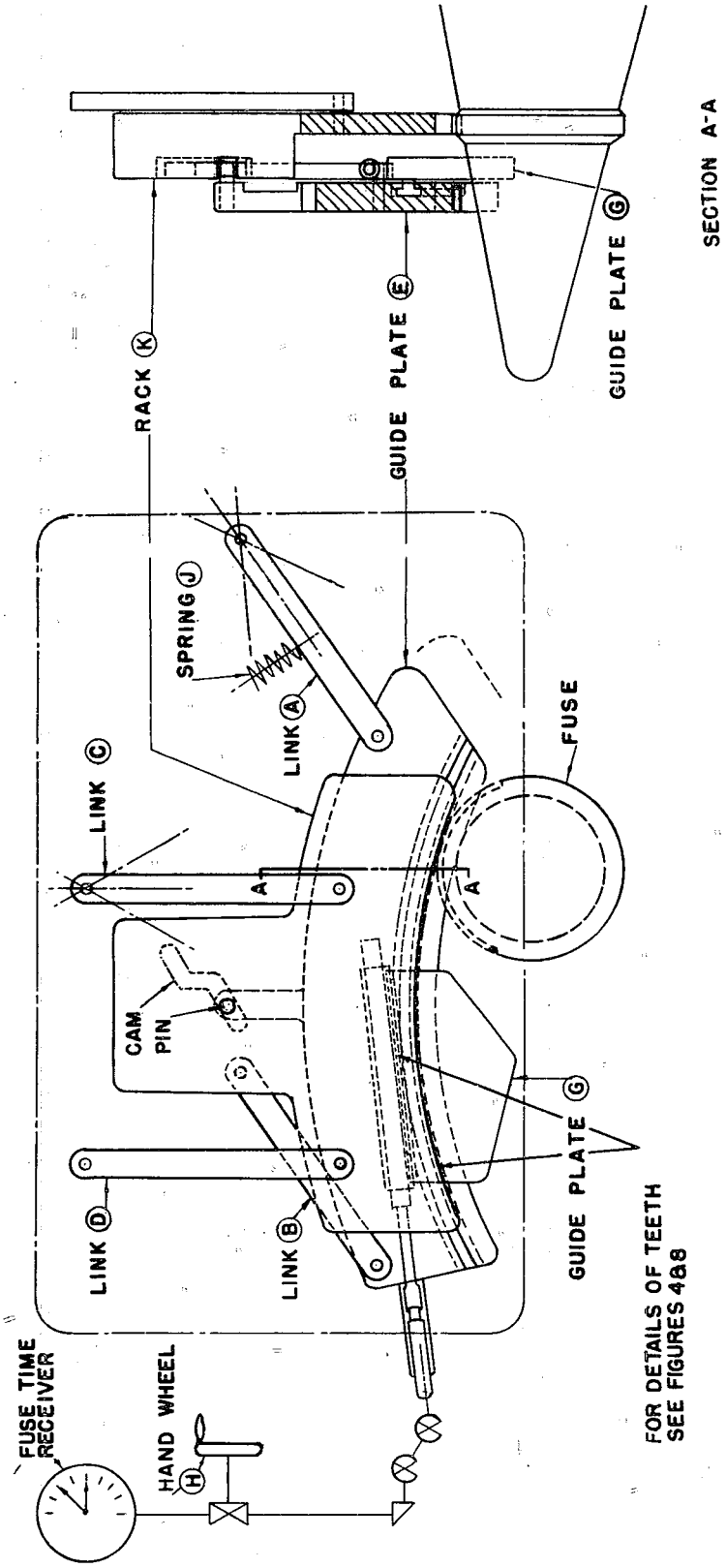


Figure 3
FUSE-SETTER FOR HIGH ANGLE GUNS

All automatic fuse-setting machines used by the Imperial Japanese Navy are fitted to the breech face of the gun. (See Figures 1 and 2). Briefly, the principle upon which they work is as follows: As the loading tray, with the round to be fired, is pushed over to the ramming position, the fuze passes between guide plants in the machine. While passing through the guides, a toothed fuse-setting ring, on the fuse, comes into contact with a rack, which causes the fuse ring to rotate. The length of time during which the fuse ring is in contact with the rack (and hence the time delay set on the fuse) is determined by the fuse-setter, matching his pointers in the fuse receiver.

