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DEEP SEA RELEASE MECHANISM

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Joint Tsunami Research Effort

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Many oceanographic measurements are most easily obtained by dropping a weighted instrument package to the ocean floor. After the measurements are made the weight is released and the buoyant instrument package floats to the surface for recovery. This report describes a release device actuated by the closing of an electrical switch.

Key Words: oceanographic measurements, release device, actuated, solenoid plunger, and valve.

1. INTRODUCTION

One commonly used release device (Van Dorn, 1953) depends on a magnesium link but the uncertainties in corrosion rates cause large errors in release times. The release device described in this report is actuated by the closing of an electrical switch. A solenoid plunger breaks a glass "valve" that equalizes the pressure in a fluid-filled cylinder and permits a piston to be extracted (fig. 1).

2. DESCRIPTION

The release device consists of three main parts (fig. 2). The first part contains the solenoid and a sleeve. The next section consists of a glass tube valve or differential pressure release, an auxiliary pressure release and the piston housing. The third component is the expendable piston.

The solenoid has approximately 1000 turns of No. 30 HNC NYCLAD wire that is completely filled and encased in plastic. The chrome-plated plunger has a brass screw with a nut at one end, which serves as the striking device to break a small glass tube. The power source to activate the solenoid is a compact 45-V battery contained in the instrument package. The striking device of the plunger is held at a

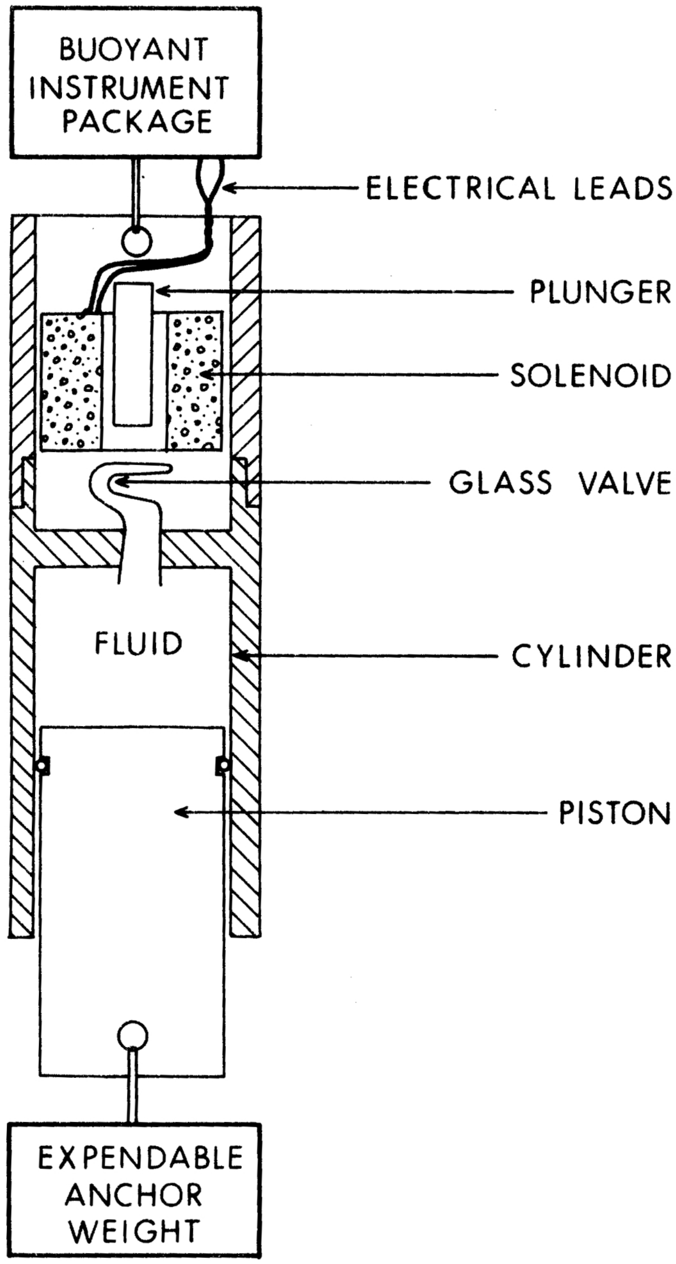

Figure 1. Schematic showing basic principles of operation of release device.

