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Burning to Detonation Transition in High Explosives

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Quarterly Progress Report

BURNING TO DETONATION TRANSITION IN HIGH EXPLOSIVES

by

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PROGRESS REPORT

I. INTRODUCTION

The Deflagration to Detonation Project has been concerned for the first quarter with the construction and initial testing of a special thermal sensitivity apparatus which is specifically designed for TNT testing. The apparatus is herein described and diagrams are given to explain the operation.

II. STATUS/PROGRESS TO DATE

The complete apparatus is shown in Figure 1. It consists of ten heating tubes shown in Figure 2 which are immersed in a molten salt bath. The tubes were made by drilling a stainless steel rod and machining away the excess metal on the outside so that the tubes are 1/4-inch O.D. with .020-inch walls. This method of construction was used to insure corrosion resistance to the molten salt by avoiding welds and plugs. The wall thickness of the tubes is thin enough to give good conduction of heat from the salt but poor conduction to the rest of the apparatus. Each tube contains 1/4-inch Pyrex glass frit ground to pass a 35-mesh sieve, but remain on a 60-mesh sieve.

The TNT is dropped on the glass frit which is at bath temperature. The frit transfers the heat very rapidly due to its large surface area. After the test the frit is discarded and replaced. Since there are two sets of heating tubes, one can be cleaned and loaded with the new frit while the test is being conducted on the other.

As seen on Figure 1, the tubes go through a 1/2-inch transite plate and are clamped to a 3/8-inch stainless steel plate 12 inches in diameter with a Teflon washer. Copper tubing is coiled between the two plates for water cooling. Directly above the top of the heating tubes with a ten thousandth-inch clearance is the powder measure. Figure 1 shows them separated for clarity. The powder measure (Fig. 3) is a stainless steel disc with ten 3/16-inch holes to contain

the explosive. Below these holes are stainless steel stoppers with off-center 3/16-inch holes and projecting ears. In operation, the ears are pushed forward until the two holes line up and drop the explosive into the heating tubes.

The brass gear fits over the powder measure and contains a pin to push its projecting ears. On the outside are ten pins which contact two microswitches. One stops the motor driving the brass gear and must be overridden to start the gear moving. When the gear moves it drops the explosive into the heating tube and triggers the second microswitch which turns on the timer. The gear continues to move until the next pin contacts the microswitch.

When the explosive fires or cooks off, the gases go up thru the two holes which are lined up and into a copper tube (not shown). This tube is connected to the mercury switch shown in Figure 5 at the sidearm. The gases push the mercury down below the tungsten rod breaking electrical contact which stops the timer.

The entire moving section is enclosed by a polycarbonate dessicator top which fits on the 12-inch plate. This enables the apparatus, except for the bath itself, to be evacuated by a mechanical pump protected by a liquid nitrogen trap.

III. PROBLEM AREAS

At the present time the apparatus is operating as expected with the exception of the mercury switch which does not always work properly. However, it is expected that this difficulty will be cleared up since it appears that the difficulty is in the alignment of the two holes directly above the heating tubes and below the copper tubing leading to the mercury switch. The research machinist is working on this at present.

IV. PROGRAM PLANS

As soon as the apparatus is working, the data for the Arrhenius plot curves will be obtained. It is anticipated that this will be accomplished by the next report.