The first type of automatic fuse-setting machine produced is illustrated in the general-arrangement drawing (Enclosure (B)) and was developed in 1933-34. In this machine the setting rack was cut and a drum revolved to vary the contact time. The moving teeth of the fuse ring, meeting the stationary teeth of the setting drum, were frequently badly damaged, with consequent inaccurate fuse setting and failure of the machine. It was therefore scrapped, and the present type, working on the same broad principle, has taken its place. This type will now be described in principle.

Referring to Figure 3, guide plate E is connected to the main body of the fuse-setting machine by pivoting links A and B. Guide plate G is attached to guide plate E by a "T" section rail which fits in a "T" groove in the lower front--face of E. Guide plate G can be moved relative to E, by screw gearing driven by the fuse-setter's handwheel. Both guide plates are free to swing together about the point of suspension of the links A and B. Spring J normally keeps guide plates E and G in the "down" position. The point of suspension of the guide plates, and the points at which the links are attached to the main body form a parallelogram. Plate K, on whose lower edge the rack is cut, is similarly attached to the main body, and is suspended in front of the guide plates E and G. In the upper portion of plate K, an "S" shaped cam groove is cut, and a pin, formed on guide plate E, works in this groove.

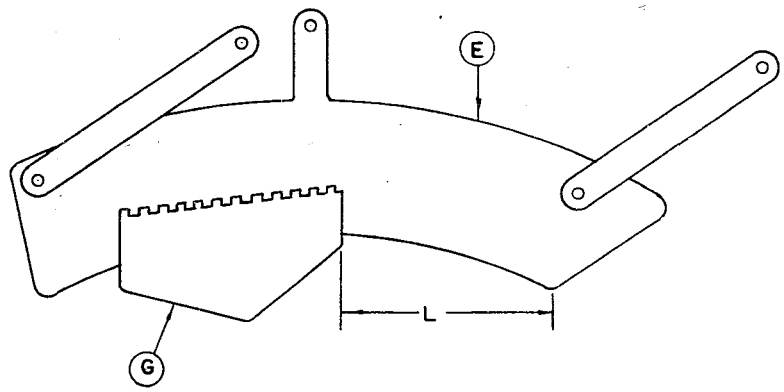


Figure 4

The guide plate G is moved through the distance L (Fig. 4), a measure of the time to be set on the fuse. When the loading tray is moved over towards the breech, in the direction of the arrow A in Fig. 5, the smooth part of the nose of the fuse in front of the time setting ring meets the leading edge of the guide plate E. The continued motion of the ammunition causes guide plates E and G to move bodily in the direction of the arrow B, Fig. 5.

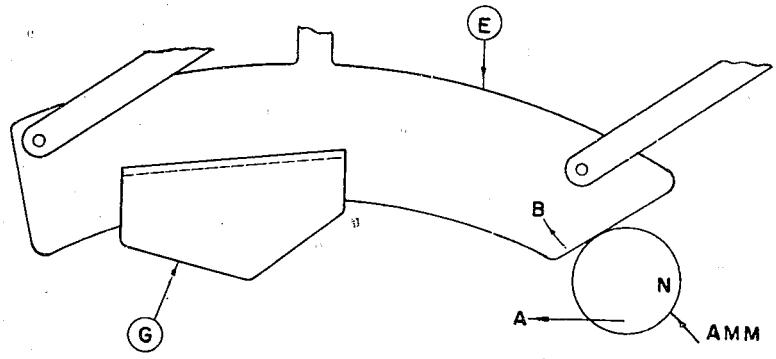


Figure 5

This movement continues until the guide plate E and the fuse are in the relative position shown in Fig. 6. During this movement of plate E the rack plate K (under the influence of pin Y shown in Fig. 7, moving in the cam groove X) is caused to swing in the direction of the arrow C. The shape of the cam groove is such that the forward velocity component of the rack is equal to that of the ammunition. By this means, the meshing of the rack and fuse ring is a smooth operation causing no damage to the teeth. It is possible to calculate the correct shape of the cam groove, but in practice, it is done by trial and error, using models.

