Nov. 3, 1942. F. H. HOPKINS 2,300,895

PRESSURE CONTROLLED INSTRUMENT

Filed Dec. 22, 1941 3 Sheets-Sheet 1

Fig. 1

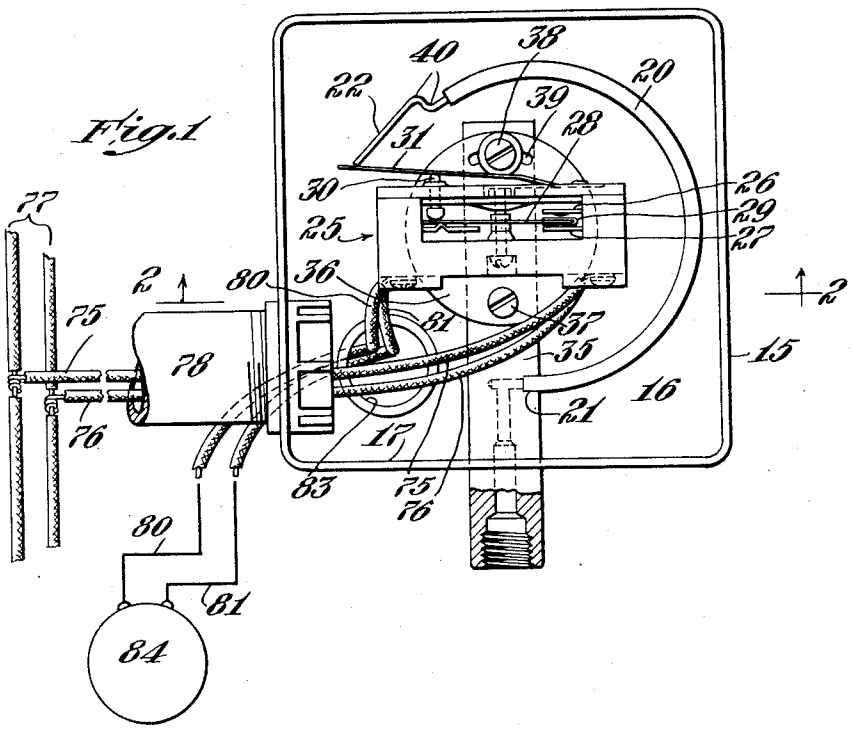


Fig. 2

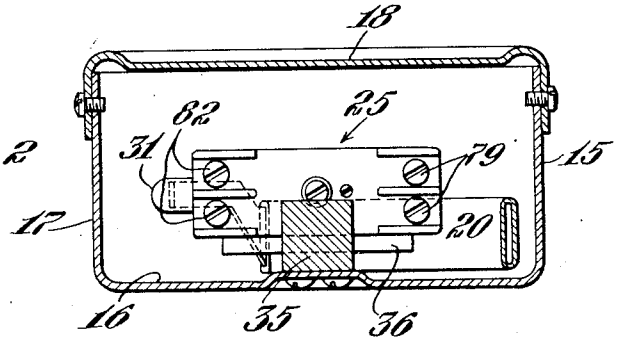
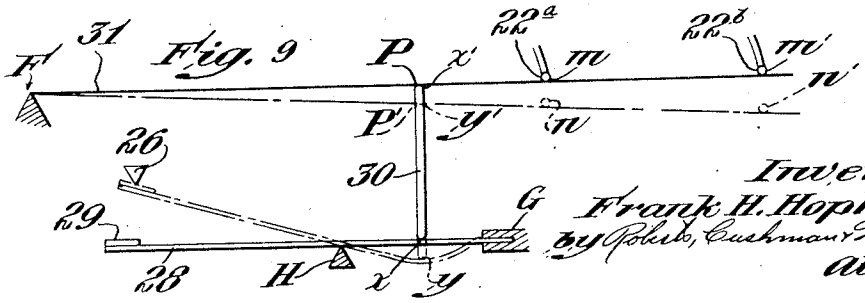


Fig. 9



Inventor
Frank H. Hopkins
by Pollard, Cushman & Woodbury
Att'ys.

