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K. CORNELL

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WATERPROOF CASING WITH MEANS ESTABLISHING MOVABLE
COMMUNICATION BETWEEN ENCLOSED APPARATUS
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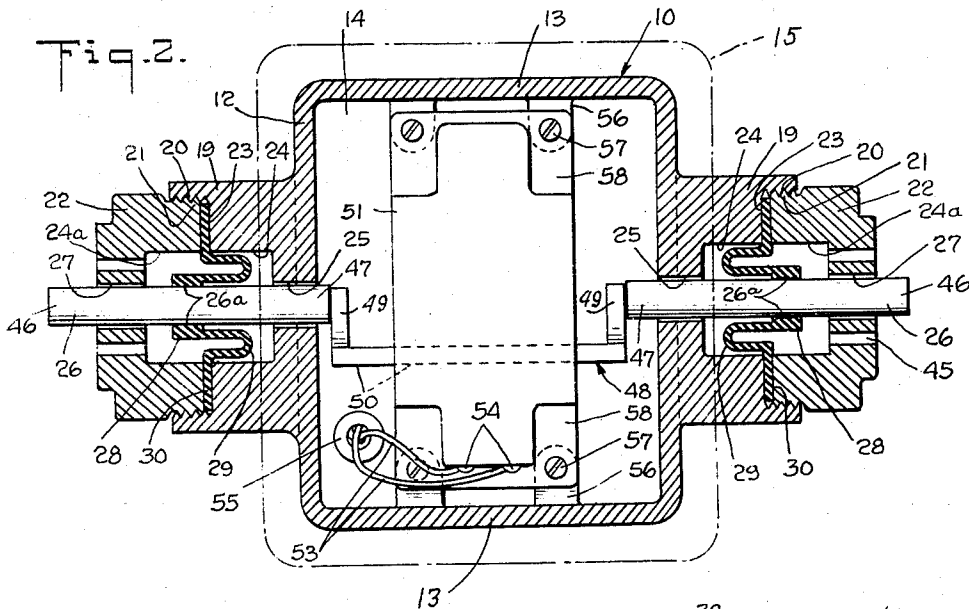
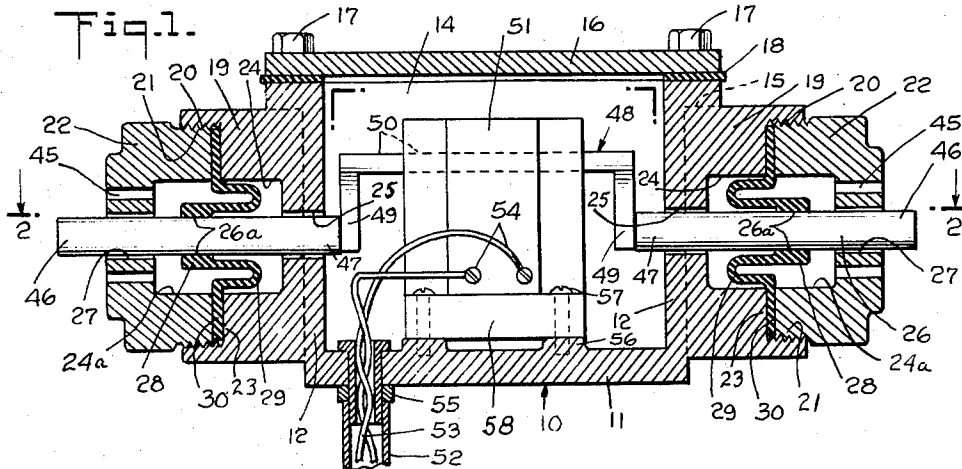
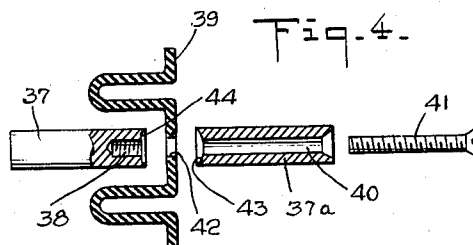
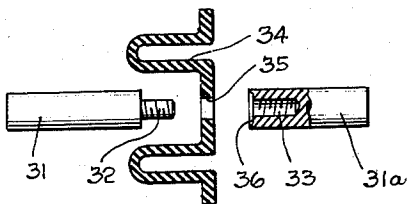


Fig. 3.



