May 26, 1936. G. E. PRAY 2,041,726

FLUID CONTROLLED SWITCH

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FIG. 1.

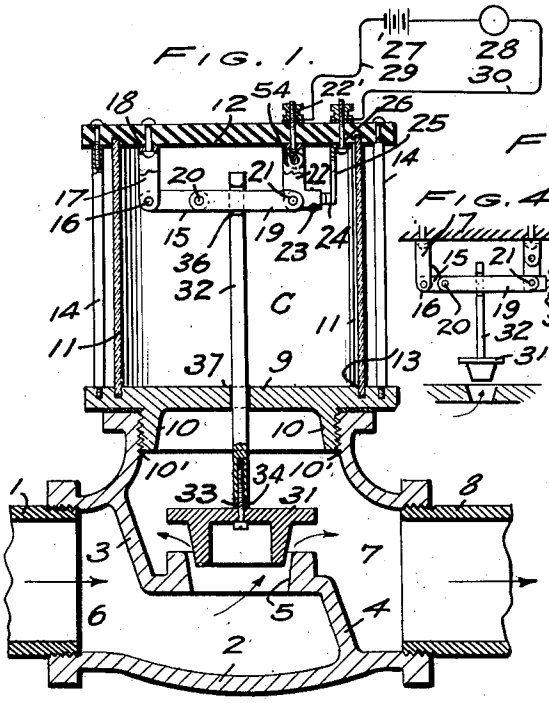


FIG. 2.

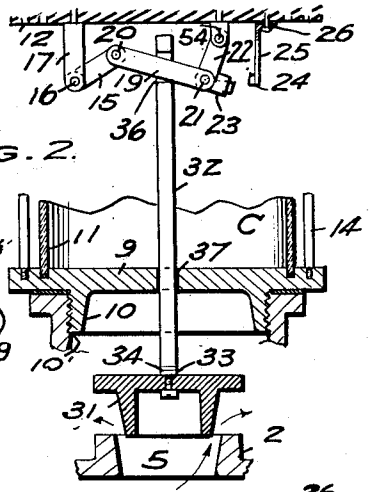


FIG. 4.



FIG. 3.

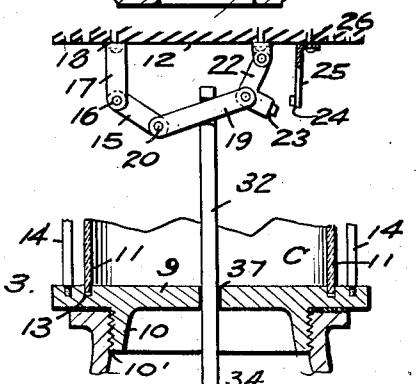


FIG. 5.

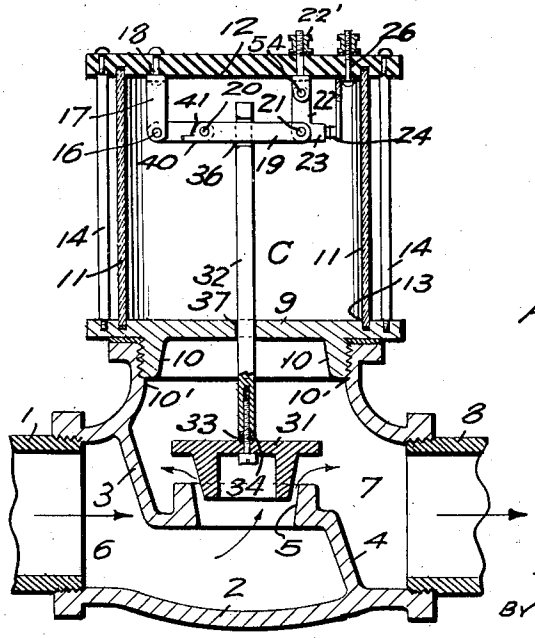
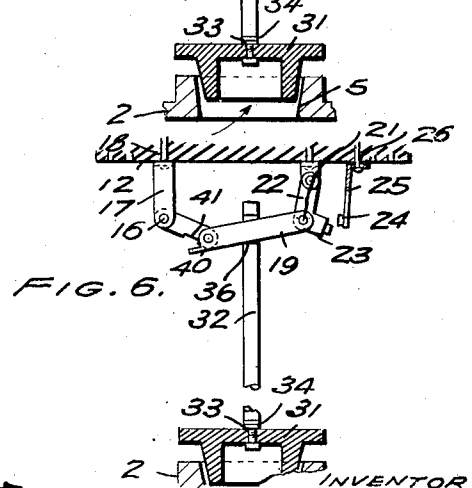


FIG. 6.