Nov. 3, 1942. F. H. HOPKINS 2,300,895

PRESSURE CONTROLLED INSTRUMENT

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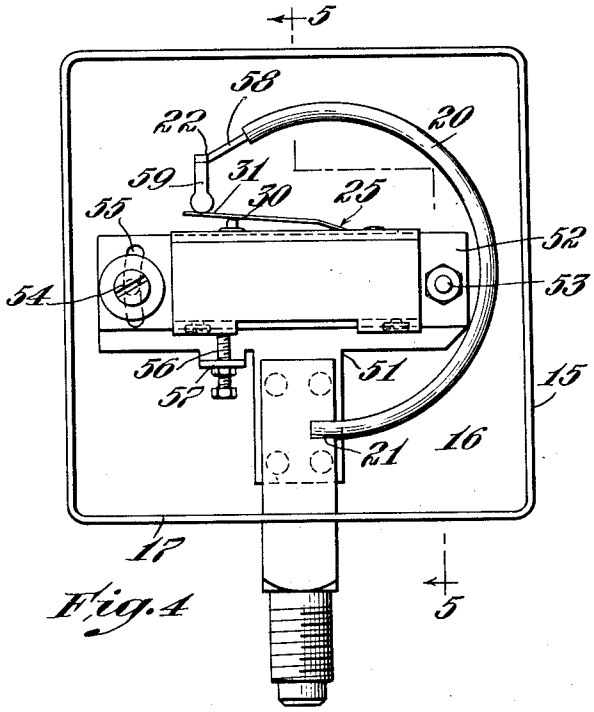


Fig. 4

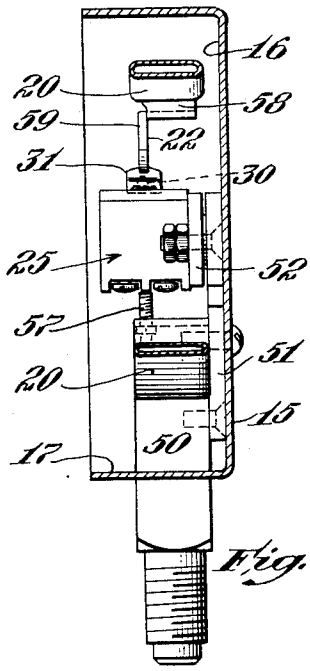


Fig. 5

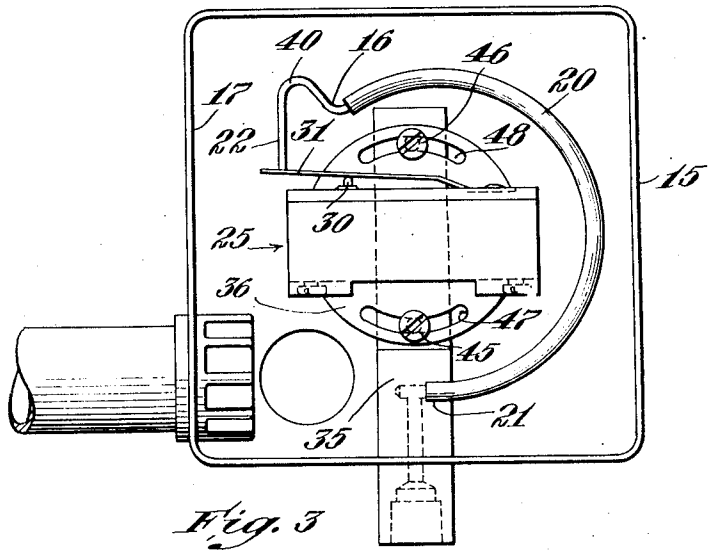


Fig. 3

Inventor
Frank H. Hopkins
by Roberts, Cushman & Woodbury
Attys.

Nov. 3, 1942. F. H. HOPKINS 2,300,895

PRESSURE CONTROLLED INSTRUMENT

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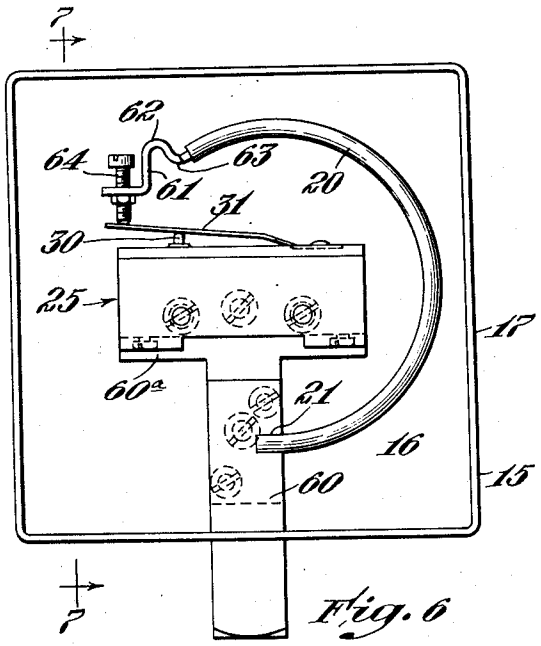


