Oct. 11, 1960 W. H. MILLER 2,955,618

PRESSURE RESPONSIVE ACTUATOR

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Fig. 1.

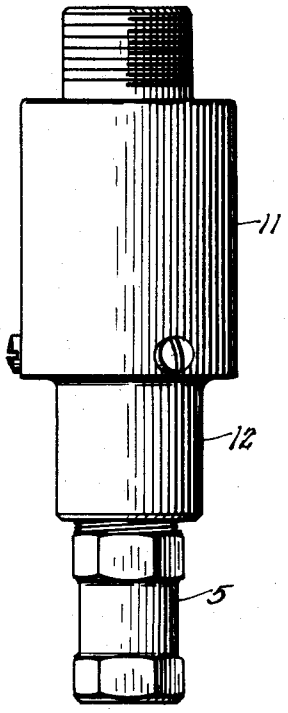


Fig. 2.

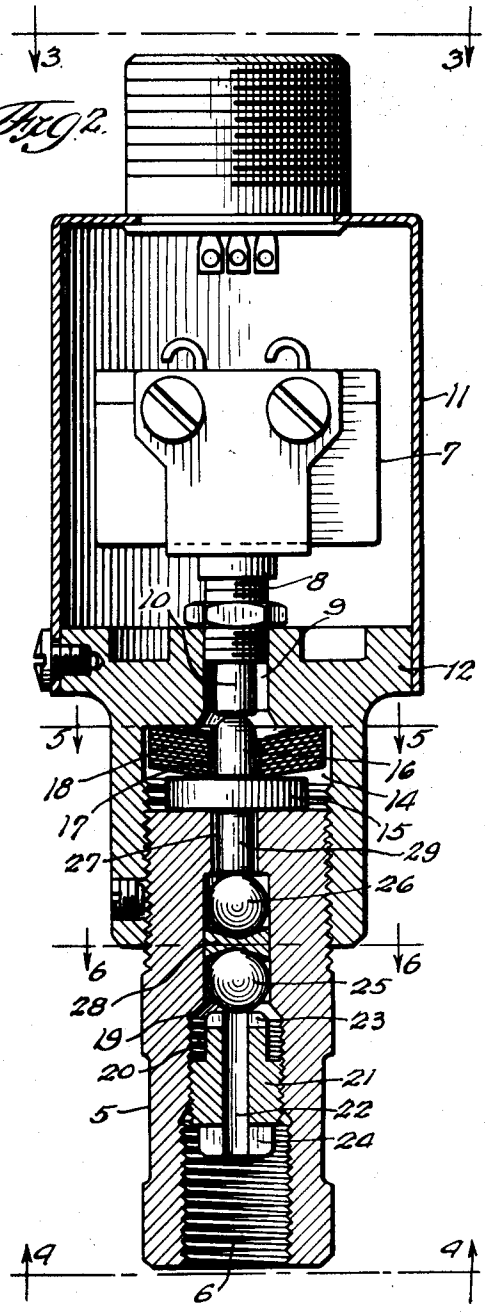
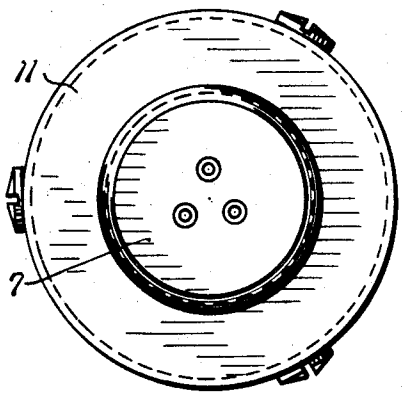


Fig. 3.



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Fig. 4.

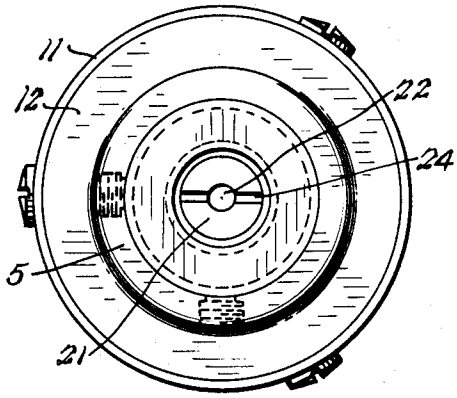


Fig. 5.

