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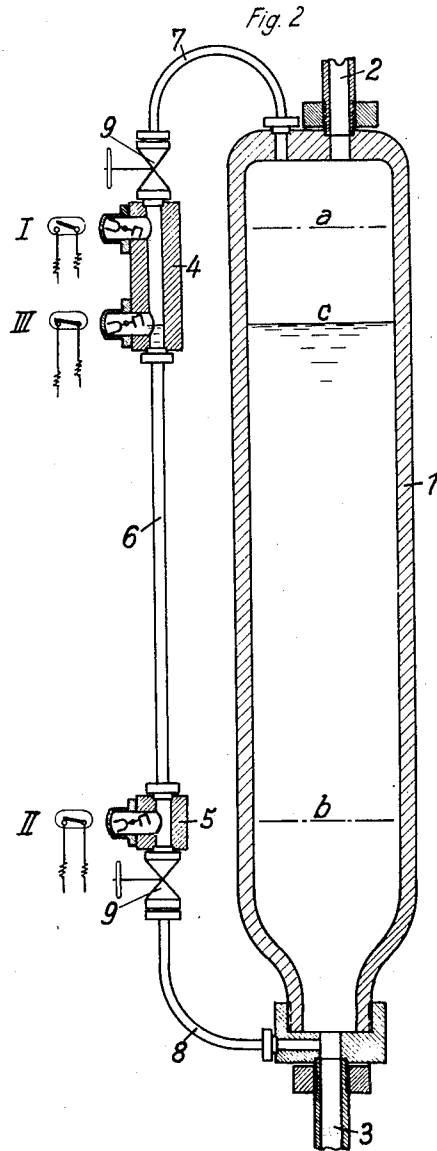
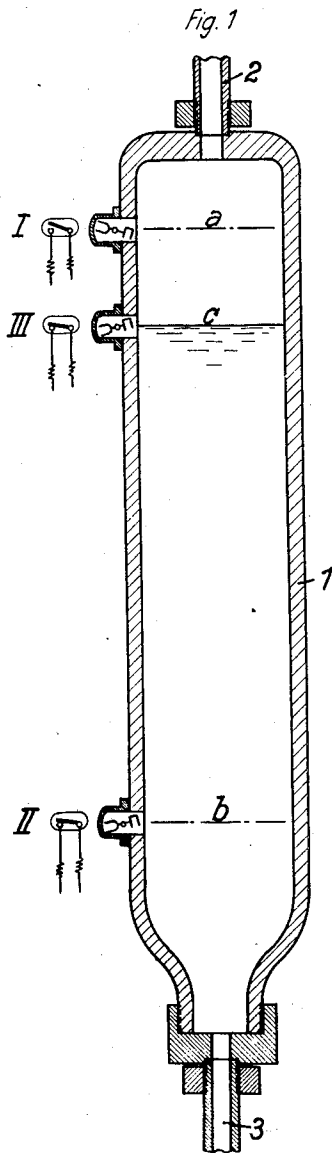
W. PIRWITZ

2,062,674

CONTROL SWITCH DEVICE FOR HYDRAULIC ACCUMULATORS

Filed Feb. 20, 1934

2 Sheets-Sheet 1



Inventor:
Wilhelm Pirwitz
By *Adrian* 44.