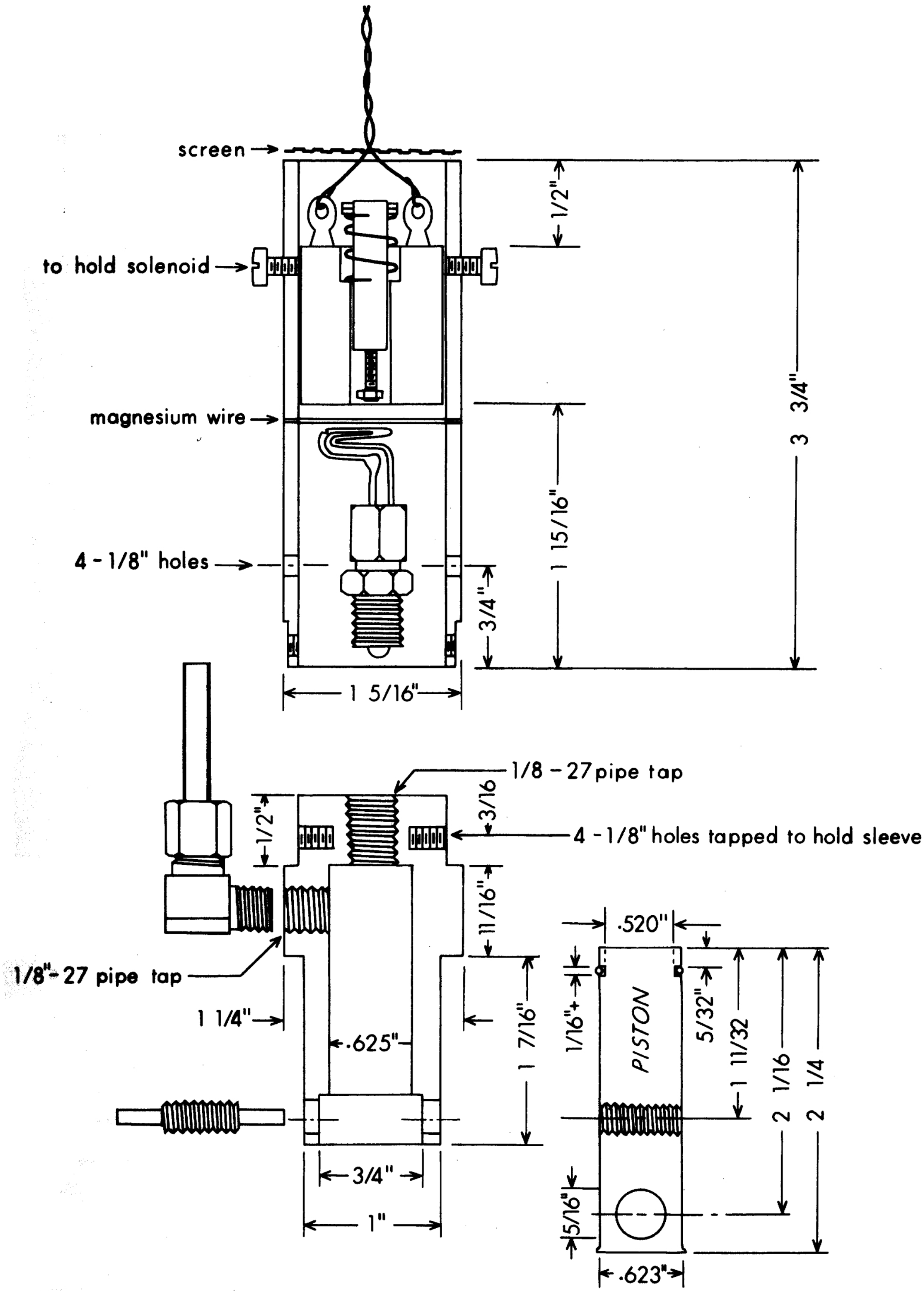

Figure 2. Engineering drawing of the individual parts and their size.