INVENTOR
KENNETH CORNELL

BY *Howard E. Thompson Jr.*
ATTORNEY

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WATERPROOF CASING WITH MEANS ESTABLISHING MOVABLE COMMUNICATION BETWEEN ENCLOSED APPARATUS AND EXTERNAL PARTS

Kenneth Cornell, Westfield, N. J.

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9 Claims. (Cl. 74—18.2)

This invention relates to waterproof casings for housing switches, solenoids and similar apparatus and having means establishing communication between such apparatus and externally movable parts. More particularly the invention relates to waterproof casings of the class described wherein the means providing communication with externally movable parts is so arranged as to eliminate the effect of water pressure or the like externally of the casing.

In the drilling of under water oil wells and in many other under water operations the housing of various apparatus including limit switches and other control devices, as well as solenoids and similar actuating elements has presented a considerable problem. In the first place, such apparatus must generally be completely sealed from exposure to water, particularly salt water. In addition the high pressures under which such apparatus must operate when submerged at substantial depths in water present problems not encountered at normal atmospheric pressure or in shallow layers of water. By way of illustration, external water pressure is often sufficient, with the conventional water-tight casings of this type, to either bring about unintended actuation of a switch or other control device, or to impede the desired movement of a solenoid or actuating element.

An object of the present invention is to provide a water-tight casing adapted to receive various switches, solenoids and other apparatus of the type mentioned which overcomes the difficulties above mentioned and which at the same time is simple and economical to produce and reliable and efficient in operation.

Regarded in certain of its broader aspects my invention comprises a water-tight casing for actuating or controlling apparatus comprising a casing part with detachable cover means forming one wall thereof, an enlarged chamber within said casing part for reception of such apparatus, a pair of reciprocating members extended through walls of said casing from said chamber to the exterior of said casing, each of said members being mounted on said casing by flexible means providing a water-tight seal, and a rigid member within said chamber operatively coupled with said apparatus and having engagement with the inner ends of said reciprocating members to translate in-and-out movement of one reciprocating member to an equivalent reverse movement of the other reciprocating member. The mounting for said reciprocating members is provided by the clamping engagement of peripheral edges of annular flexible diaphragms on said members between recessed protruding portions of said casing and recessed annular clamp means having adjustable engagement with said protruding portions. The recesses in said protruding portions and annular clamp means provide a chamber in which the flexible sealing means for said reciprocating members can freely move and vents are provided in the annular clamp means permitting free circulation of water to outer surfaces of the flexible sealing means or diaphragms whereby to equalize the effect of

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water pressure upon said opposed reciprocating members. Means may also be provided for applying an internal pressure within said casing in instances where excessive external pressures are to be encountered.

The novel features of my invention will readily be apparent from a consideration of the following description taken together with the accompanying drawing in which a typical embodiment of the invention is illustrated with various parts thereof identified by suitable reference characters in each of the views and in which:

Fig. 1 is an elevation view of the casing partially in section and diagrammatically indicating a limit switch as operatively mounted within said casing;

Fig. 2 is a plan view partially in section taken along the broken line 2—2 as shown in Fig. 1;

Fig. 3 is an exploded view of a modified form of reciprocating member and diaphragm; and

Fig. 4 is an exploded view similar to Fig. 3 showing a further modification in the reciprocating member-diaphragm assemblage.

For purpose of illustration I have shown in the drawing one form of my water-tight casing device comprising a casing part 10 having a bottom wall 11, side walls 12, and end walls 13 forming an enlarged chamber 14 for reception of apparatus as hereinafter described. The upper edges of the end and side walls are provided with a peripheral outwardly extending flange 15 for the mounting of a top wall or cover plate 16, said plate being detachably secured in place by bolts 17 or other suitable fastening means and a gasket 18 of rubber or similar material being provided between the cover 16 and flange 15 to provide a water-tight seal.

In co-axial alignment substantially centrally of the side walls 12 are outward projections or bosses 19 having enlarged threaded recesses 20 to receive threaded projections 21 of diaphragm clamping members 22. The threaded recesses 20 terminate in annular shoulders 23 which extend to inner deep recesses 24. The walls 12 are provided with apertures or bores 25 centrally of the recesses 24 to slidably receive reciprocating members 26 which extend through aligned bores 27 in the clamping devices 22.