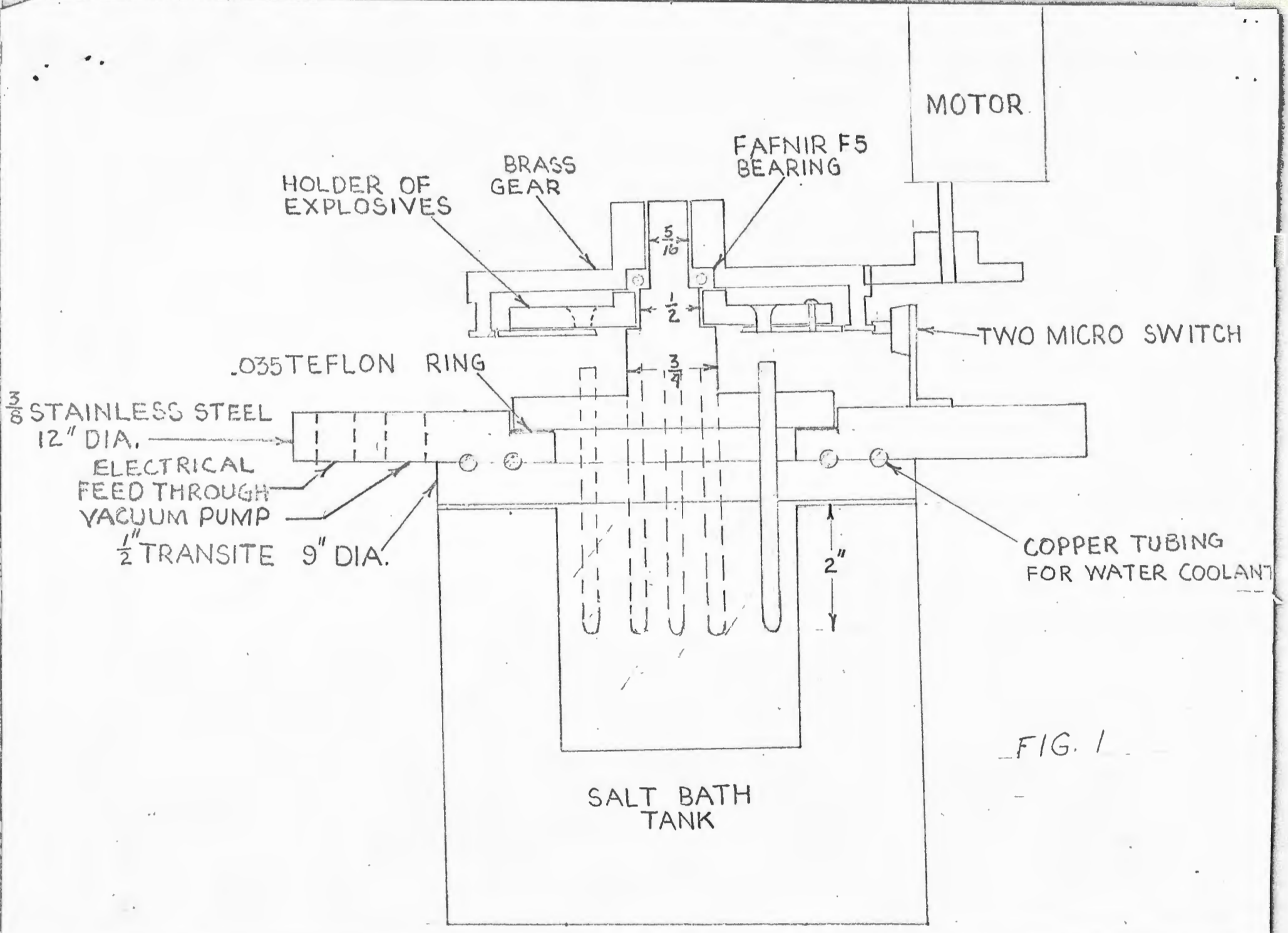

MOTOR
FAFNIR F5 BEARING
BRASS GEAR
HOLDER OF EXPLOSIVES
5/16
1/2
TWO MICRO SWITCH
.035 TEFLON RING
3/4
3/8 STAINLESS STEEL 12" DIA.
ELECTRICAL FEED THROUGH
VACUUM PUMP
1/2" TRANSITE
9" DIA.
2"
COPPER TUBING FOR WATER COOLANT
SALT BATH TANK

