A Hydraulically Actuated Safety Device[1]

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ABSTRACT

A hydraulically actuated safety device has been built and has proved effective in reducing accidental, premature operation of oceanographic samplers. It consists of a cylinder, a piston, and a shear actuated by the piston. Increasing hydrostatic pressure acting on one side of the piston shears a pin at a predetermined depth, thus arming instruments sensitive to sudden motion.

Introduction. Many oceanographic sampling devices are actuated by bottom contact, by use of a messenger, or by some other method that starts the sampling operation at a specific depth, time, or place. Usually this requires that the device be cocked in some way and secured to prevent premature operation, but armed before it is lowered out of reach. The arming sometimes consists of removing a clamp or pin, which, when in place, prevents any motion of the release or tripping mechanism. Once armed, many samplers become sensitive to sudden acceleration, deceleration, or violent contact with parts of the ship. In rough weather, when these conditions are difficult to avoid because of motion of the ship and seas, premature actuation of the sampling device often becomes a distinct hazard, or at best a time-consuming inconvenience.

The mechanism described offers a simple and effective method of arming oceanographic sampling devices by means of the hydrostatic pressure at a predetermined depth. When the sampler is thus armed some distance below the surface, the length of wire between it and the ship tends to dampen any sudden oscillation, and the possibility of premature tripping is greatly reduced. The mechanism has seen considerable use on several cruises of Woods Hole Oceanographic Institution vessels during the past two years and has functioned with consistent reliability to arm various piston corer designs.

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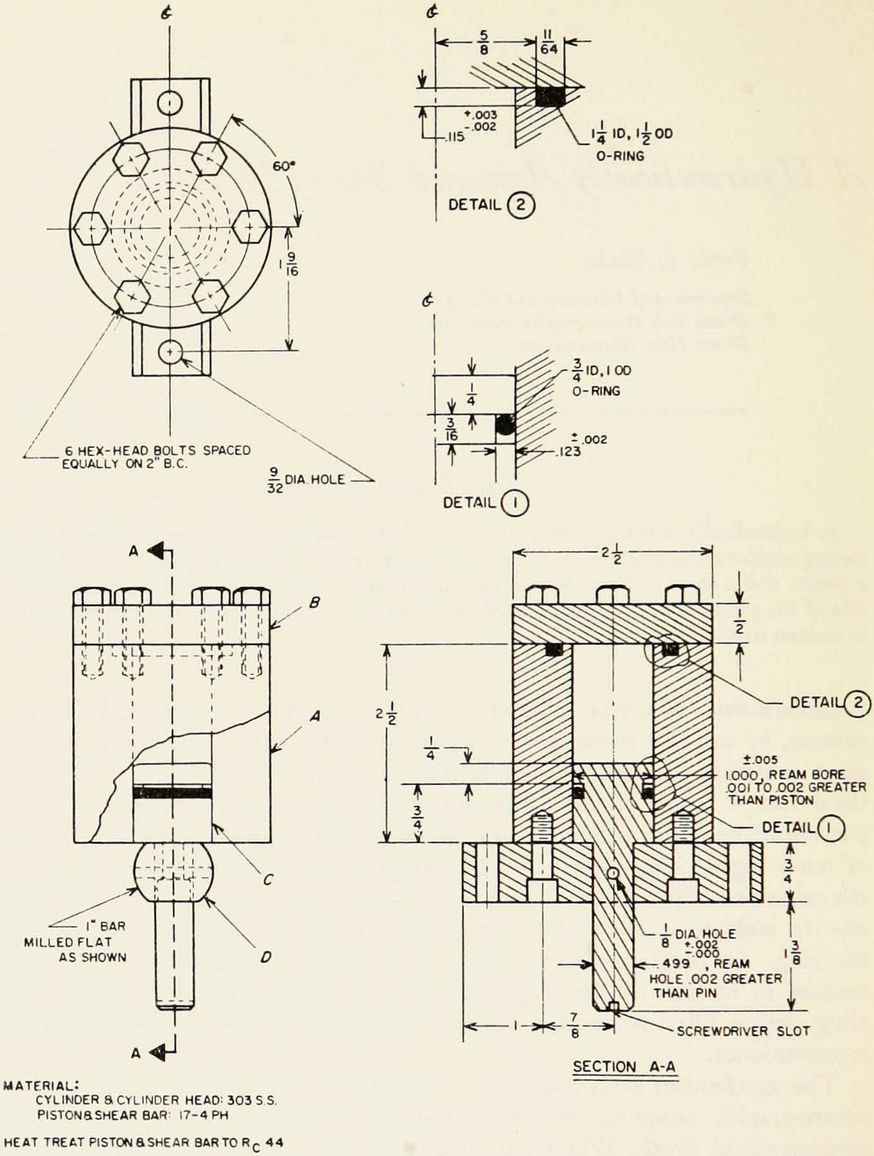

Figure 1. Construction of the hydraulically actuated safety device.