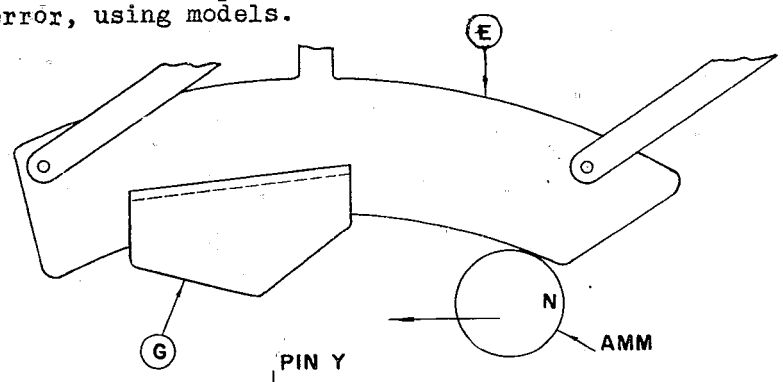


Figure 6

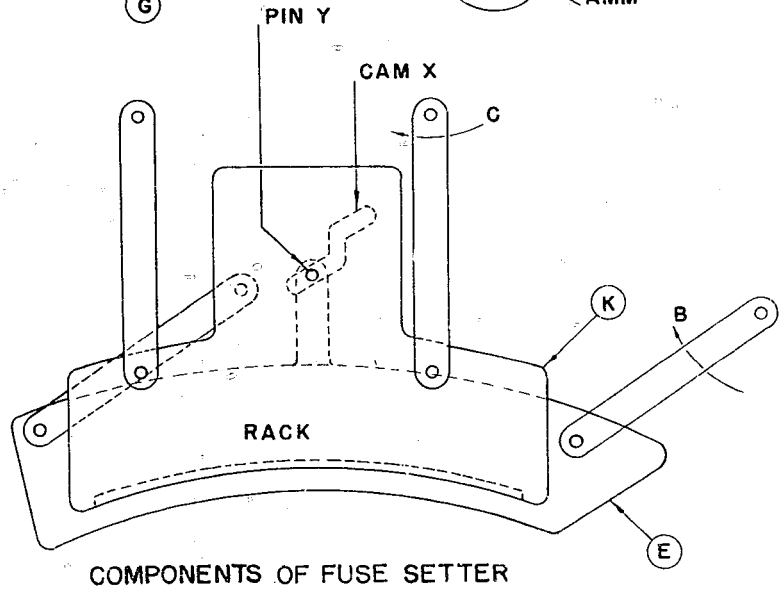


Figure 7

COMPONENTS OF FUSE SETTER
FOR HIGH ANGLE GUN

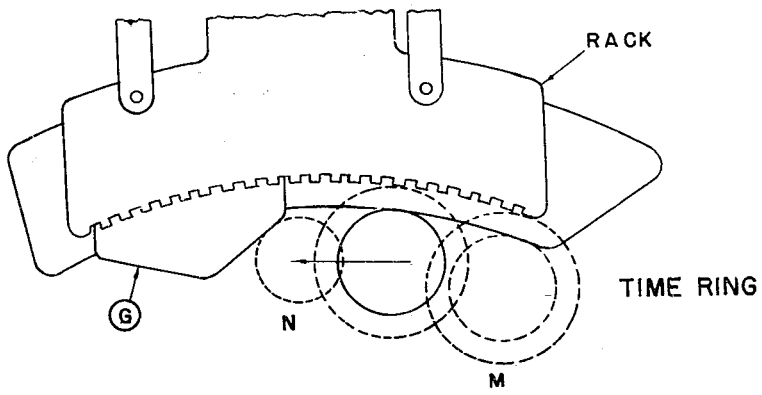


Figure 8

COMPONENTS OF FUSE-SETTER FOR HIGH ANGLE GUN

When the rack and time ring teeth are meshed, the fuse is in the position M, Fig. 8. The forward swing of the guide plates and rack plates has by this time ceased, as explained above, and the time ring of the fuse starts to rotate. The fuse setting motion continues until the nose of the fuse meets the leading edge of guide plate G. (Position N, Fig. 8). During the time when the fuse is traveling from position M to N, the rack, the edge of the guide plate E, and the path of the center of the fuse are concentric. On meeting guide plate G, the nose of the fuse again causes the two plates E and G to swing upwards together, and the rack is carried forward by the action of the pin in the cam groove. The rack is thus given the same forward velocity as the fuse time ring and disengagement of the teeth is performed without damage. The machine described and illustrated diagramatically in the figures, is the type used for a right-hand gun. Machines fitted to left-hand guns are similar in principle, but in order to rotate the fuse time ring in the correct direction, it is necessary to fit the rack in the bottom of the machine facing upwards, so as to mesh with the underside of the fuse time ring instead of with the top. Both types of machines can be seen in Figures 1 and 2.

With these fuse setting machines, it is essential that the round be accurately positioned in the loading tray and that it not be allowed to bump when being pushed to the loading position. Loading trays are fitted with special grips for this purpose.