Fig. 6

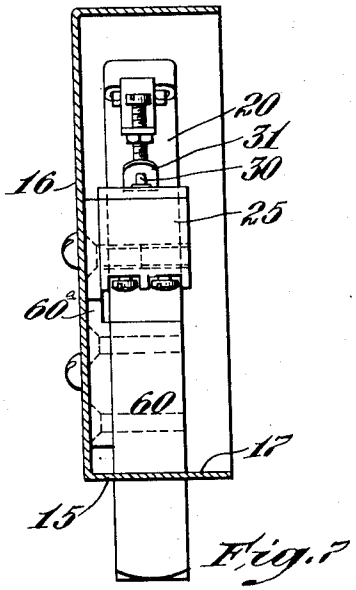


Fig. 7

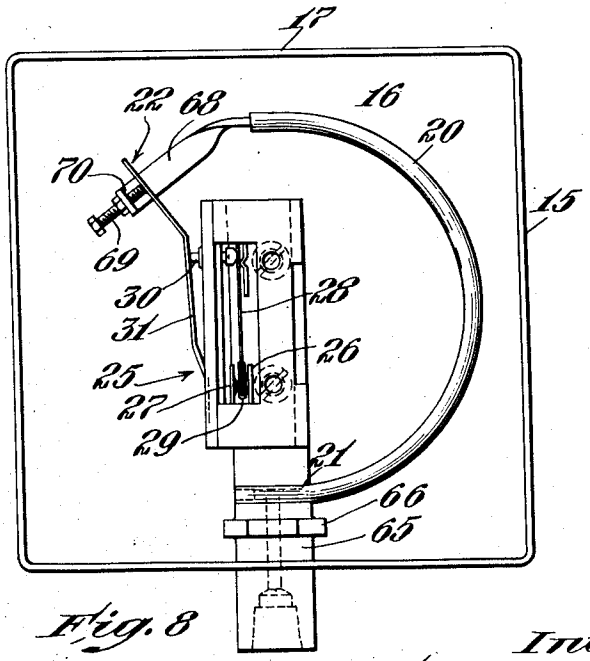


Fig. 8

Inventor
Frank H. Hopkins
by Pollitz, Cushman & Nordberg
Attys.

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UNITED STATES PATENT OFFICE

2,300,895

PRESSURE CONTROLLED INSTRUMENT

Frank H. Hopkins, Fairfield, Conn., assignor to Manning, Maxwell & Moore, Incorporated, New York, N. Y., a corporation of New Jersey

Application December 22, 1941, Serial No. 423,942

9 Claims. (Cl. 200—81)

This invention relates to an improvement in a pressure controlled instrument, and more particularly to an instrument of the type which comprises a snap switch and Bourdon tube, the latter acting upon the former in response to variances in pressure, temperature or the like to open or close an electrical circuit.

One purpose for such an instrument is to control the operation of a domestic water supply system within minimum and maximum pressure limits, e. g., twenty and forty pounds, respectively. When the pressure in the system falls to the minimum limit (20 pounds), the Bourdon tube acts to close a switch by which a pump is actuated and holds the switch closed until the pressure in the line has reached to the upper limit (40 pounds) at which time the switch is opened and the pump circuit broken.

The primary object of this invention is to regulate the operation of the system so that the switch contacts are closed when a predetermined minimum pressure is reached and are held closed until the predetermined maximum pressure is attained. This requires two controls, first, that which determines the point at which the switch contacts are closed, and second, that which determines the length of the range of pressure or pressure differential during which the switch should remain closed.