INVENTOR
GEORGE E. PRAY
Francis H. Vandenwerker
BY Chas. R. Rowe

ATTORNEYS

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FIG. 7.

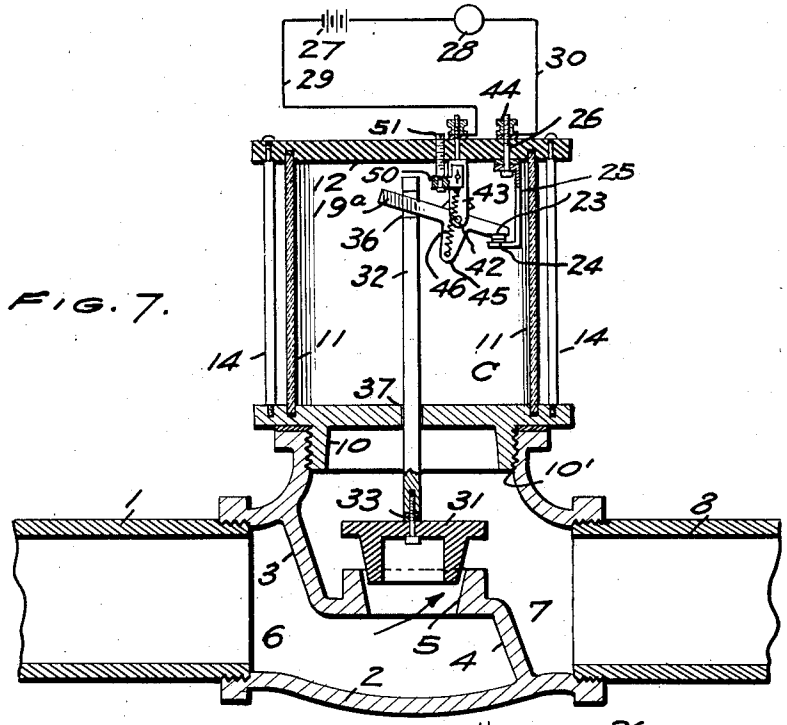
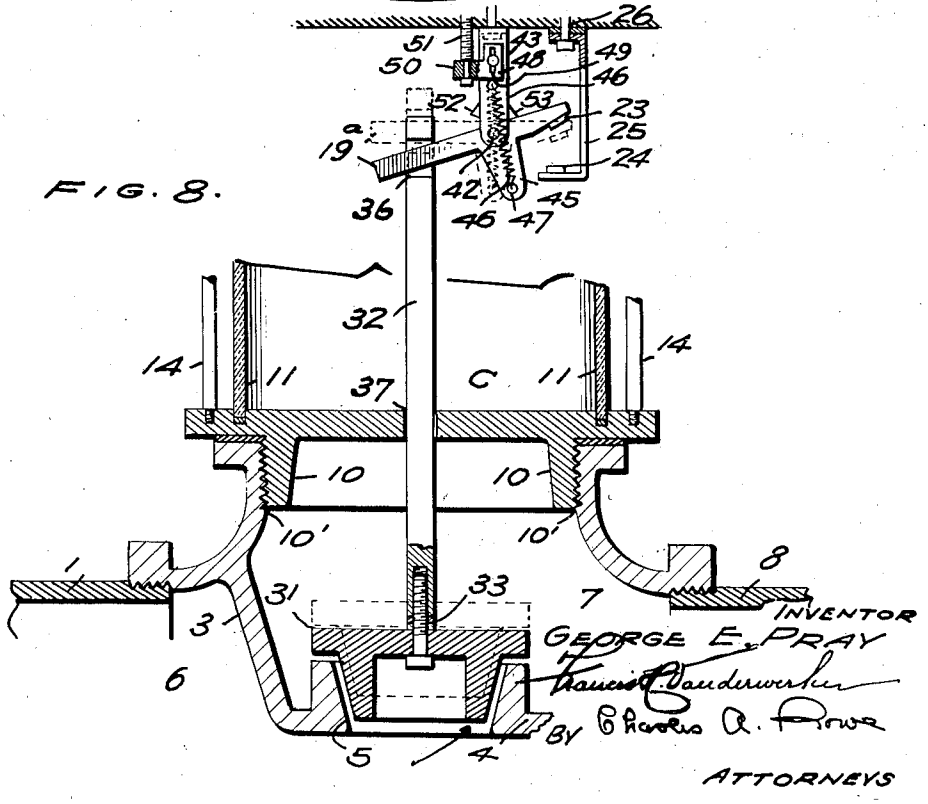



FIG. 8.