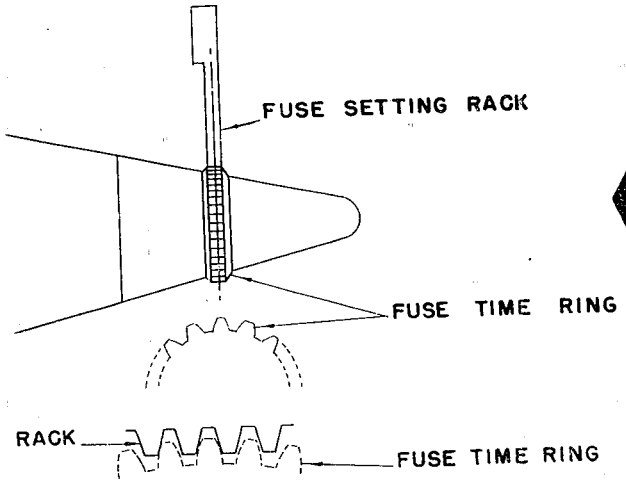


Figure 9

FUSE-SETTING RACK AND PROFILE TYPE

Figure 10

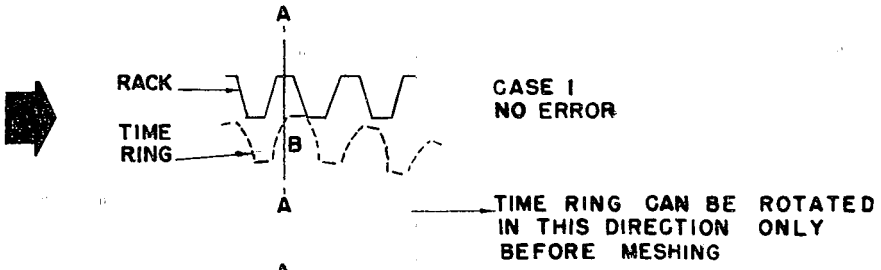


Figure 11

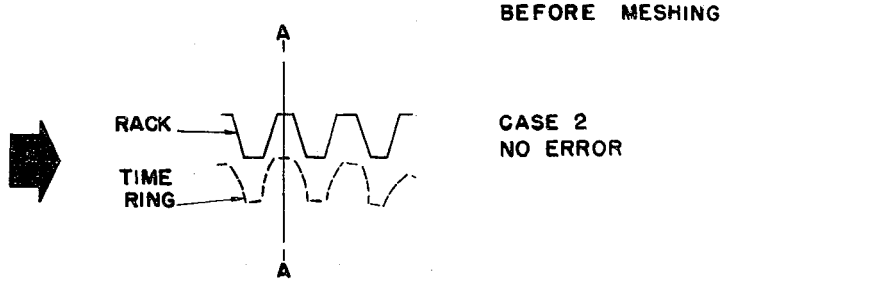
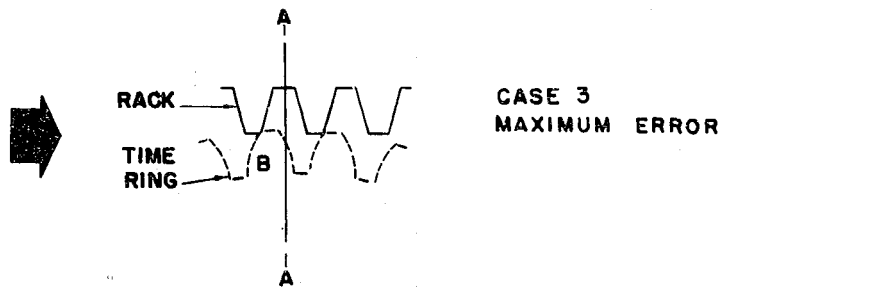


Figure 12



The accuracy of these machines is determined mainly by the pitch of the teeth of the fuse time ring and the rack. The pitch is kept as small as possible consistent with adequate strength, and corresponds to about 0.64 seconds of fuse time. The theoretical error in fuse setting due to this is therefore plus and minus 0.32 seconds. Backlash in the drive from the fuse time receiver to the fuse setting machine, causes an additional error of about plus and minus 0.09 seconds of fuse time. The theoretical overall accuracy of the machine is therefore plus and minus 0.41 seconds. In practice, the accuracy is slightly better than this, the error being about minus 0.09 to plus 0.41 seconds of fuse time. A possible reason for this is that before meshing with the rack the fuse time ring can only be revolved in one direction. A negative error due to rotation of the time ring while in this process of meshing with the rack is thus not possible. This point is illustrated in Figures 10, 11, and 12. In case 1 (Fig. 10), when the tooth B happens to be to the right of the line AA, the teeth will be forced into mesh without setting a false time on the fuse, since the fuse time ring is at this stage set to ZERO. It cannot, therefore, be further rotated relative to the fuse. In case 2, the teeth of the fuse ring are lying accurately below the teeth of the rack before meshing and there is again no error. In case 3 however, whence the tooth B lies to the left of the line AA a false time, which may be as much as 0.32 seconds, will be set on the fuse before the teeth are meshed. This amount remains as an error of fuse setting.

To increase the accuracy of this method of fuse setting, experiments were being carried out on fuses fitted with a white metal fuse setting ring with no teeth. These experiments were not satisfactorily completed at the end of the war.