Each of the reciprocating members 26 carries by suitable bonding or water-tight clamping at a central point 26a, a flexible diaphragm 28 having a bellows portion 29 and a peripheral flange portion 30 adapted to be clamped between the shoulder 23 and the protruding threaded portion 21 of the clamping device 22. The flexible diaphragms 28 can be fashioned of metal, rubber, synthetic rubber, or such materials reinforced with fabric or fiber, it being understood that the diaphragm should be strong enough to withstand considerable external pressure while permitting free movement of the reciprocating members 26. In Figs. 1 and 2 of the drawing the diaphragms 28 have been indicated as suitably cemented or bonded to the reciprocating members 26. It is to be understood however, that any suitable means can be provided for forming a water-tight engagement between the diaphragms and reciprocating members.

By way of illustration I have shown in Fig. 3 of the drawing a modified form of construction wherein a reciprocating member corresponding with the member 26 is made up of an inner part 31 carrying a threaded stud 32 for detachable engagement with an outer part 31a having a threaded recess 33. The diaphragm 34 is then provided with a central aperture 35 for closely engaging the stud 32 and is clamped between abutting surfaces of the parts 31, 31a. The inner end of the part 31a is suitably recessed slightly to provide an annular rib 36 which can embed itself in the diaphragm 34 to insure a positive position and firm water-tight engagement of the

diaphragm between the parts 31, 31a of the reciprocating member.

The further modification shown in Fig. 4 of the drawing also embodies a built-up reciprocating member corresponding with the member 26 having an inner part 37 carrying a threaded recesses 38 at the end thereof adapted to engage diaphragm 39. The outer part 37a of the reciprocating member has a bore 40 extending longitudinally thereof to receive a screw 41 which passes through aperture 42 in the diaphragm 39 and into the threaded recess 38 in the part 37. The inner end of the part 37a is recessed to provide an annular flange or bead 43 to firmly position the diaphragm 39 between parts 37, 37a as they are clamped together and to insure a water-tight seal therebetween. A similar recessed portion forming annular flange or bead 44 is also preferably employed in the inner portion 37 of the reciprocating member.

Returning now to a consideration of Figs. 1 and 2 of the drawing, it will be evident that the recesses 24 in the bosses 19 and aligned recesses 24a in the clamping members 22 provide space in which the bellows portion 29 of the flexible diaphragms can freely move in the reciprocation of the member 26. In the clamping members 22 a plurality of vent bores or apertures 45 are provided to permit free movement of water into the chambers 24a in inward movement of the members 26 and corresponding discharge of water from the chambers 24a in the outward movement in the members 26.

It will be evident that the members 26 are of a length to provide ends 46 protruding outwardly of the clamping members 22 for engagement by manually or mechanically actuated elements either controlled by or controlling the apparatus arranged within the water-tight casing. The inner ends 47 of the reciprocating members 26 protrude inwardly of the side walls 12 for bearing engagement with a rigid link or yoke 48 extending transversely of the chamber 14. The link or yoke 48 is independent of the reciprocating members 26 and can be co-axially therewith or can comprise an off-set or U-shaped part as shown in the drawing having legs 49 registering with the inner ends 47 of the reciprocating members and joined in spaced relation to the reciprocating members by a connecting portion 50. The connecting portion 50 whether offset as shown in the drawing, or co-axially with the reciprocating members 26 is suitably linked or coupled to the particular apparatus 51 mounted within the chamber 14. The apparatus 51 which has been diagrammatically shown in the drawing can be a limit switch, toggle switch, or other control device for which a desired response is obtained on predetermined movement of the reciprocating members 26 and connecting yoke 48 due to the application of external force to the reciprocating members. Alternatively the apparatus 51 can comprise a solenoid, motor or other device for imparting internal force and movement to the yoke 48 and reciprocating members 26. It will be evident that the details of the linkage between the yoke 48 and the particular movable part of apparatus 51 will vary from one apparatus to another and it is intended that the part 48 which is separate and independent from the reciprocating members 26 be specially fashioned to efficiently co-act with the particular apparatus 51 which is mounted within the chamber 14. It is important to note however, that the member 48 must be a rigid member having sufficient strength to withstand the opposed pressures which may be applied thereto through the action of water on the outer surfaces of the diaphragms 28. When operation is contemplated at extreme depths in water it may be desirable to offset the effect of external pressure at least in part by filling the chamber 14 with material under pressure which will not interfere with the operation of apparatus 51. Thus, for example, in some instances the chamber 14 may be filled with transformer oil, or the like. In other instances, air or other gas under pressure may be fed to the chamber 14 through a cable 52 carrying electrical wires 53 leading to

terminals 54 on the apparatus 51. The cable 52 is of course, coupled with the casing 10 by suitable clamping means 55 providing a watertight seal therewith capable of withstanding contemplated water pressures.