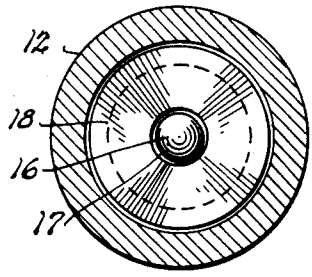


Fig. 6.

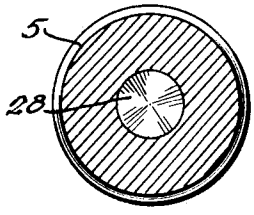
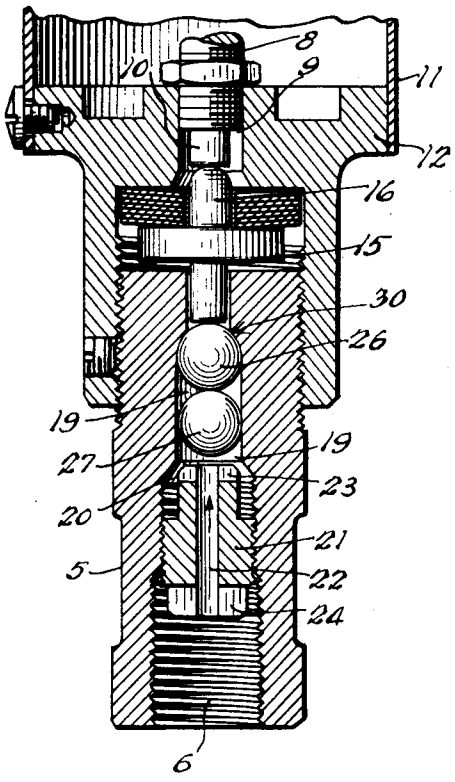


Fig. 7.



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PRESSURE RESPONSIVE ACTUATOR

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6 Claims. (Cl. 137—777)

This invention relates to pressure switches and more particularly to a structure of this type adapted for use in high pressure systems.

Pressure switches have been constructed in various ways but they generally present a problem when used in hydraulic systems employing high pressures and high temperatures. It seems that invariably the pressure seal will leak and spill the hydraulic fluid usually at the point of contact between the operating member of the switch and the pressure-actuated element. Although efforts have been made to effect a satisfactory seal at this point, the construction used has been costly and has limited the application of the structure. This has been particularly true in cases of high temperatures.

An object of the invention is to provide, therefore, a pressure switch particularly suitable for use in high pressure systems and systems employing high temperatures.

A further object of the invention is to provide a pressure switch that is simple and inexpensive to construct.

A still further object of the invention is to provide a simple and inexpensive pressure switch that is capable of almost unlimited application.

A still further object of the invention is to provide a pressure switch with a novel form of seal that increases its effectiveness with increased pressures and is capable of use in high temperature installations.

Other objects and advantages of the invention will be apparent from the following description when taken in connection with the accompanying drawings, in which:

Figure 1 is an elevational view of a pressure switch embodying the invention;

Fig. 2 is an enlarged vertical cross section of the pressure switch shown in Fig. 1;

Fig. 3 is a top view taken along line 3—3 of Fig. 2;

Fig. 4 is a bottom view taken along line 4—4 of Fig. 2;

Fig. 5 is a section taken along line 5—5 of Fig. 2 and looking in the direction of the arrows;

Fig. 6 is a section taken along line 6—6 of Fig. 2 and looking in the direction of the arrows; and

Fig. 7 is a detailed view of a modified embodiment.

The embodiment of the invention disclosed, particularly in Figs. 1 to 6, inclusive, of the accompanying drawings includes a pressure connection 5 adapted for attachment to a suitable source of pressure supply, this attachment being made at the threaded end 6. While various types of switches may be employed, a form of snap switch 7 is shown supported by a threaded stem 8 adjustably connected in a threaded passage 9, the switch 7 being provided with the usual actuating arm 10 that will either open or close the contacts of switch 7 when engaged and moved by an actuator. Switch 7 may be carried in a housing 11 suitably attached to pressure connection 5. The manner of attachment may vary somewhat according to the specific installation, but, in the embodiment shown in the drawings, fitting 12 is interposed between switch housing 11 and pressure connection 5.