INVENTOR
GEORGE E. PRAY
BY Francis A. Sanderson
Charles A. Howe
ATTORNEYS

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## FLUID CONTROLLED SWITCH

George E. Pray, Fort Monmouth, Oceanport, N. J.

Application August 17, 1932, Serial No. 629,161

4 Claims. (Cl. 200—81)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to a means for controlling circuits and proposes a circuit controlling mechanism operatively responsive to the flow of a fluid.

An object of the invention is to provide a circuit control mechanism dependent essentially for its effective operation upon the gradient factor, or change in the rate of fluid flow, and independently of static pressure.

The invention provides a protective device, which will operate between certain required limits of fluid or liquid flow, to control an electric circuit when either of these limits is reached.

A mechanism embodying the present invention, while capable of sensitive adjustment, contemplates as an important feature a period of delay or retardation in the circuit controlling action of the system. Thus, its circuit controlling action is insensitive to slight variations of fluid flow. Moreover, avoidance of sparking in the switching action is inherent in the present invention.

A device constructed in accordance with the present invention is substantially automatic in action and constantly resets itself. In its circuit controlling action, it is equally sensitive to either of the desired operative limits of flow, irrespective of fluid pressure.

Such a device is applicable to cooling systems, regardless of the nature of the circulating medium, such as systems used with high-power rectifier circuits, and radio vacuum tubes; or high-power radio transmitters, or to any cooling system employing a flow of liquid whether water, oil, alcohol or other similar medium. While particularly advantageous for use as a flow relay in connection with radio transmitter cooling systems, it is adaptable to a wide range of useful applications.

These and other objects are attained by certain embodiments of the invention illustrated by way of example in the accompanying drawings, in which:

Fig. 1 is a sectional elevation of one form or embodiment of the invention, the electrical contact elements being shown in circuit closing position;

Figs. 2 and 3 are similar views of the same form, the contact elements being shown in open circuit position at upper and lower limits, respectively;

Fig. 4 is a sectional detail of the same form showing an alternative arrangement of switch contacts;

Fig. 5 is a sectional elevation of a slight modification of the lever system based on the form shown in Figures 1 to 3;

Fig. 6 is a sectional detail of the same form shown in Fig. 5, wherein the circuit contacts are in open position;

Fig. 7 is a sectional elevation of a further modification, the contact elements being in circuit closed position; and

Fig. 8 is a partial section of the form shown in Fig. 7, the contact elements being in open position.

It will be understood that this invention may be employed in connection with any fluid circulating system, irrespective of the nature of the circulating medium.

Referring to the drawings, the circulating medium flowing from a source of supply (not shown) is fed through inlet pipe 1, suitably connected to a casing 2, formed by way of example as a valve casing, and having web portions 3 and 4 integral with the casing and serving to define an orifice 5, which orifice may take the form of a valve seat. A movable valve element or flow responsive device, hereinafter more fully described, is disposed in operative relation with the said orifice, which is open more or less during the normal operation of the mechanism to the end that the valve element may be sensitive to variations in the rate of fluid flow, independently of fluid pressure within the system.

Moving in the direction indicated by the arrows, the circulating medium flows by way of passage 6, through orifice 5 to passage 7, and thence to discharge pipe 8, with which the casing 2 communicates by means of suitable fluid-tight connection. The device also comprises an upper chamber C having its base 9 provided with a threaded collar 10 for attachment to an interiorly threaded collar opening into valve casing 2 at 10'. The side walls 11 of chamber C are preferably formed of glass or other transparent material to permit inspection of the mechanism housed in said chamber. The head 12 of the chamber as here shown is composed of insulating material. The side walls 11 are shown fitted into grooves 13 in the head 12 and base 9, and the parts of the chamber are bolted in assembled relation by means of tie rods 14 or the like.