The bottom wall 11 of the casing 10 is provided with suitable inward projections 56 providing means for positioning and attaching apparatus 51, as for example by the use of screws 57 extending through the base or mounting portion 58 thereof. Alternatively the mounting portion 58 may be a standard mounting plate to which various types of apparatus 51 can be readily secured before insertion into the chamber 14.

It will be evident from the foregoing that the construction of my water-tight casing and pressure equalizing device provides for a substantial balancing of external forces applied to the moving parts by reason of water pressure externally thereof so that the application of external force to the reciprocating members 26 will be carried undistorted to the apparatus 51. Conversely, force and motion imparted to the inner ends of the reciprocating members 26 by a solenoid or similar apparatus 51 will be transmitted undistorted to the exterior of the device for utilization in any desired manner. It will further be evident that the construction of my device permits the use within the chamber 14 of various apparatus 51 which may be designed for normal atmospheric operating conditions, thus obviating the need for specially designing each different type of apparatus to operate under the severe conditions encountered in deep water operation.

It will be apparent that the balancing of forces in the movement of the two reciprocating members 26 does not necessarily require the co-axially alignment of the members 26 in the manner specifically disclosed. While this arrangement has certain advantages from the standpoint of production of the device and adaptation to use with various apparatus 51, it will be apparent that in some instances the reciprocating members 26 may be in a side-by-side relationship co-acting internally of the casing with a pivoted member replacing the yoke part 48. With such a member pivoted equidistant from the parallel reciprocating members 26 it will be evident that a predetermined inward movement of one member 26 would require a corresponding outward movement of the other member 26 and that accordingly pressures applied to the diaphragms engaging the members 26 would be equalized in the same manner as pressures are equalized with the co-axial alignment of the reciprocating members.

Various changes and modifications in the device as herein disclosed will occur to those skilled in the art and to the extent that such changes and modifications are embraced by the appended claims, it is to be understood that they constitute part of my invention.

I claim:

1. A water-tight casing for actuating and control apparatus comprising a casing part with detachable cover means forming one wall thereof, an enlarged chamber within said casing part for reception of such apparatus, a pair of reciprocating members extending through walls of said casing from said chamber to the exterior of said casing, each of said members being mounted on said casing by flexible means providing a water-tight seal, a rigid movable member within said chamber operatively coupled with said apparatus and having bearing engagement with the inner ends of said reciprocating members to translate in-and-out movement of one reciprocating member to an equivalent reverse movement of the other reciprocating member, and said flexible mounting and sealing means being of identical and opposed construction such that water pressure applied externally of said casing produces balanced opposed forces in the engagement between said reciprocating members and said rigid movable member.

2. A water-tight casing for actuating and control apparatus as defined in claim 1 wherein the flexible mount-

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ing and sealing means for said reciprocatory members comprise annular diaphragms firmly coupled with said members and having peripheral flange portions secured by clamping means within externally recessed portions of said casing part.

3. A water-tight casing for actuating and control apparatus as defined in claim 2 wherein said diaphragms are bonded to said reciprocatory members.

4. A water-tight casing for actuating and control apparatus as defined in claim 2 wherein said diaphragms are mounted by compression between detachably coupled parts of built-up reciprocatory members.

5. A water-tight casing for actuating and control apparatus as defined in claim 2 wherein said diaphragms include bellows portions movable within chambers formed between said casing and clamping means.

6. A water-tight casing for actuating and control apparatus as defined in claim 2 wherein said diaphragms include bellows portions movable within chambers formed between said casing and clamping means, and said clamping means having a plurality of apertures providing free movement of water into and out of said last named chambers on outer sides of said diaphragms.

7. A water-tight casing for actuating and control apparatus as defined in claim 1, wherein said reciprocatory

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members are arranged coaxially in opposed walls of said casing and said rigid member extends transversely of said casing with end portions thereof in abutting relation to inner ends of said reciprocatory members.

8. A water-tight casing for actuating and control apparatus as defined in claim 1 wherein said reciprocatory members are arranged coaxially in opposed walls of said casing and said rigid member extends transversely of said casing with end portions thereof in abutting relation to inner ends of said reciprocatory members, said opposed end portions of the rigid member being offset with respect to the transversely extending portion thereof.

9. A water-tight casing for actuating and control apparatus as defined in claim 1 wherein said reciprocatory members are arranged in substantially parallel relationship in one wall of said casing, and the rigid member is pivoted within said casing at a point equidistant from opposed bearing portions thereof which engage inner ends of said reciprocatory members.

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