Description. Fig. 1 shows the hydraulically actuated safety device. A heavy walled cylinder (A) is closed at one end by the cylinder head (B). The cylinder head is attached with six head bolts and is sealed with a standard static o-ring seal. Piston (C) is provided with a standard dynamic o-ring seal and is free

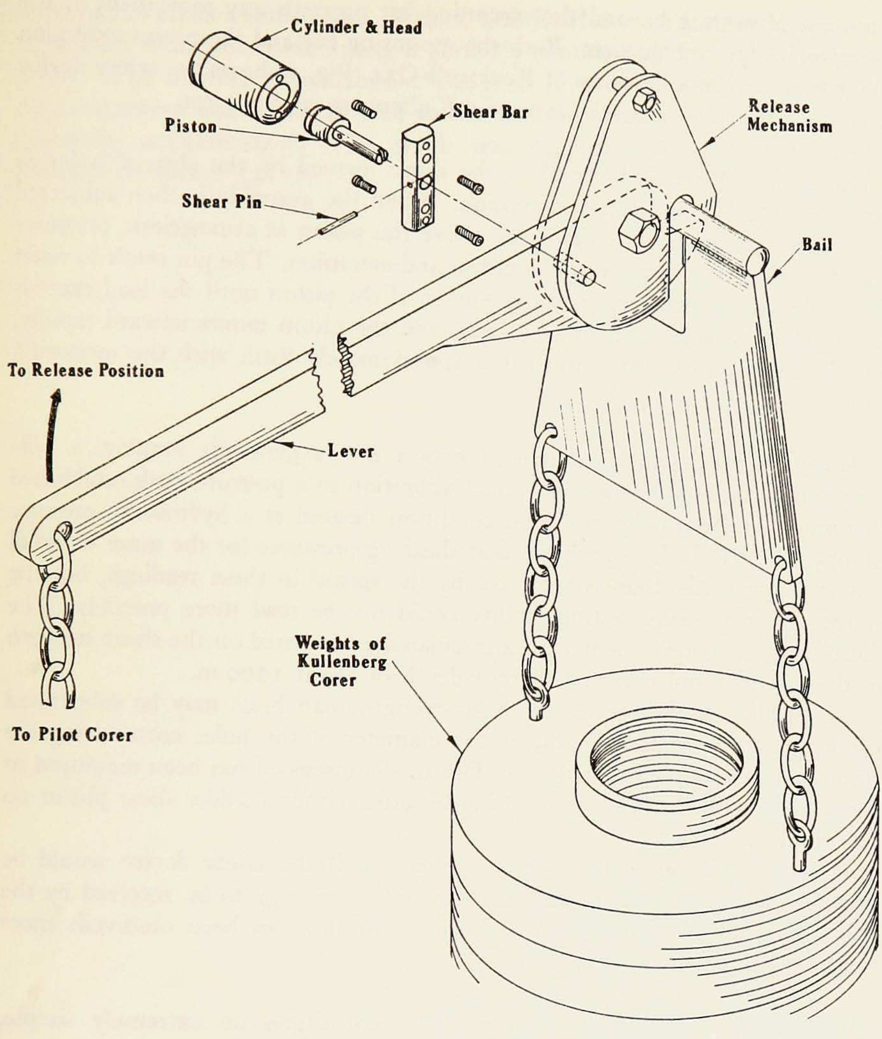

Figure 2. Safety device installed on piston corer release mechanism.

to move nearly the full length of the cylinder when the air above it is compressed. An extension of the piston projects below the cylinder and for some distance through a hole in the mounting bar (D). The mounting bar, attached to the cylinder, holds the piston captive but only partially closes the open end of the cylinder. When the piston is at the beginning of its stroke, a hole through the mounting bar is in alignment with a hole through the piston extension, thus forming a double shear. The assembly is attached to a sampling device by means of the two holes in the mounting bar, so that the part of the piston extension projecting beyond the mounting bar prevents any movement of the release or trigger mechanism. Both the mounting bar and the piston extension are heat-treated to a hardness of Rockwell-C44. Fig. 2 shows the safety device as used on the release mechanism of a Kullenberg piston corer.

Operation. A pin is inserted in the shear formed by the aligned holes of the mounting bar and piston extension. When the assembly is then subjected to external pressure, with the space above the piston at atmospheric pressure, a force acts on the bottom of the piston and extension. The pin tends to resist this force and prevents upward movement of the piston until the load exceeds its strength. At this time the pin shears and the piston moves upward rapidly, withdrawing the extension until it is approximately flush with the mounting bar.

Discussion. The model shown in Figs. 1 and 2 generally employs a 1/8-inch yellow brass rod as a shear pin. Calibration in a pressure tank established that this material in the as-drawn condition sheared at a hydrostatic pressure of 1750 ± 50 PSI. It is probable that shearing pressures for the same material repeat much better than is indicated by the spread in these readings, but the gauge of the pressure testing facility could not be read more precisely. The figure is in good agreement with a calculated value based on the shear strength of the material and corresponds to a depth of about 1200 m.

Material of higher or lower shear strength than brass may be substituted to change the actuation depth, or the diameter of the holes constituting the shear may be enlarged or reduced. The model discussed has been employed in connection with shallow depth coring by using either a solder shear pin or no pin at all.

It was hoped originally that the actuation of the safety device would be accompanied by a pulse of sufficient acoustical energy to be received by the ship's Edo UQN Echo-sounder. To date this has not been observed; more sensitive equipment may be required.

Conclusion. The device described here constitutes an extremely simple, effective, and reliable safety feature for sampling equipment that might be adversely affected by sudden motions. It consists of so few moving parts, essentially of only a cylinder containing a piston actuated by hydrostatic pressure, that there is little possibility of malfunction. Thorough field tests seem to indicate that this device could now find much wider application, not only as a safety device but also as a depth dependent release or actuating mechanism.

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