The circuit controlling mechanism comprises a lever system, including an electric switching means, all housed in chamber C in the present instance, and an element responsive to fluid flow

operatively disposed in the valve casing, said element being operatively coupled to the lever system by means of a connecting rod or plunger.

Referring more particularly to the embodiment shown in Figs. 1 to 5, the said lever system comprises a toggle arm 15 pivotally connected as at 16 to a stud 17, rigidly secured to insulated head 12 as at 18. The lever system also includes another toggle arm 19 pivotally connected to arm 15 as at 20, said arm 19 being pivotally secured to fulcrum point 21 of a link 22, which is pivotally connected at 54 to a terminal stud 22', which stud is attached to insulated head 12 and also functions as an electric circuit connection. A portion of toggle arm 19 extends beyond the fulcrum point of connection and terminates in one contact element 23 of a switch means. The other contact element of said switch is formed as at 24 on a stud or terminal 25, which may be of any conducting material such as phosphor bronze, and is attached to the insulated head 12 as at 26. A simple series circuit is shown by way of example including a current source as 27, and comprising some form of signal which may be either an audible alarm or a visual indicator as 28, and circuit leads 29 and 30 running to the aforesaid terminals.

The flow responsive means is shown in the form of a valve element 31, provided with a stem or rod 32, to which it is suitably secured by a screw connection as at 33, and washers as at 34 may be employed, if desired, to provide a means of extending or adjusting the length of said rod. Said rod is loosely coupled or linked to toggle arm 19 of the lever system by a slotted connection as at 36, which serves as one method to permit a period of lost motion or retarded action in the response of the valve element 31 to flow of fluid. The rod 32 has operative movement in the manner of a piston rod through a perforation 37 in the base 9.

In operation, the movable valve element 31 is so positioned as to be influenced by the flow impulse or gradient factor of the fluid medium, and independently of hydrostatic pressure inherent in the circulating system. Assuming for example in the usual case where a liquid is the circulating medium, the element 31 in its normal operation in accordance with the present invention is so placed as always to be suspended more or less out of contact with the seat or orifice 5, and, therefore, such hydrostatic pressure as may be inherent in the system is equalized or balanced on all sides of said element 31. Thus said element is responsive only to the flow impulse of the circulating medium, and independently of pressure.

Referring to Figs. 1 to 3, the embodiment there shown will perform the functions of a protective device, which operates between certain required limits of flow to interrupt an electrical circuit when either of these limits has been reached. In Fig. 1 the parts occupy a position where the flow of fluid is assumed to be at a desired medium rate or value, in which case the contact elements are in circuit closing position. Depending upon variations in the rate of flow, if the flow increases beyond a critical value, the parts take up a position as shown in Fig. 2 and the flow responsive element 31, communicating movement through rod 32 to the lever system, causes the contacts to open and break the circuit. Similarly, if the flow falls below a critical value, the parts take up a position as shown in Fig. 3, and again the contacts are broken to open the circuit, in such case the element 31 dropping downwardly and communicating such movement through the rod 32 to the lever system.

The embodiment shown in Figs. 1 to 3 readily lends itself to an alternative form whereby the contacts are in open circuit position when the fluid flow is at a desired or normal level as will be clear by reference to Fig. 4. When the flow exceeds a desired level the toggle arm 19 of the lever system is carried upwardly by the movement of the flow responsive element 31 and its rod connection 32, and the circuit is completed through the movable contact at the end of arm 19 and the lower fixed contact element 38. When the flow drops below a desired level, the movement of the element 31 is downwardly, carrying toggle arm 19 in the same direction through action of the connecting rod and the movable contact element completes the circuit through upper fixed contact element 39.

A device embodying the present invention may be adapted to open the circuit only when the flow drops below a desired or critical value. A slightly modified form of device for this purpose is shown in Figs. 5 and 6, wherein the toggle arm 19 is provided with a projection 40 which co-operates with a recess 41 in arm 15. Thus when the fluid flow is proceeding at its normal or desired value, the parts are in the position shown in Fig. 5, the upper movement of the lever system being limited by the locking action of projection 40 in shoulder recess 41, the contact elements being in circuit closing position. When the fluid flow falls below the desired value the downward movement of valve element 31 and its rod connection with the lever system opens the circuit controlling contacts.