More specifically in the illustrated embodiments which will be described in detail hereinbelow, the first control is attained by initially setting the coacting switch and tube elements a predetermined distance apart; the second control is attained by so designing the coacting element of the Bourdon tube (hereinafter referred to as a finger) that the period of its effective coaction with the switch element may be altered as desired to adjust the "gap," i. e., the period during which the switch contacts remain closed.

These and other objects of the invention will be apparent from an examination of the following description of several embodiments of the invention and of the accompanying drawings which illustrate such embodiments and in which

Fig. 1 is a face view of an instrument embodying one form of this invention, the cover thereof having been removed and the switch being shown in section with the switch open;

Fig. 2 is a sectional view with the cover in place, taken along the line 2—2 of Fig. 1;

Fig. 3 is a view, similar to Fig. 1, of an instrument embodying a second form of the invention, the switch being in elevation;

Fig. 4 is a view, similar to Fig. 3, of an instrument embodying a third form of the invention;

Fig. 5 is a sectional view taken along the line 5—5 in Fig. 4;

Fig. 6 is a front elevation of an instrument embodying a fourth form of the invention, the cover being omitted;

Fig. 7 is a sectional view taken along the line 7—7 in Fig. 6;

Fig. 8 is a front elevation of an instrument embodying a fifth form of the invention, the cover being omitted; and

Fig. 9 is a diagrammatic view illustrating the gap control feature of this invention.

All the instruments illustrated in the drawings are of the same general type, comprising a casing 15, a Bourdon tube 20, and a switch 25 embraced within the arc of the tube 20. The casing 15 comprises a back wall 16 (Fig. 2) side walls 17, and a removable cover 18. The Bourdon tube 20 is of the usual well known type fixed at its stationary end in a socket 21 in a socket member mounted within the casing 15 and provided at its free end with an adjustable switch-actuating finger 22. The switch 25 may be of any desired construction. The switch herein shown for purposes of illustration is of the kind known as a "Mu" switch made by the Mu Switch Corporation, of Boston, Massachusetts. This switch comprises a pair of spaced contacts 26 and 27, a leaf spring 28 carrying at one end a tip 29 which normally engages the contact 27, a depressible pin 30 by which the spring 28 may be flexed to bring the tip 29 into engagement with the contact 26, and an elongate arm 31 flexibly fulcrummed at one end and with its free end portion overlying the tip of the pin 30. A switch of this type is set forth in United States Patent No. 1,780,758, dated November 4, 1930. The internal construction and operation of the switch forms no part of the present invention, it merely being essential that the switch include a depressible actuator such as the pin 30 and an elongate arm pivoted or flexibly fulcrummed at one end, which like the arm 31 rests against the actuator so that it will depress the latter in response to pressure applied to the arm.

Figs. 1 and 2 show an instrument wherein the socket 21, in which the stationary end of the tube 20 is fixed, is provided in a socket member 35 which enters the casing 15 through an opening in one side wall and is secured to the back wall 16. The forward portion of the socket member 35 is cut away and upon it a plate 36 is secured by screws 37 and 38. The screw 37 extends through a hole (not shown) in the plate, and the screw 38 extends through an arcuate slot 39 in the plate. Thus the screw 37 serves as a pivot about which the plate may be swung between the limits set by the slot 39—being secured in any desired position of adjustment by the screw 38. The switch 25 is rigidly mounted upon the plate 36 for movement therewith. The finger 22 is preferably of stiffly ply-

able material and is provided as shown with bends at 40 and its tip constiutes a contact element designed to engage that portion of arm 31 which lies to the left of pin 30 (Fig. 1).

The instrument shown in Fig. 3 differs structurally from that just described in that both the screws 45 and 46 by which the plate is secured to the socket member 35 pass through arcuate slots 47 and 48 so that the positioning movement of the plate is one of rotation. The reference characters used in Figs. 1 and 2 are employed in Fig. 3 to designate common elements of which further description is believed unnecessary.

In the instrument shown in Figs. 4 and 5, the block 50 constituting the socket member rests upon and is fastened to a T-shaped base 51. A plate 52, on which the switch 25 is rigidly mounted, is secured to the base 51, so as to extend substantially at right angles to the block 50, by screws 53 and 54. The screw 54 passes through an arcuate slot 55 in the plate so that the latter can be adjusted about the screw 53 through an arc limited by the slot 55. A set screw 56 carried by a lug 57 projecting forwardly from the plate 52 bears against the switch 25 and provides for accurate adjustment of the plate 52 and switch 25. The finger 22 comprises a tongue 58 and a post 59 substantially at right angles to the tongue and having a ball-shaped tip for contact with arm 31.