FIG. 1

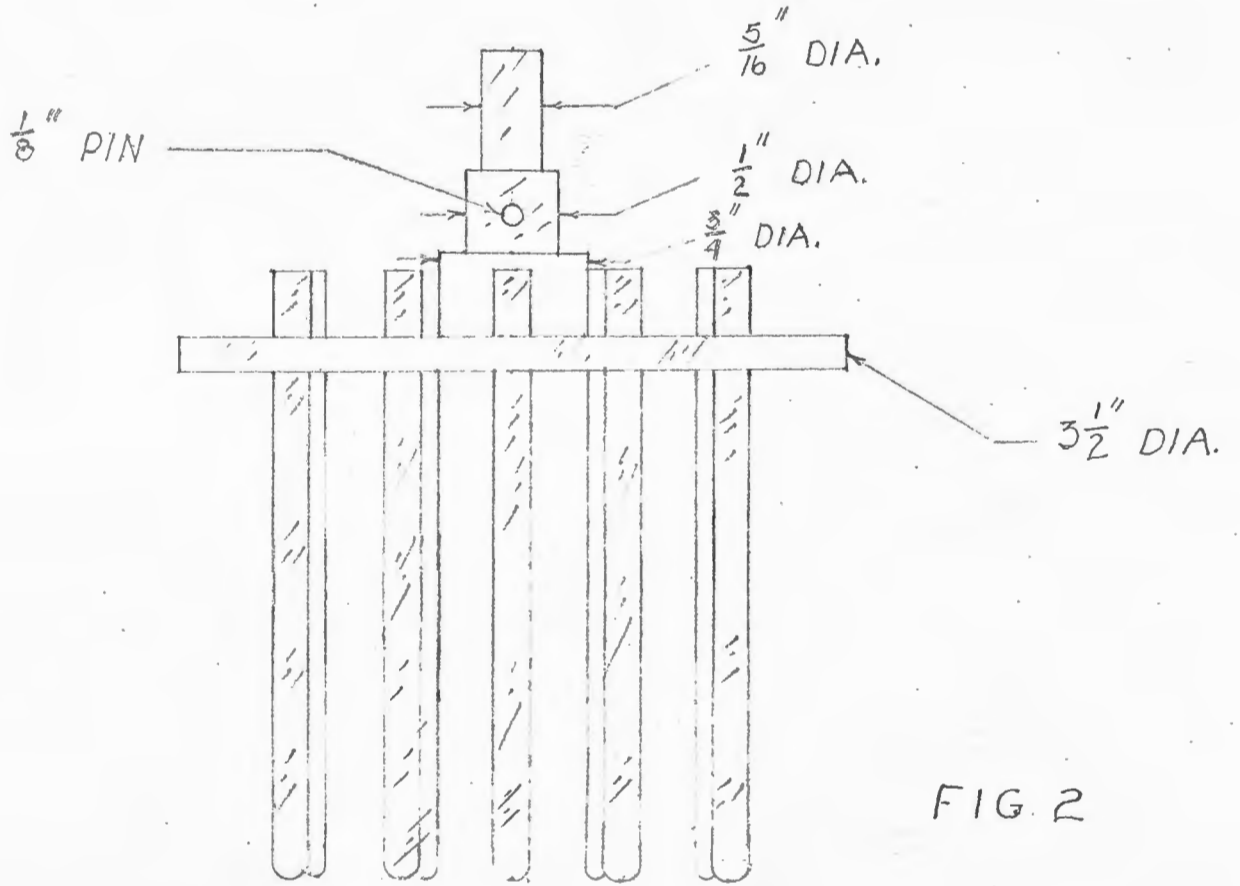