approximately .05 in. from the glass tube by a very flexible stainless steel spring. A thin magnesium wire (taut) attached to the sleeve is placed between the plunger and the glass tube to insure against prebreakage of the glass by the plunger during surface handling. The sleeve houses the solenoid and also serves as a connection between the piston housing and the instrument package. The solenoid is held in place near the top of this housing. A band across the top diameter of this sleeve stops the plunger from coming out of the solenoid.

The glass tube, having a shape of a question mark, is held firmly in place on top of the piston housing. This glass tube is broken by the solenoid striking device. It is etched near the sharp bend to insure breakage.

When the glass is broken the pressure differential in the piston housing no longer exists and the piston may then slide out of the rest of the mechanism. The expendable brass piston is the only part of the mechanism that is eventually left behind with the anchor. A tension of about 5 lb is sufficient to separate the piston from the rest of the release device.

As a back-up in case the glass fails to be broken, a magnesium rod will deteriorate and release the pressure differential. The circumference of the protruding magnesium rod has been coated with FLECTO VARATHAN liquid plastic, and only the diameter face of the rod is exposed to sea water. This delays the chemical deterioration of the magnesium rod considerably and allows the mechanism to be submerged for long periods of time. Figure 3 shows two graphs of deterioration rates as a function of time. The solid line is the deterioration rate at the surface pressure in sea water. The dashed line is the deterioration rate at 7500 psi measured in a limited amount of sea water and at 25°C. These two curves are not to be considered as absolutely accurate but only as a guideline for the deterioration rate.

When the piston is inserted all the remaining voids in the housing are filled with silicone oil. A magnesium pin near the bottom holds the piston firmly in place so that the device will not separate during surface handling. Once the instrument package is released from the surface, this magnesium pin begins to deteriorate. After the pin has completely deteriorated, the increased pressure at depth produces a pressure differential that will support a heavy load. The maximum load that can be supported at any depth is given by the product of the area of the piston head times the hydrostatic pressure. When the glass is broken the pressure differential no longer exists and the piston slips out of the piston housing. The instrument package is then free to float to the surface leaving the expendable brass piston and anchor behind.