Figs. 6 and 7 illustrate an instrument in which the block or socket member 60 and the switch 25 are both rigidly secured to a T-shaped base 60a mounted on the back wall 16 of the casing. The switch-actuating finger carried by the free end of the Bourdon tube 20 comprises a tongue 61 formed with suitable bends 62 and 63 and a set screw 64, the tip of which coacts with the arm 31 of the switch.

In the instrument shown in Fig. 8 the block or socket member 65 passes through an opening in a forwardly directed lug 66 forming part of a plate 67 which engages the back wall of the casing and which supports the switch 25. The switch-actuating finger carried by the free end of the tube 20 comprises a flat strip 68 of flexible metal and a set screw 69 which is carried by a forwardly directed lug 70 at the tip of the strip 68, the screw 69 engaging the arm 31 of the switch 25.

From the above description of the various embodiments, it will be noted that in each embodiment the status of the switch 25 is controlled by the Bourdon tube 20 which responds in the usual well-known manner to changes in pressure in the system under control, being contracted in radius when the pressure drops and expanded when the pressure rises.

Each embodiment includes means by which the relation of the switch 25 and the Bourdon tube 20 can be set so that the switch will be closed when the pressure in the system has fallen to a predetermined minimum. In the instruments shown in Figs. 1 to 5, inclusive, the switch 25 is rigidly mounted upon a plate which is adjustable within the casing to determine the initial distance between the tip or contact element of the actuating finger 22 carried by the Bourdon tube 20 and the arm 31 of the switch. In the instrument shown in Figs. 6 and 7, the set screw 64 which forms part of the actuating finger 22 can be advanced toward or retracted from the arm 31 of the switch, and the same is true of the set screw 69 of the instrument shown in Fig. 8.

Each embodiment also includes means for varying the gap between the opening and closing of the switch 25, that is to say, the pressure differential between the closing and opening points. To this end, the finger 22, as above suggested, is preferably stiffly plyable so that it may be bent to vary the location of its tip or contact element longitudinally of the switch-actuating arm 31.

Fig. 9 is a diagram illustrative of the utility of moving the point of contact of the actuator finger 22 longitudinally along the arm 31 toward or from the switch pin 30. Thus in Fig. 9 the arm 31 is diagrammatically indicated as a rigid lever fulcrumed at F. The upper end of the switch pin 30 contacts the lever 31 at the point P and its lower end contacts the switch spring 28 at a point between the fixed supports G and H. The position of the switch spring 28 in closing the switch between contacts 26 and 29 is indicated in dotted lines, it being noted that to provide the switch-closing flexure of the spring 28 the lower end of the pin 30 must move through the vertical distance $x—y$. The upper end of the pin must likewise move through the distance $x'—y'$. Thus the point of contact of the upper end of the pin 30 with the arm 31 must always move between the points P and P' in closing and opening the switch.

If now it be considered that the actuating arm carried by the Bourdon tube contacts the lever 31 at the point 22^a, it will be clear that this point must move a distance $m—n$ in order to obtain the necessary action of the pin 30 for closing or opening the switch. On the other hand, if the actuator arm carried by the Bourdon tube were so located as to contact the lever 31 at the point 22^b then it would be obliged to move through the distance $m'—n'$ in closing or opening the switch, and it is clear that the distance $m'—n'$ is greater than the distance $m—n$ in proportion to the distances between the points 22^b and 22^a and the point F. Thus, for example, if the distance $m—n$ corresponds to a change of sixteen pounds in the pressure within the Bourdon tube then the distance $m'—n'$ might for example represent a pressure change of approximately twenty-three pounds. It will thus be clear that by adjusting the finger 22 so that its tip engages the arm 31 at different distances from the point P, the pressure differential through which the switch remains closed may be varied at will.

In each embodiment the finger 22 is so formed and of such material that it can be bent and its outer end moved toward and from the tube into any desired position, such, for example, as the positions 22^a and 22^b (Fig. 9).