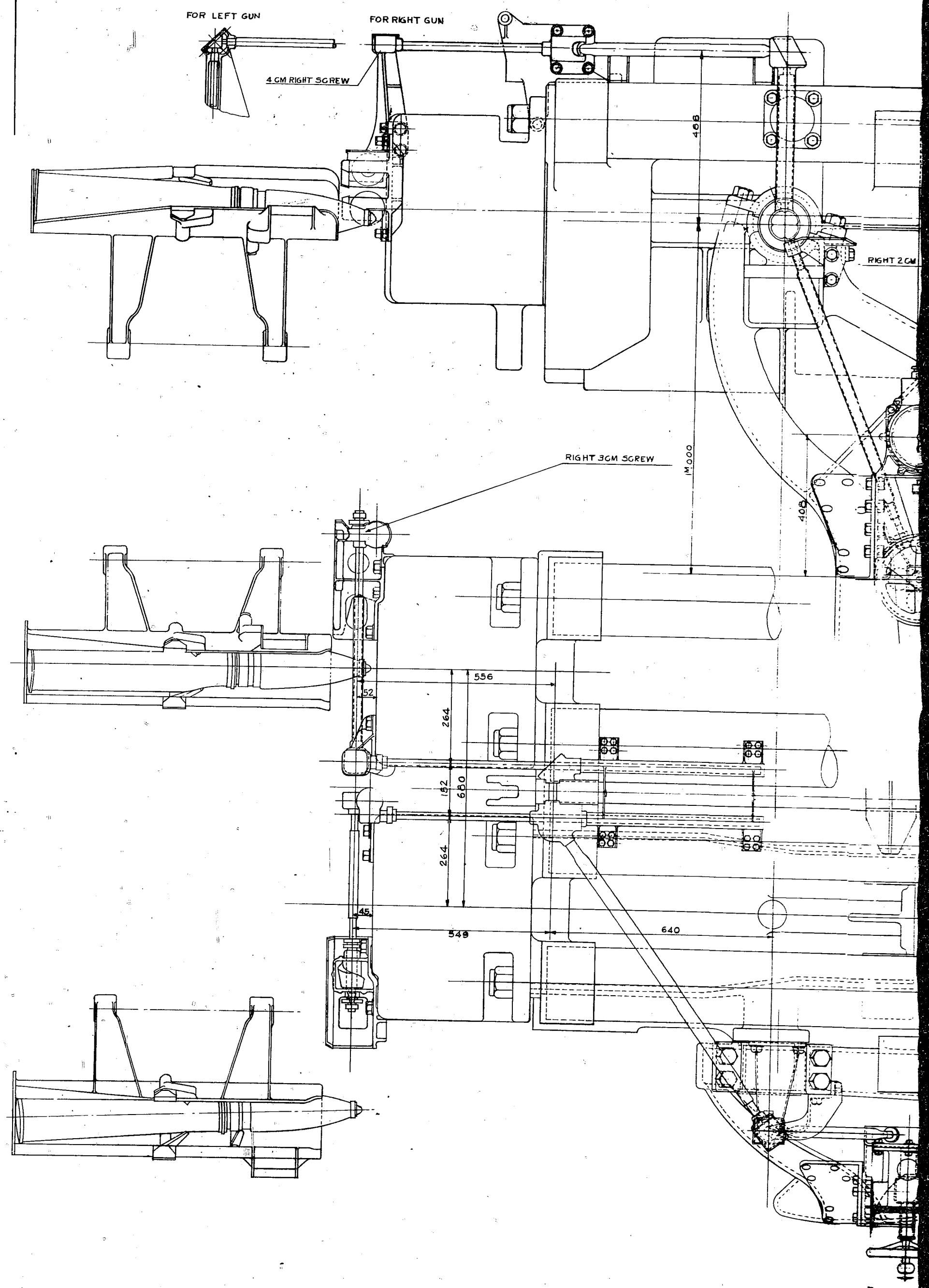
The dead time set in the computors when these fuse setting machines were in use was 2 seconds.