Fitting 12 has a chamber 14 receiving an actuator 15 having an upper extension 16 arranged to engage extension 10 and lie within a central aperture 17 of a plurality of Belleville springs 18 functioning to hold actuator 15 out of operating relation with switch extension 10.

Pressure connection 5 may be threaded into the bottom of chamber 14 so that the lateral portion of actuator 15 will seat against the upper face of this pressure connection 5 when it is held from operating relation with switch extension 10 by the Belleville springs 18.

Pressure connection 5 is provided with a passage 19 enlarged and threaded at 20 to receive an adjustable bushing 21 having an open passage extending through and slotted at ends 23 and 24. Slotted end 24 permits the use of a tool to adjust bushing 21 back and forth so as to predetermine the movement of two substantially spherical bodies 25 and 26 disposed in passage 19. Passage 19 continues upwardly and terminates at the top in the form of a restricted passage 27 adapted to receive a lower end 29 of switch actuator 15. This lower end 29 of actuator 15 may be normally spaced from upper ball 26 or in contact therewith as illustrated in Fig. 2. A spacer 28 separates the two balls 25 and 26 while the adjustable bushing 21 controls the amount of movement of these balls when pressure is exerted against the lower ball 25 through passage 22.

Spacer 28 is preferably compressible so that it may be squeezed outwardly by the pressure of the lower ball 25 against the upper ball 26 for the purpose of increasing its engagement with the wall of passage 19. The spacer 28, as shown in Figs. 2 and 6, has a concavity or depression adjacent each of the balls 25 and 26 for receiving a portion of the balls 25 and 26. This configuration of spacer 28 causes a greater outward expansion of the spacer 28 for a given amount of compressive force applied by the balls 25 and 26 than is obtained when a flat, disc-type spacer is used. A spacer having a cone-shaped depression on each side has been found to provide the most effective seal. This compression and consequent expansion of spacer 28 very effectively increases the pressure seal and prevents leakage into the upper portion of the passage 19, in which upper ball 26 is disposed. The application of pressure against lower ball 25 results in a slight movement outwardly of spacer 28, and, of course, the necessary movement of upper ball 26 against switch actuator 27 in order to effect the operation of switch 7. The amount of movement may, of course, be controlled by adjustable bushing 21, but I have found that the pressure switch disclosed herein very effectively operates to control switch 7 through the use of minimum movement for spherical bodies 25 and 26. The pressure applied, of course, against switch actuator 15 acts to overcome the over-center springs 18 in order for actuator 15 to engage and operate switch extension 10.

Spacer 28 may be made of different materials, but I have found that a plastic known as Teflon is quite suitable because of its ability to withstand high temperatures and at the same time being compressible enough to increase its surface engagement with the wall of passage 19 and effect a seal at this point. It is obvious that the effectiveness of the seal increases with the increase of pressure due to the action of the balls 25 and 26 pressing against the spacer 28 when pressure is exerted against lower ball 25.

I have found that these balls 25 and 26 may be ground with sufficient accuracy so that they may fit tightly within passage 19, and, in cases of certain pressure ranges, provide a satisfactory seal without the use of spacer 28. Fig. 6 illustrates a modified form showing that the seal provided by upper ball 26 may be made

more effective through the use of a spherical seat **30** in the upper end of passage **19**. When the actuator **15** is moved upwardly its entire distance, upper ball **26** will snugly fit into spherical seat **30**.

Without further elaboration, the foregoing will so fully explain the character of my invention that others may, by applying current knowledge, readily adapt the same for use under varying conditions of service, without eliminating certain features, which may properly be said to constitute the essential items of novelty involved, which items are intended to be defined and secured to me by the following claims.