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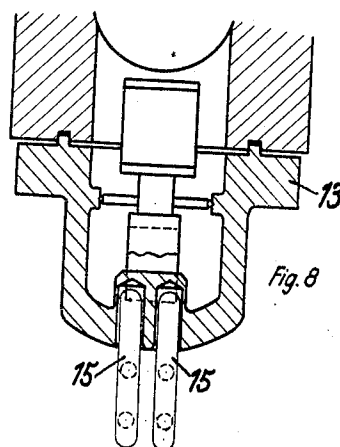
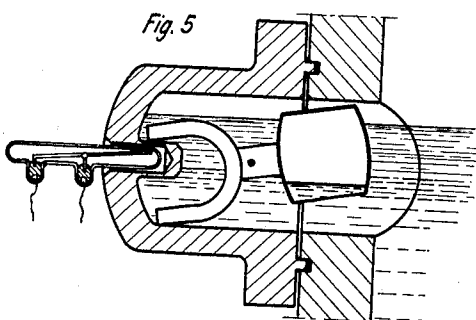
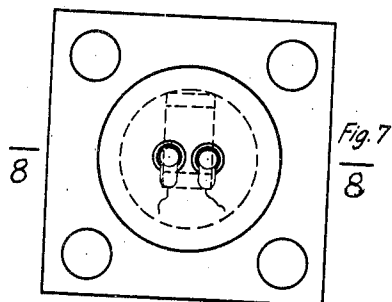
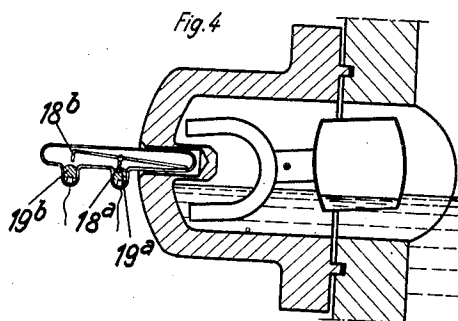
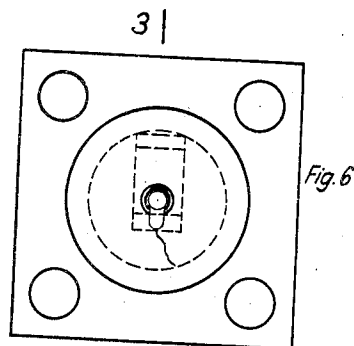
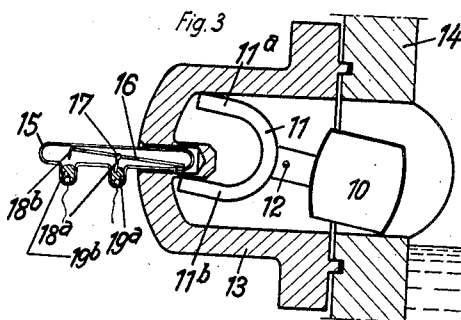
W. PIRWITZ

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CONTROL SWITCH DEVICE FOR HYDRAULIC ACCUMULATORS

Filed Feb. 20, 1934

2 Sheets-Sheet 2



Inventor:
Wilhelm Pivitz
By Alfred A. Allen,
Att'y.

UNITED STATES PATENT OFFICE

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CONTROL SWITCH DEVICE FOR HYDRAULIC
ACCUMULATORS

Wilhelm Pirwitz, Duisburg, Germany, assignor to
Schloemann Aktiengesellschaft, Dusseldorf,
Germany, a corporation of Germany

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5 Claims. (Cl. 200—84)

My invention relates to liquid level control switches for hydraulic accumulators which contain water and air under high pressure and in which the water is directly charged by the air without the intermediary of a piston.

In accumulators of this type, it is necessary to prevent the water, contained in the accumulator from rising or falling beyond predetermined levels. For this purpose switch devices are provided which control the supply and cut-off means for the compressed water in accordance with the water level in the accumulator.

A switch device of known construction comprises a plurality of oscillatory or tilting switches, provided simply at each controlling level in the pressure chamber of the accumulator. Each of such switches comprises a diving bell and a mercury tube switch as electrical contactor, both being pivotally supported in the pressure chamber by means of suitable mechanical means, such as a lever. The diving bells are adapted to be oscillated or tilted about their pivot in opposite directions depending upon the water in the accumulator rising or falling as the case may be, and to operate thereby on the contactors which open or close circuits for controlling the supply and cut-off means for the compressed water according to its level. The pivots of the switches are supported by a mounting, which is attached to the wall of the pressure chamber.

