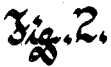
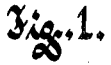


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TIME DELAY INSTRUMENTALITY

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Fig. 3.

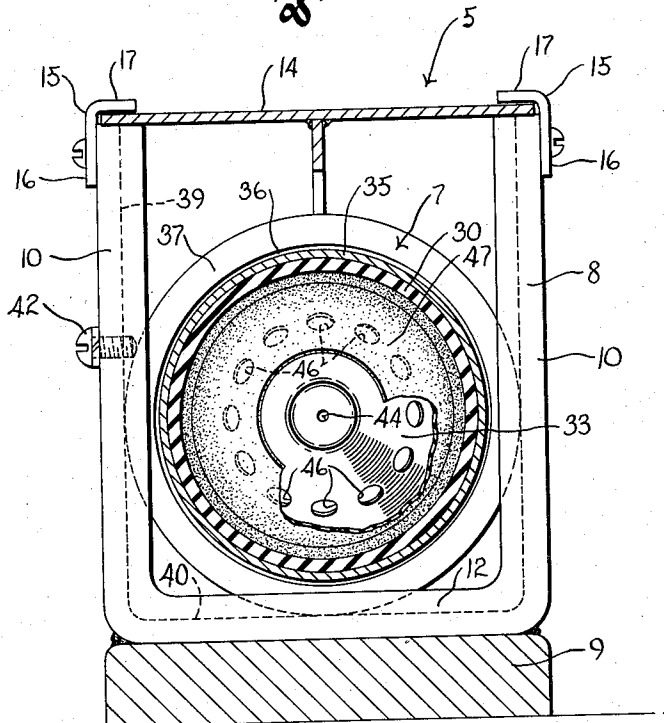
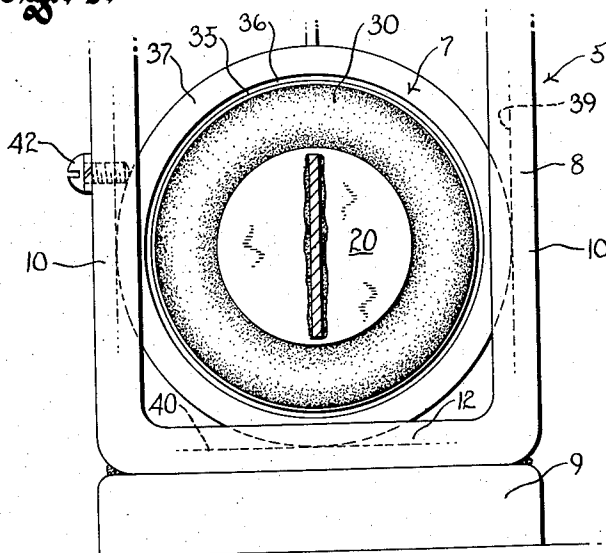


Fig. 4.



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2,851,101

TIME DELAY INSTRUMENTALITY

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8 Claims. (Cl. 161—1)

This invention relates to time delay instrumentalities for effecting return movement of an operating member to a predetermined position toward which it is biased, after a time delay interval following displacement of the operating member out of said position. As an example, time delay instrumentalities of this nature are frequently used to effect delayed reclosure of an electric switch by the operating member when it returns to its predetermined position at which the switch is held closed thereby.

Time delay instrumentalities of this type are usually provided with a control unit which operates upon the familiar air bleed principle. Thus, the control unit may comprise a chamber from which air is quickly expelled upon displacement of the operating member from its predetermined switch closing position and into which air is slowly bled to effect delayed return motion of the operating member to its switch closing position.

Generally speaking, one of the most serious objections to the conventional air bleed type of time delay instrumentality is the danger of its bleed orifice becoming plugged with dirt or other foreign material to thus render the instrumentality inoperative altogether or, at least, make it impossible to maintain consistent operating characteristics.

With this objection in mind, it is a purpose of this invention to provide a time delay instrumentality with a control unit which features exceptional reliability and which operates upon the principle of positive displacement of liquid from one chamber to another to thus overcome the disadvantages inherent in the conventional air bleed units.

More specifically, it is a purpose of this invention to provide a self contained control unit for time delay instrumentalities of the character described featuring a completely closed hydraulic system having no moving seals or glands and which control unit requires no accurate or close fitting parts.

Still another purpose of this invention is to provide a control unit of the character described comprising a liquid filled leak-proof container made of flexible material so that the unit will be able to withstand an increase in volume due to temperature rises.

A further object of this invention resides in the provision of a time delay instrumentality of the character described in which the time delay period will always be proportional to the extent of displacement of the operating member of the instrumentality from its predetermined position toward which it is yieldingly biased.