I claim:

1. A device responsive to fluid pressure for effecting mechanical movement of an actuator comprising a hollow pressure fitting having first and second coaxial openings; an actuator mounted for axial movement in said first opening; means positioned between said openings in said fitting and movable relative thereto for moving said actuator in response to a fluid pressure applied to said fitting, said means including two force transmitting elements, one of said elements positioned adjacent said actuator; a compressible pad separating said elements and having a depression adjacent at least one of said elements, said element adjacent said depression having a convex surface portion received in said depression, said pad providing a pressure seal between said pad and said fitting whenever said pad is compressed between said force transmitting elements; and means at said second opening for applying a fluid pressure to urge said other element toward said one element.

2. A device responsive to fluid pressure for effecting mechanical movement of an actuator comprising a hollow pressure fitting having first and second coaxial openings; an actuator mounted for axial movement in said first opening; means positioned between said openings in said fitting and movable relative thereto for moving said actuator in response to a fluid pressure applied to said fitting; said means including two force transmitting elements, one of said elements positioned adjacent said actuator; a compressible pad separating said elements and having a depression adjacent each element, each element having a convex surface portion adjacent said pad, said pad providing a pressure seal between said pad and said fitting whenever said pad is compressed between said force transmitting elements; and means at said second opening for applying a fluid pressure to urge said other element toward said one element.

3. A device responsive to fluid pressure for effecting mechanical movement of an actuator comprising a hollow pressure fitting having first and second openings; an actuator mounted for axial movement in said first opening; means positioned between said openings in said fitting and movable relative thereto for moving said actuator in response to a fluid pressure applied to said fitting, said means including two spherical members, one of said members positioned adjacent said actuator; a compressible pad separating said members and having a depression adjacent each of said members, said pad providing a pressure seal between said pad and said fitting whenever said pad is compressed between said members; and means at said second opening for applying a fluid pressure to urge said other member toward said one member.

4. A device responsive to fluid pressure for effecting mechanical movement of an actuator biased to oppose such movement comprising a hollow pressure fitting having first and second openings; an actuator mounted for axial movement in said first opening; means positioned between said openings in said fitting and movable relative thereto for moving said actuator in response to fluid pressure applied to said fitting, said means including two spherical members, one of said members contacting said actuator, a compressible pad separating said members and having a depression adjacent each of said members, said pad providing a pressure seal between said pad and said fitting whenever said pad is compressed between said members; means carried by said pressure fitting and adjustable with respect to said fitting for positioning said pressure responsive means in said fitting, said positioning means contacting the other of said members; and means at said second opening for applying a fluid pressure to urge said other member toward said one member.

5. A device responsive to fluid pressure for effecting mechanical movement of an actuator comprising a hollow pressure fitting having first and second openings; an actuator mounted for axial movement in said first opening; means positioned between said openings in said fitting and movable relative thereto for moving said actuator in response to a fluid pressure applied to said fitting, said means including two spherical members, one of said members positioned adjacent said actuator, a compressible pad separating said members and having a depression adjacent each of said members, said pad providing a pressure seal between said pad and said fitting whenever said pad is compressed between said members; a seat in said fitting for receiving said one member upon movement of said pressure responsive means to move said actuator, said seat and said one member providing a pressure seal; means at said second opening for applying a fluid pressure to urge said other member toward said one member.

6. A device responsive to fluid pressure for effecting mechanical movement of an actuator biased to oppose such movement comprising a hollow pressure fitting having first and second openings; an actuator mounted for axial movement in said first opening; means positioned between said openings in said fitting and movable relative thereto for moving said actuator in response to fluid pressure applied to said fitting, said means including two spherical members, one of said members contacting said actuator, a compressible pad separating said members and having a depression adjacent each of said members, said pad providing a pressure seal between said pad and said fitting whenever said pad is compressed between said members; a seat in said fitting for receiving said one member upon movement of said pressure responsive means to move said actuator, said seat and said one member providing a pressure seal; means carried by said pressure fitting and adjustable with respect to said fitting for positioning said pressure responsive means in said fitting, said positioning means contacting the other of said members; and means at said second opening for applying a fluid pressure to urge said other member toward said one member.

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