In this known construction, the arrangement of the contactors inside the pressure chamber makes it necessary to have the contactors extend outside the pressure chamber through an insulating plug. Because of the very high pressures in the accumulator the passing of the conductor through this plug must be made very carefully to avoid leakage. Furthermore, to withstand the high pressures, the mercury tube switch must be of particularly rugged construction. Also, it may be considered a drawback to have the electrical part of the switch located entirely inside the pressure chamber and therefore not visible from outside so that its condition and its operation can not be examined when at work.

The present invention has as its object to provide a switch device for hydraulic accumulators of the above type in which said drawbacks are avoided.

This is accomplished in the first place by the electrical part of the switch being bodily separated from its mechanical part and the former being situated outside the pressure chamber. For transferring the oscillating movement of the diving bells to the contactors, the diving bells are

associated with permanent magnets so as to form an oscillating scale which when not immersed has an overload at its diving bell end which overload is compensated when the water in the accumulator rises.

With this arrangement only the diving bells, the permanent magnets and their pivots remain inside the pressure chamber all which parts can easily withstand high pressures. As the electrical part of the switch is located outside the pressure chamber, it is both visible and accessible from the outside when at work, and the pressure chamber need not be relieved or emptied when the electrical part has to be removed for overhauling and resetting as the case may be. The contactor can be a mercury tube switch of conventional type, but it is to be understood that the invention is not limited to a special type of electrical contactor.

Another feature of this invention is that the mercury tube switches are stationary, the movements for making and breaking contacts being then performed by armatures pivotally supported inside the tubes and actuated by the permanent magnets.

The latter, according to this invention, have the form of a horse shoe, which is so arranged relative to its respective mercury tube switch that the contact armature of the tube is adapted to pivot in the space between the limbs or pole pieces of the magnets. Thus, the armatures are positively pulled both to their make and break positions by magnetic force, and vibrations of the armatures and of the relays controlled by them can not occur.

The magnetic pull of the armature in both directions of its oscillating movement enables the armature to be balanced with respect to its pivot. As the weight of the armature therefore need no longer be overcome for moving the same, the permanent magnet and the diving bell can be made smaller than would be the case otherwise. In this way the sensitivity of the control is still further increased.

A further advantage is that the small dimensions of the oscillating switch mechanism require only small recesses in the pressure chamber, as compared with the known construction above referred to.

The high sensitivity of the control makes it possible to control a number of contactors by one oscillating switch mechanism only. This is advantageous because thereby the number of parts located inside the pressure chamber of the accumulator is reduced and the thickness of its

walls has to be weakened at fewer places only.

Further objects and advantages will appear upon reference to the following description and the accompanying drawings in which

5 Figs. 1 and 2 are sectional elevations of water vessels of an hydraulic accumulator fitted with switches embodying the present invention.

Figs. 3, 4 and 5 are longitudinal sections, along line 3—3 of Fig. 6, showing the switch in three
10 different positions.

Fig. 7 is an outer side view of a modification in which the switch is associated with more than one contactor.

Fig. 8 is a cross section, along line 8—8 of Fig. 7.

15 In Fig. 1, 1 indicates the water vessel of a hydraulic accumulator of well-known construction, which is filled with compressed water and air, the water being directly charged by the air without the intermediary of a piston. Pipes 2 and 3 are
20 provided for filling the water vessel with compressed air and water respectively. The supply and cut-off means for the water vessel which are connected to pipes 2 and 3 are not shown here, as they do not form any part of my invention
25 and may be of conventional form.

In order that the accumulator can be used without trouble, means are provided preventing the water in vessel 1 from rising above level *a* or falling below level *b*. For this purpose, switches I and II are arranged at the height of the levels *a* and *b* respectively, the switch I for stopping the feed pump of the accumulator and the switch II for closing the cut-off valve, when the water has reached the respective levels. A third switch III
35 is arranged a short distance below level *a* at level *c* for restarting the feed pump, when the water has fallen from level *a* to level *c*. This way of controlling hydraulic accumulators is well known and forms no part of the present invention.