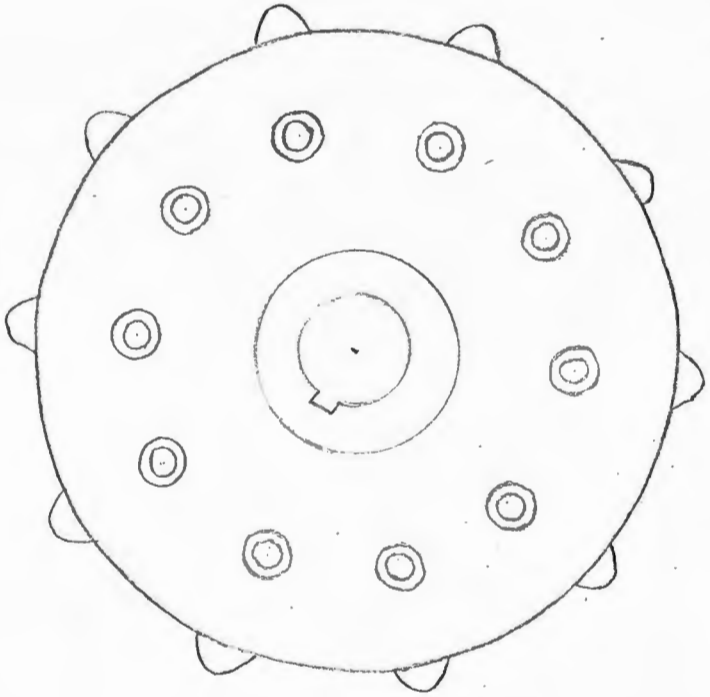
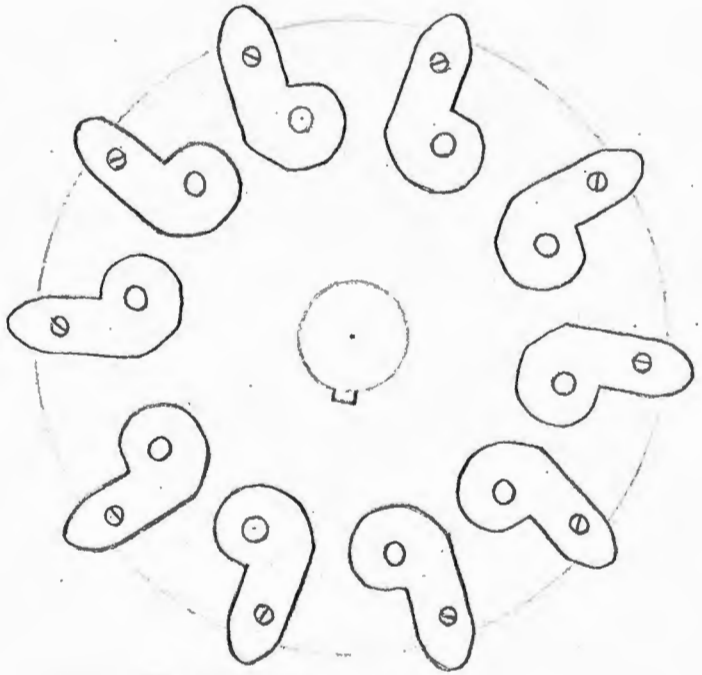