With the above and other objects in view, which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the herein-disclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate one complete example of the physical embodiment of the invention con-

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structed according to the best mode so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a side elevational view of the time delay instrumentality of this invention, showing the control unit thereof in longitudinal section;

Figure 2 is a view similar to Figure 1 but illustrating the positions which the parts assume upon displacement of the operating member of the instrumentality from its predetermined position seen in Figure 1;

Figure 3 is a cross-sectional view taken through Figure 2 along the plane of the line 3—3; and

Figure 4 is a sectional view taken through Figure 2 along the plane of the line 4—4.

Referring now more particularly to the accompanying drawings, in which like numerals indicate like parts throughout the several views, the time delay instrumentality of this invention generally comprises a slide or operating member 5 movable to and from a predetermined position shown in Figure 1 toward which it is biased and at which it holds a switch 6 closed. The instrumentality features a novel substantially cylindrical control unit 7 which is operatively connected with the member 5 to control the biased return movement thereof to its predetermined switch closing position.

It will be understood, of course, that the electric switch 6 is merely illustrative of one of the many different mechanisms that may be governed by the time delay instrumentality of this invention.

The operating member or slide 5 is carried by a support comprising a U-shaped frame 8 mounted upon a base 9. The upstanding legs 10 of the frame are of equal length and diametrically embrace the control unit 7, while the bight 12 of the frame seats upon the base 9 and is welded or otherwise secured thereto.

The slide or operating member 5 in the present case comprises a yoke of substantially inverted U-shape having a flat bight 14 slidably supported upon the upper ends of the legs 10 of the frame and guided for back and forth reciprocatory motion along a path parallel to the base 9, crosswise of the bight 12 of the frame 8, by means of clips 15. The clips 15 are angle-shaped and have their upstanding legs 16 secured to the upper end portions of the frame legs 10 at their exteriors, and have their horizontal flanges 17 projecting toward one another and loosely overlying the bight 14 of the operating member to hold it against displacement from the frame.

The legs 19 of the operating member project downwardly to lie adjacent to the opposite ends of the control unit 7. Spaced apart opposing abutments or pads 20 are provided on the lower end portions of the legs 19, and the inner faces of the pads are parallel and lie in planes normal to the path of motion of the operating member. These pads are preferably circular, as shown in Figure 4, and bear against the longitudinal ends of the control unit 7 to connect the latter with the operating member.

Also by way of illustration, a tension spring 22 is shown connected with the operating member in alignment with the common axis of the pads 20 to yieldingly bias the operating member to the left toward a predetermined position seen in Figure 1, at which a finger 23 on the operating member engages the actuator 24 of the switch 6 to hold the switch closed. Displacement of the operating member out of its predetermined position, to the right, as shown in Figure 2, may be effected as by means of a link 26 connected with the operating member at a point on the common axis of the pads 20, but at the end of the operating member remote from the spring 22.

The control unit 7 is provided by a substantially cylindrical container of flexible material and filled with liquid 28 under slight pressure. The construction of the con-

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tainer is unique in that it comprises a pair of opposing cup-like members 29 and 30 the bottoms 31 of which provide the opposite ends of the container and forcefully bear against the inner faces of the pads 20 on the operating member under the slight hydraulic pressure in the container. The rim portion of each of the cup-like members 29 and 30 is formed with an outwardly directed circumferential flange 32, and these flanges embrace the peripheral portion of a rigid disk 33 providing a partition in the container across the adjacent open ends of the cup-like members 29 and 30 thereof.

The side walls of the cup-like members are reinforced and rendered substantially rigid by means of cylindrical rings 35 encircling the exteriors of the cup-like members adjacent to the flanges 32 thereof, and the rings, in turn, are provided with outwardly directed flanges 36 which embrace the flanges 32 of the cup-like members. The entire assembly of parts comprising the control unit 7 is held tightly together by an annular clamping ring 37 which is channel-shaped in section and has its flanges embracing those of the rings 35 under considerable pressure. The clamping ring, therefore, maintains the flanges 32 of the cup-like members tightly compressed between the peripheral portion of the partition 33 and the flanges 36 of the side wall rings 35, thus producing a liquid tight seal between the rim portions of the cup-like members.

The control unit is mounted on the U-shaped frame coaxially of the pads 20 on the operating member. For this purpose, the clamping ring 37 of the control unit is fitted into grooves 39 in the inner sides of the frame legs, and seats in a similar groove 40 in the bight 12 of the frame 8. These grooves hold the rigid central portion of the control unit against all but upward movement, and to preclude such upward motion of the control unit, a screw 42 may be threaded into one of the legs 10 to have its inner end project into the groove thereof and bear against the exterior of the clamping ring 37 at a point spaced a distance above the widest dimension of the ring, in the manner shown in Figures 3 and 4.