40 The two embodiments of Figs. 1 and 2 differ only from another in as far as in the embodiment shown in Fig. 1, the switches are arranged in the water vessel 1 itself, while in the embodiment shown in Fig. 2, the switches are arranged in a
45 pipe system communicating with vessel 1. In the latter case, the two switches I and III are both mounted in the same casing 4, and the switch II in a separate casing 5. Casings 4 and 5 are connected with each other by pipe 6, whereas
50 casing 4 is connected to the air chamber of vessel 1 by curved pipe 7 and casing 5 is connected to the water chamber of vessel 1 by curved pipe 8. Valves 9 are arranged above and below the casings 4 and 5 respectively, for cutting off the communicating system from vessel 1, so that the
55 switches can be fitted to the system and removed again without having to relieve pressure from vessel 1.

In Figs. 1 and 2, the switches I—III are represented in a diagrammatic way. Each switch comprises an oscillating mechanical part and a substantially stationary electrical part. The mechanical part is located inside and the electrical part outside the pressure chamber, this latter term being used in this connection in a broad
65 sense, so as to indicate the space enclosed both by the water vessel 1 and the pipe system communicating therewith.

The switches will now be more fully described with reference to Figs. 3 to 8 inclusive.

Each switch comprises a diving bell 10 which forms together with a permanent magnet 11 a scale-like structure, fulcrumed at 12.

The diving bell end of the scale is somewhat
75 heavier than the magnet end when not immersed,

as shown by Fig. 3. When, however, the water rises and rushes into diving bell 10, so that the latter becomes more and more immersed, the overload on the diving bell end of the scale will be compensated (Figs. 4 and 5).

The pivot pin 12 of the scale is supported in a mounting 13, which is attached to wall 14 of the pressure chamber. A mercury tube switch 15 which forms the electrical part of the switch is secured to said mounting 13 by the tube being
10 partly inserted into a recess of mounting 13. Thus, all parts of the switch are assembled in the said mounting so that the switch can be readily fitted and removed as required. For reasons which will be apparent later, the mounting
15 is of non-magnetic material, e. g. bronze, whereas wall 14 of the pressure chamber can be made of magnetic material, such as steel.

A contact armature 16 is pivoted at 17 to mercury tube switch 15 and counter-balanced with
20 respect to its pivot, electrodes 18a and 18b being provided both at the pivot and at the outer end of the armature respectively. Electrode 18a is constantly dipping into a cup-shaped projection 19a of tube 15, filled with mercury, whereas electrode 18b is so disposed as to dip into a mercury
25 filled cup-shaped projection 19b or not, making or breaking contact according to the position of armature 16. The inner end of armature 16 extends into the field of magnet 11 and is thereby
30 controlled as to its position, when the magnet is oscillated together with diving bell 10 about pivot 12.

In the embodiments shown, the magnet 11 has horse-shoe form. Its two limbs or pole pieces 11a
35 and 11b embrace the inner end of tube 15, so that armature 16 is pivotally mounted between the two limbs and can be pulled in either direction and held in its end positions by magnetic force.

In Fig. 3, only the lower limb 11b operates upon armature 16. The inner end of the latter which is close to the magnet will therefore be lowered and its outer end be raised, and the contact will be broken, as shown with respect to switch I in
40 Figs. 1 and 2.

When the water in the pressure chamber rises, the air in the diving bell will be trapped, and on a further rise of the water level, the diving bell will be raised by its buoyancy as shown in
50 Figs. 4 and 5 so that the scale structure performs an oscillating movement about pivot 12.

In Fig. 4, the diving bell and the magnet have reached an intermediate position, the limbs 11a and 11b of the magnet being equally far away
55 from armature 16 so that the latter will remain in its position.