In the modification shown in Figs. 7 and 8, the circuit controlling contacts close only when the flow exceeds a desired value, and open only when the flow decreases below the desired value. Means is also provided to produce a snap action of the switch means when the fluid responsive element goes above or below predetermined limits of movement. In said embodiment, the lever system comprises a main arm 19a having one portion coupled as in the other forms to rod 32 and having the same slotted link coupling with said rod to provide a period of lost motion or retarded action as in other forms. Arm 19a is pivotally connected at fulcrum point 42 to stud 43, which stud is of electrically conductive material and is secured to the insulated head in electrical communication with terminal 44. The arm 19a which is also a conductor of electricity has an extension terminating in contact element 23 of the switch means. The other contact element 24 of the switch is formed on stud 25, attached to the insulated head 12 at 26 and protrudes above the head to serve as a terminal connection. The structure just described constitutes a switch means which functions in the same manner as in other forms of the device. The lever arm 19a has a member 45 extending downwardly from the dead center or fulcrum point 42. To provide for snap action, means such as spring 46 is attached at 47 to the member 45 and at its opposite end is attached to adjusting plate 48, adjustably secured to stud 43 by slotted connection 49. A lug 50 secured to said plate 48 operates with adjusting screw 51 to provide for adjustment of the tension of spring 46. Additional stop shoulders 52 and 53 are provided on either side of stud 43 to limit the movement of lever arm 19a when the circuit contacts are

either in open or closed position. In operation, the contacts **23** and **24** are in circuit closing position when the flow exceeds a desired or critical value, as shown in Fig. 7. When the flow falls below the desired value, the contacts are in open position breaking the circuit, as shown in Fig. 8. When the flow is proceeding at a correct or desired value, the parts are in the position indicated by the dotted lines in Fig. 8, and the contacts are also open under this condition.

Changes and modifications are contemplated within the scope of the appended claims:

I claim:

1. An electric switch circuit control mechanism, comprising an electric switch and a lever system for actuating the switch; means responsive to fluid flow comprising a valve structure and including interior web portions formed to define an orifice for directing the flow of a circulating fluid; a movable element of said valve having a tapered formation; and means for locating said element in normal operative relation to said orifice whereby said element is supported and operated by the flow of fluid through said orifice, said means including an adjustable coupling for coordinating said element and lever system to control the operation of said system in response to maximum and minimum predetermined variations in the rate of fluid flow.

2. An electric switch circuit controlling mechanism of the character described, comprising an electric switch; a lever system for actuating the switch; means comprising an element normally supported by flow of a circulating fluid and responsive to variations of flow for controlling the operation of the lever system at maximum and minimum predetermined flow levels; and means for coupling said element and lever system, and including contact elements operative with the switch, whereby said switch is thrown into circuit opening position when the rate of flow is either above or below a desired level.

3. An electric switch particularly adapted to be controlled by a fluid comprising a lever system for actuating said switch, means responsive to fluid flow comprising a valve structure and including interior web portions formed to define an orifice for directing the flow of a circulating fluid, a movable element for said valve, means for locating said element in normal operative suspension in said fluid and in normal operative relation to said orifice so that said movable element is sensitive to variations in the rate of fluid flow and independent of fluid pressure within said system, an upper chamber located above said orifice, said chamber comprising a transparent wall and an insulated cover, said lever system supported from said insulated cover and electrical contacts associated with said lever system, a movable rod co-operating with said lever system and said movable element for controlling the opening and closing of said contacts when the rate of fluid flow is either above or below a desired level.

4. An electric switch particularly adapted to be controlled by a fluid comprising a lever system for actuating said switch, means responsive to fluid flow comprising a valve structure and including interior web portions formed to define an orifice for directing the flow of a circulating fluid, a movable element for said valve, means for locating said element in normal operative suspension in said fluid and in normal operative relation to said orifice so that said movable element is sensitive to variations in the rate of fluid flow and independent of fluid pressure within said system, an upper chamber located above said orifice, said chamber comprising a transparent wall and an insulated cover secured to said valve structure by a plurality of tie rods, said lever system supported from said insulated cover and electrical contacts associated with said lever system, a movable rod co-operating with said lever system and said movable element for controlling the opening and closing of said contacts when the rate of fluid flow is either above or below a desired level.

GEORGE E. PRAY.