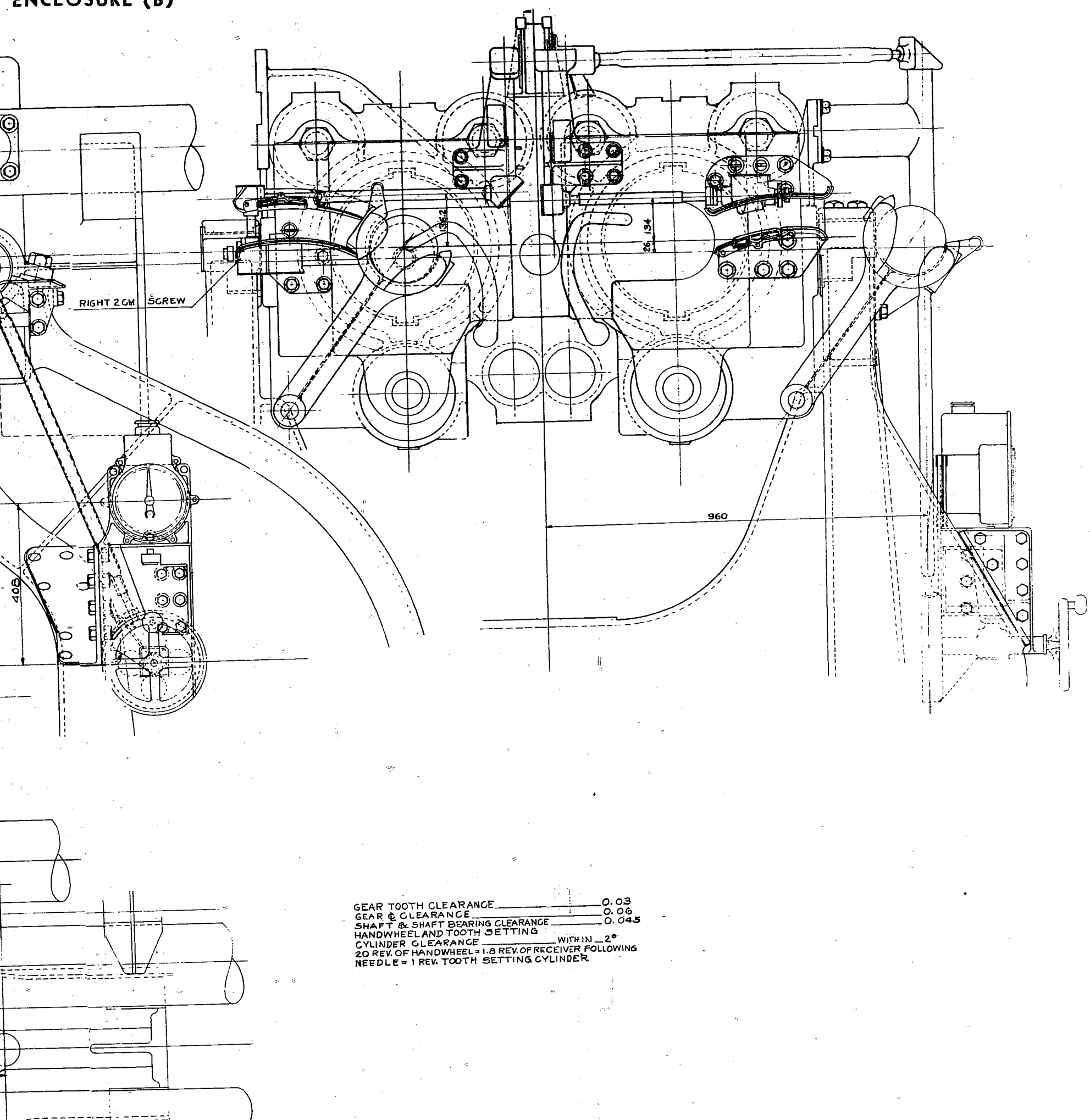
ENCLOSURE (A)

LIST OF DOCUMENTS SENT THROUGH ATIS TO
WASHINGTON DOCUMENT CENTER

NavTechJap No.	ATIS No.	Subject
ND50-3621	3611	Factors influencing the accuracy of time-delay fuse setters. (June 1935).
ND50-3651	4137	Report on tests of fuse setting machine fitted to 12.7 HA guns (1936).
ND50-3632	4073	Second report on fuse setting machine (Modification 2) for 12.7 cm AA gun (November 1936.)

ENCLOSURE


FOR LEFT GUN
FOR RIGHT GUN
4 CM RIGHT SCREW
RIGHT 2 CM
RIGHT 3 CM SCREW
466
1M000
408
556
52
264
182
680
264
45
549
640



GEAR TOOTH CLEARANCE ——— 0.03
GEAR ℄ CLEARANCE ——— 0.06
SHAFT & SHAFT BEARING CLEARANCE ——— 0.045
HANDWHEEL AND TOOTH SETTING
CYLINDER CLEARANCE ——— WITHIN 2°
20 REV. OF HANDWHEEL = 1.8 REV. OF RECEIVER FOLLOWING
NEEDLE = 1 REV. TOOTH SETTING CYLINDER.

GENERAL ARRANGEMENT
AUTOMATIC FUSE SETTING
MACHINE