In Fig. 5, the diving bell is still more raised. The upper limb 11a of the magnet has now come so close to armature 16 as to pull it upwardly,
60 and the electrode 18b now dips into the mercury filled cup 19b, so that the contact is made. This position is shown in Figs. 1 and 2 with respect to switches II and III.

In Figs. 7 and 8, a modified embodiment is
65 shown, in which two mercury tubes 15 are controlled by a single magnet, the two tubes being arranged side by side in the same mounting 13. The tubes are of the same type as the one above described, the mechanical part of the switch being also left unchanged, so that further description is not deemed necessary. By the parallel
70 arranging of a number of contactors, it is possible to control at one time a plurality of circuits by a single oscillating movement of the

switch, which may be of importance when the accumulator is fed by a plurality of pumps which are to be started in series.

I claim:

- 5 1. A control switch mechanism comprising a permanent magnet having a pair of spaced arms, said magnet being pivoted for unitary oscillation of said arms in the plane thereof, a switch armature also pivoted for oscillation in the same
10 general direction as said magnet and having a portion thereof extending between said magnet arms, and means limiting oscillatory movement of said armature to an extent such that when the magnet is swung in one direction said arma-
15 ture is swung in one direction by the magnetism of one of said arms and when the magnet is swung in the other direction the armature is swung in the other direction by the magnetism of the other of said arms.
- 20 2. A control switch mechanism comprising a pair of spaced magnetic members connected together and pivotally mounted for unitary oscillation in the plane thereof, and a switch armature pivoted for oscillation in the same general direc-
25 tion as said members and having a portion thereof disposed with respect to said members, and the mechanism including means for limiting oscillatory movements of said armature, so that when the members are swung in one direction one of the same is effective by its magnetism to swing said armature in one direction, and when the members are swung in an opposite direction the other member is effective by its magnetism to swing said armature in the other direction.
- 30 3. In combination with a vessel to contain liquid, a pair of spaced magnetic members within the limiting confines of said vessel pivoted for unitary oscillation of said members in the plane thereof, means operable in response to rise of
40 liquid in said vessel to move said members in one direction, said means being arranged to move said members in the opposite direction upon fall of liquid level, and a switch armature outside the limiting confines of said vessel pivoted for oscillation in the same general direction as said mem-
45 bers and having cooperating means limiting os-

cillatory movements thereof and further having a portion thereof disposed with respect to said members so that when the latter are swung in one direction one of the members is effective by its magnetism to swing the armature in one di-
5 rection and when said members are swung in the other direction the other member is effective by its magnetism to swing said armature in the other direction.

4. A control switch mechanism comprising a 10 permanent magnet of substantially U-shape having a pair of spaced arms, said magnet being pivoted for unitary oscillation of said arms in the plane thereof, a switch armature pivoted inter-
15 mediate its ends for oscillation in the plane of said magnet arms and having one end thereof extending between said magnet arms, means limiting oscillatory movements of said armature so that when the magnet arms are swung in one
20 direction one of the arms is effective by its magnetism to swing said armature in one direction and when said magnet arms are swung in the opposite direction the other arm is effective by its magnetism to swing the armature in the op-
25 posite direction, a contact carried by said armature, and a casing enclosing said armature and having a contact with which said armature contact cooperates.

5. A control switch mechanism for hydraulic accumulators for controlling the water levels in-
30 side the pressure-chamber, comprising a diving bell and a permanent magnet substantially of the horse-shoe type connected with said diving bell so as to constitute therewith an oscillating as-
35 sembly adapted to respond to the rise and fall of the water in said pressure chamber, and a mercury tube switch extending from the outside into the wall of said pressure chamber and enclosing an oscillating contact armature, the inserted end
40 of the tube of said switch projecting between the pole-pieces of said magnet and said armature being mounted within said tube for oscillation in the same general direction as the magnet so that said contact armature will swing in the
45 plane of the pole-pieces of said magnet.

WILHELM PIROWITZ.