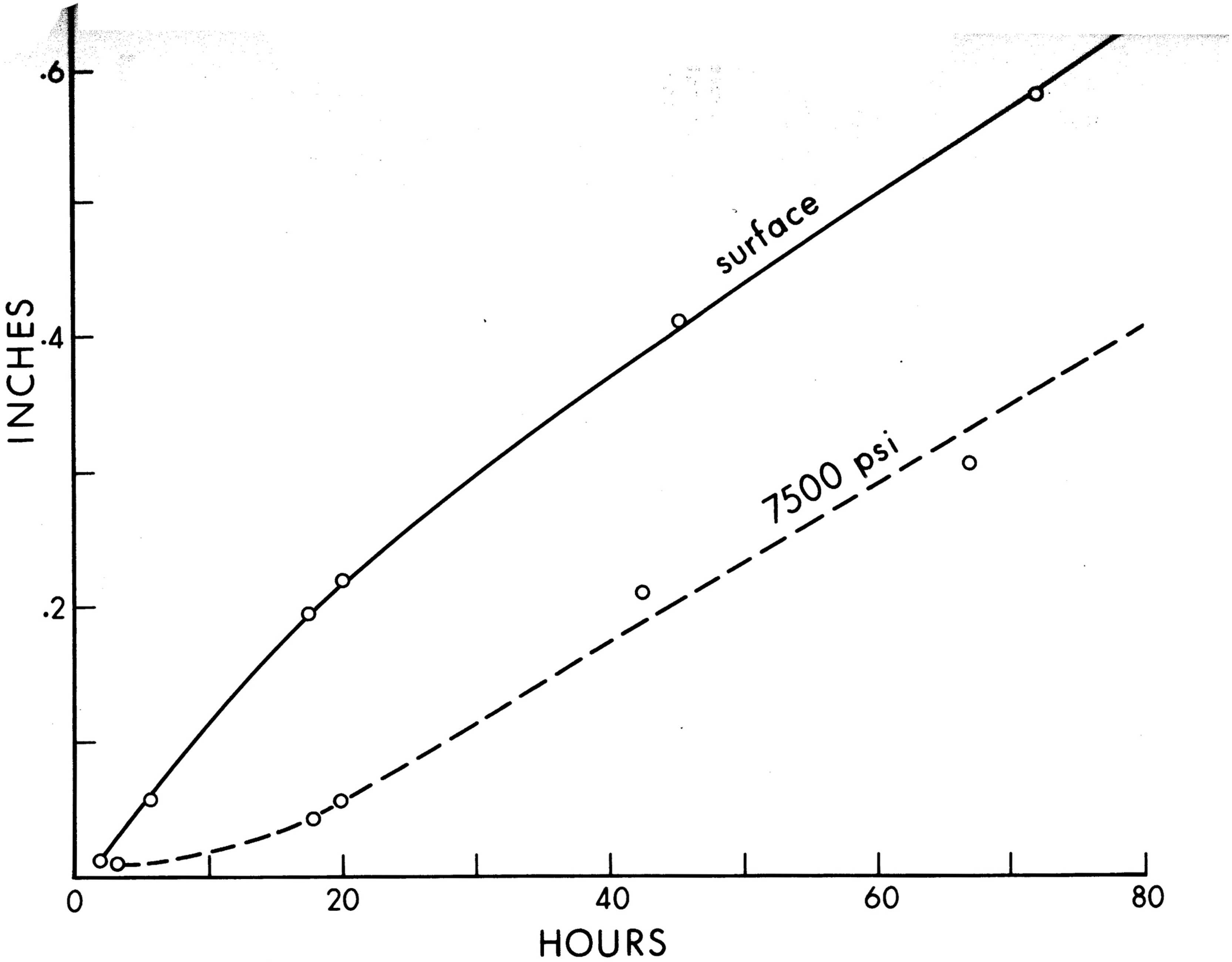

Figure 3. Chemical deterioration rate of the magnesium auxillary release. Solid line represents the deterioration at surface pressure. Dashed line represents the deterioration at 7500 psi.

3. TESTING

This instrument was tested at atmospheric and higher pressures. The higher pressure range was between 7500 psi and 9000 psi. The pressure chamber used was ESSA's housed at the University of Hawaii Look Laboratory.

The surface testing was done in approximately 3 ft of sea water using a 5-lb weight as the anchor. In this test the mechanism performed as expected, releasing the anchor at each specified time.

The higher pressure testing was performed at 25°C; at present no refrigerated test chamber is available. Various parts of the mechanism were tested separately at 9000 psi. The solenoid was tested at 9000-psi cycling the pressure. Tests of the complete mechanism were made at pressures up to 7500 psi.

The back-up magnesium release rod was tested at surface pressures and at 7500 psi for various lengths of time. The chemical deterioration test at 7500 psi was performed using a small volume of sea water in a container and may not be accurate.

4. SUMMARY

This release mechanism has an advantage over dissolving link releases of immediately freeing the instrument package after a predetermined length of time. The timing mechanism and power supply are contained in the instrument package. The release is made of brass for ease in machining but could be made of other suitable materials. The instrument was tested at surface and higher pressures and performed satisfactorily in all tests. The deterioration curves are not to be considered as accurate but only to provide an approximation in establishing the length of the magnesium rod to be used for various lengths of submergence time.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

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