As stated previously, the ends 31 of the container, which may be referred to as the bottoms of the cup-like members 29 and 30, are caused to bear against the inner surfaces of the pads 20 on the operating member under slight hydraulic pressure. Thus, assuming that the chambers provided by the opposing cup-like members are communicated with one another, all of the inward flexing motion imparted to the bottom of either cup will be hydraulically transmitted to the bottom of the other to flex the same outwardly. The ends 31 of the container, of course, are free to be flexed back and forth along a path normal to the partition 33 by reason of the flexibility of those portions of the cup-like members adjacent to the junctions between their side walls and their bottoms 31.

Referring to Figures 1 and 2, it will be observed that it is the function of the control unit 7 to permit substantially unrestricted or rapid movement of the operating member 5 to the right out of its predetermined position and against the biasing force exerted thereon by the spring 22, and to control the return motion of the operating member to the left so as to delay for a predetermined time interval the reclosure of the switch 6.

For this purpose, the partition 33 is provided with a restricted orifice 44 at its center which at all times provides limited communication between the chambers defined by the cup-like members. The purpose of the orifice 42 is to materially restrict the transfer or displacement of liquid from the interior of the cup-like member 30 into the opposite cup-like member 29 during return motion of the operating member 5 under the influence of its biasing spring 22 and thus limit the rate at which the operating member is returned to its predetermined switch closing position seen in Figure 1.

Displacement of the operating member 5 out of its predetermined position, against the biasing force of spring 22, however, must be capable of being effected

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quickly, substantially unrestricted by the liquid in the container of the control unit. For this purpose, the partition 33 is provided with a by-pass comprising a series of holes 46 therein larger than and spaced radially outwardly of the orifice 44, and which collectively provide for substantially free transfer of liquid from the interior of the cup-like member 29 to the interior of the cup-like member 30 upon displacement of the operating member out of its predetermined position shown in Figure 1.

The by-pass provided by the holes 46 in the partition is closed, however, during return motion of the operating member, and this is effected in a novel manner by means of an annular flexible flap-type fluid pressure responsive valve 47 having its outer peripheral portions clamped between the flange of the cup-like member 30 and the adjacent face of the partition. The inner portions of the valve normally engage over the apertured portion of the partition to close the by-pass as seen in Figure 1.

The flap valve 47, of course, is preferably formed as a thin centrally apertured normally flat membrane of flexible material such as neoprene. Inasmuch as it overlies the face of the partition 33 which opposes the bottom of the cup-like member 30, the valve will be flexed away from the partition to open the by-pass only as a consequence of inward flexure of the bottom of the cup-like member 29 by the operating member when the latter is moved out of its predetermined position.

Attention is directed to the fact that the flap valve is biased toward a position closing the by-pass afforded by the holes 46 in the partition. This is accomplished by reason of the dish-like shape of the partition 33, which has its convex side facing toward the bottom of the cup-like member 30. This convexity of the partition causes stretching of the membrane which provides the valve to normally maintain it snugly engaged over the apertured portion of the partition without interfering with distension of the flap valve into the interior of the chamber 30 as a consequence of inward flexure of the bottom of the cup-like member 29.

From the description thus far it will be apparent that if the operating member 5 is always displaced the same distance out of its predetermined switch closing position, the return motion of the operating member will be delayed over a precise time interval. It will also be appreciated that the duration of the time delay interval will be closely proportional to the extent of displacement of the operating member out of its predetermined position.

These advantages result from the completely closed hydraulic system incorporated in the container of the control unit, and which features positive displacement of liquid from one of its chambers to the other. In this respect, there is no danger that the restricted orifice 44 in the partition will become partly or completely clogged at any time during the life of the unit, as was the case with the conventional air-bleed type of time delay instrumentalities.

It will also be appreciated that, since the liquid filled container comprises a pair of cup-like members of flexible material such as neoprene or the like, the container is easily able to withstand an increase in volume of the liquid therein due to temperature changes, without in any wise influencing the operation of the instrumentality or causing any noticeable variation in the time delay period. Moreover, the establishment of a liquid tight seal at the flanged rims of the opposed cuplike members and the limiting of flexure of the container to only the bottoms of these cup-like members, obviates the need for providing moving seals or glands which might very easily cause serious trouble through leakage.

Another feature of the control unit is that the predetermined position of the operating member which it controls may be determined by the engagement of the bottom 31 of the cup-like member 30 with the convex side of the partition 33 in the manner shown in Figure 1.

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However, an external stop may be arranged to be engaged by the slide or yoke 5 which provides the operating member to define the predetermined at-rest position thereof if desired.