FIG. 2

HEATING TUBES



TOP VIEW



BOTTOM VIEW

POWDER MEASURE

FIG 3

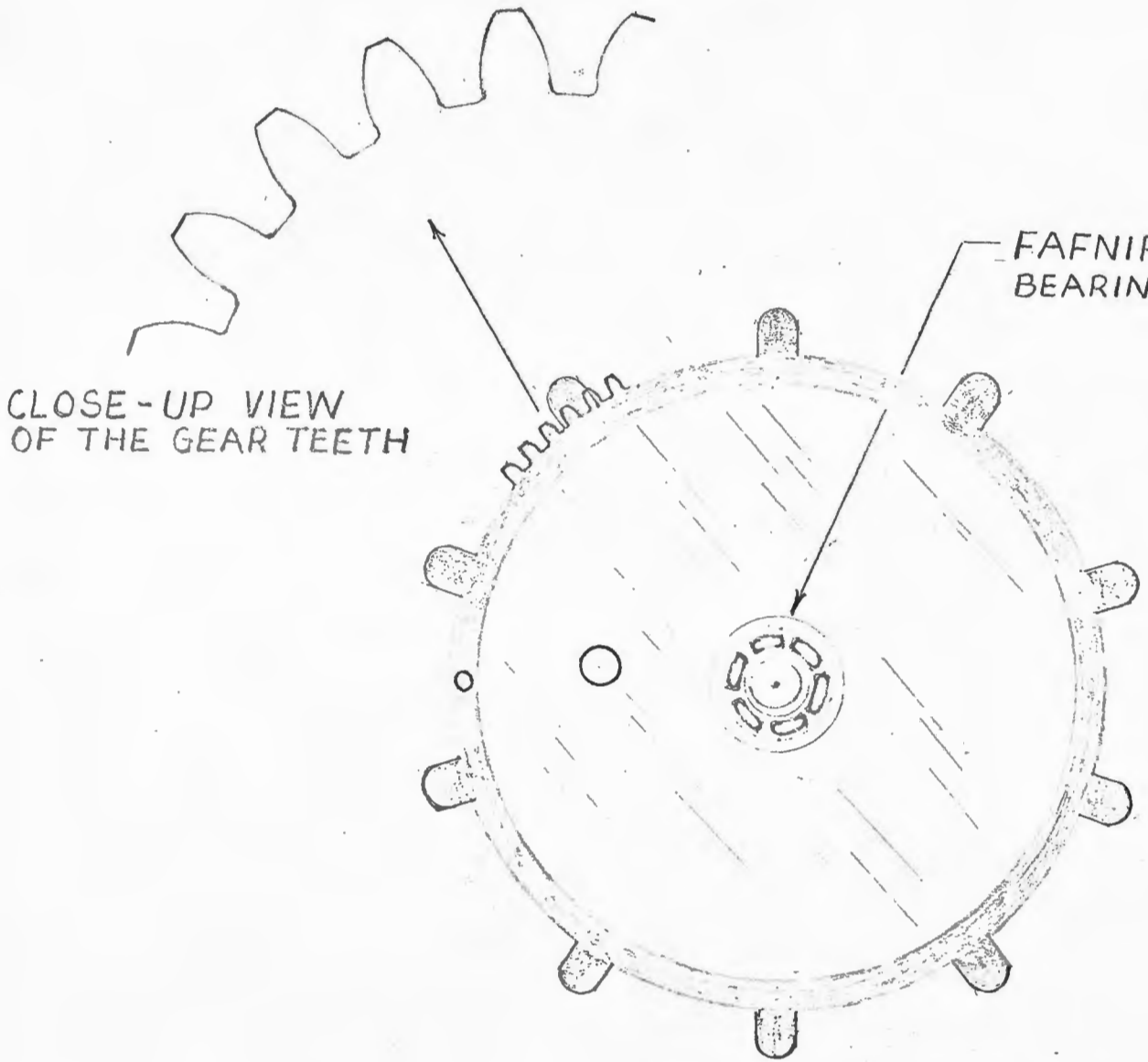
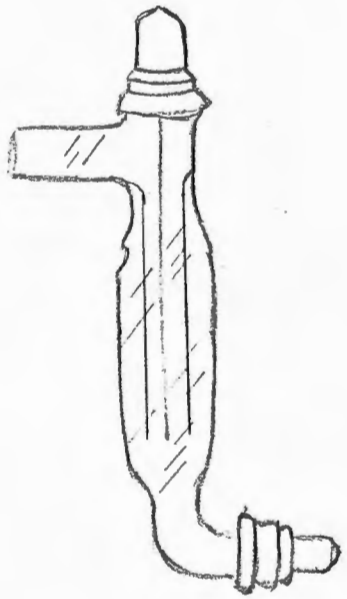

CLOSE-UP VIEW
OF THE GEAR TEETH
FAFNIR F5
BEARING
ACTUAL SIZE
BOTTOM VIEW OF
BRASS GEAR

FIG 4



MERCURY SWITCH

FIG 5

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