From the foregoing description taken together with the accompanying drawings, it will be readily apparent to those skilled in the art that this invention provides an improved time delay instrumentality featuring a self-contained control unit which requires no accurate or close fitting parts or moving seals or glands; and which, moreover, may afford exceptional uniformity and reliability in its time delay function, or may provide a time delay interval which is closely proportional to the stroke of the operating member which it controls.

What I claim as my invention is:

1. In a time delay instrumentality: a support; a yoke mounted on said support for back and forth motion along a defined path, said yoke having a pair of opposing pads fixed thereon and spaced from one another along said path; means yieldingly biasing said yoke in one direction; a liquid filled leak proof container having a substantially rigid central portion mounted on said support and fixed with respect thereto, and having flexible opposite end portions bearing against said pads under the force of hydraulic pressure in the container and adapted to be alternatively flexed inwardly of the container upon back and forth motion of the yoke, the liquid in said container constraining said end portions thereof to move in unison in like directions; a rigid partition in the interior of the container, intermediate its ends, and fixed with respect to said support, said partition dividing the container into opposite chambers communicated with one another through an orifice in the partition which restricts liquid displacement from one chamber to the other to an extent such that movement of the yoke to impart inward flexing motion to one end portion or the other of the container can be effected only at substantially slow speed; by-pass means on said partition for substantially unrestrictedly communicating said chambers for free transfer of liquid from one to the other; and means on the container providing a fluid pressure responsive valve normally closing said by-pass means, said valve being adapted to open upon motion of the yoke in a direction against the bias thereon to impart inward flexure to one end portion of the container and thus provide for rapid motion of the yoke in said direction, and slow return motion of the yoke under the influence of its biasing means when the valve is closed.

2. The time delay instrumentality set forth in claim 1 wherein the yoke is normally held by its biasing means at a predetermined position defined by the engagement of one end portion of the container with said partition therein.

3. In a time delay instrumentality: a support; means on said support defining a pair of liquid filled leak proof chambers having flexible end portions facing in opposite directions and each movable inwardly and outwardly of its chamber; means providing restricted communication between said chambers whereby said end portions of the chambers are hydraulically constrained to move in unison in like directions but at a substantially slow speed; an operating member carried by said support for back and forth motion along a path parallel to the path of in and out flexing motion of said end portions of the chambers; a pair of pads fixed on the operating member and each bearing against the end portion of one of said chambers whereby the operating member is constrained thereby to back and forth motion at a substantially slow speed; means biasing the operating member in one direction;

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and means providing for substantially fast travel of the operating member in the opposite direction comprising by-pass means connecting said chambers to permit substantially free transfer of liquid therebetween, and a fluid pressure responsive valve for said by-pass means normally closing the same but arranged to open as a consequence of motion of the operating member in said opposite direction.

4. An instrumentality according to claim 1 in which said container comprises a pair of cup-like members of flexible material, said cup-like members having their open sides facing one another and each providing one of said chambers; and further characterized by the provision of means tightly clamping the peripheral portion of said rigid partition between the rim portions of said cup-like members to provide a fluid tight joint therebetween.

5. An instrumentality according to claim 1 in which said valve means includes an annular flexible membrane having its outer peripheral portion fixed in the rigid central portion of the container adjacent the partition, the central aperture of said annular flexible membrane being in alignment with said restricted orifice in said partition and the membrane being adapted to cover the by-pass means.

6. An instrumentality according to claim 5 in which said partition has a dish-like shape with its convex side facing toward said flexible membrane, the convexity of the partition causing stretching of the membrane to normally maintain it snugly engaged over the portion of the partition in which said bypass means is located.

7. A control unit for a time delay device comprising a leak proof fluid filled container having flexible wall portions, a rigid partition fixed inside the container and dividing the same into opposed chambers having end portions facing the partition, the flexible wall portions of the container providing for relative motion between the partition and said end portions of the chambers, and said partition having a restricted orifice therein communicating the chambers but normally limiting fluid transfer therebetween so that relative motion between the partition and the end portions of the chambers can be effected only at a slow speed, means on the partition defining a bypass substantially unrestrictedly communicating said chambers to provide for substantially free transfer of fluid therebetween, and means in the container providing a fluid pressure responsive valve comprising a flexible membrane overlying said partition and sealed thereto along the periphery of said membrane, said membrane having an aperture therein aligned with said restricted orifice and adapted to normally close said bypass means and to open as a consequence of relative motion between the partition and said end portions of the chambers in one direction only to thus provide for rapid relative motion between the partition and the end portions of the chambers in said one direction.

8. A control unit according to claim 7 in which said partition has a dish-like shape with its convex side facing toward said flexible membrane, this convexity of the partition causing stretching of the membrane to normally maintain the membrane snugly engaged over the portion of the partition in which said bypass means is located.

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