The switch in each embodiment is mounted in the electric control circuit, preferably as shown in Fig. 1. The leads 75, 76 from the main supply line 77 enter the casing 15 through a pipe 78 and are removably attached by screws 79 to the one end of the switch 25. Leads 80, 81 removably attached by screws 82 to the other end of the switch 25 pass from the casing 15 through a pipe 83 to the diagrammatically shown pump motor 84.

While several embodiments of this invention have been shown and described in detail it will be understood that the invention is not limited thereto and that other embodiments of the invention may be made without departing from the spirit and scope thereof as set forth in the following claims.

I claim:

1. An instrument of the class described com-

prising a Bourdon tube, an electrical switch including a movable elongate actuator, and means for transmitting movement from the tube to the actuator, said motion-transmitting means including a movable contact element supported by the tip of the tube, said contact element being capable of independent adjustment relatively to the actuator in directions transverse and longitudinally, respectively, of the actuator thereby not only to determine the pressure at which the switch will close but also to determine the pressure range within which the switch will remain closed.

2. An instrument of the class described comprising a Bourdon tube, an electrical switch including a movable actuator, and means for transmitting movement from the tube to the actuator, said motion-transmitting means including a contact element supported by the tip of the tube, the contact element being capable of independent adjustment in directions substantially at right angles to each other with reference to the actuator.

3. An instrument of the class described comprising a case, a Bourdon tube mounted within said case, a socket in which the stationary end of the tube is fixed, a snap switch within the case and including an elongate lever arm which, in response to pressure variation actuates said switch, a plate mounted in said case, means by which said switch is rigidly secured to said plate, and a finger attached to the movable free end of the tube and adapted in response to the movement of the tube to apply pressure to the arm and thereby actuate the switch, the finger being stiffly pliable thereby to permit it to be bent to vary the distance between the pressure applying point and the lever fulcrum, the switch supporting plate being adjustable to vary the initial distance between the arm and the finger and thus set the switch for actuation at a predetermined pressure.

4. An instrument of the class described comprising a case, a Bourdon tube mounted within said case, means providing a socket in which the stationary end of the tube is fixed, a snap switch within the case including an elongated lever arm which, in response to pressure, actuates said switch, and a finger attached to the movable free end of the tube and having a lever contacting element which is adapted in response to the movement of the tube to apply pressure to the arm and thereby actuate the switch, the contact element of the finger being adjustable toward and from the lever arm thereby to determine the pressure at which contact is initially made, the finger being so constructed and arranged that the contact element is movable relative to the lever arm in a direction longitudinally of the latter thereby to vary the point at which the contact element engages the arm and thus determine the pressure differential between the closing and opening of the switch.

5. An instrument of the class described comprising a case, a Bourdon tube mounted within said case, means providing a socket in which the stationary end of the tube is fixed, a snap switch within the case and including an elongate lever arm which in response to pressure actuates said switch, a plate mounted in said case, means by which said switch is rigidly secured to said plate and a finger attached to the movable free end of the tube and adapted in response to the movement of the tube to apply pressure to the arm and actuate the switch, the switch supporting plate being adjustable to vary the distance between the arm and the finger and thus set the switch for actuation at a predetermined pressure, and the finger being movable longitudinally of the arm to vary the point at which it contacts with the arm and thereby to predetermine the pressure differential between closing and opening of the switch.

6. An instrument of the class described comprising a case, a Bourdon tube mounted within said case, means providing a socket in which the stationary end of the tube is fixed, a snap switch within the case, the switch including a depressible pin by which the switch contacts are closed, an elongate movable lever arm which rests upon one end of the pin and which, in response to pressure applied thereto, depresses the pin to close the switch contacts, and a finger attached to the movable free end of the tube and having a tip which is adapted to bear upon the arm and apply pressure thereto as the tube moves in one direction said finger being of stiffly pliable material whereby it may be bent to shift its tip longitudinally of the lever arm.

7. An instrument of the class described comprising a case, a Bourdon tube mounted within said case, means providing a socket in which the stationary end of the tube is fixed, a snap switch within the case, the switch including a depressible pin by which the switch contacts are closed and an elongate lever arm which rests upon one end of the pin and which, in response to pressure applied thereto, depresses the pin to close the switch contacts, and an actuating finger attached to the movable free end of the tube and adapted to bear upon the arm and apply pressure thereto as the tube moves in one direction, the finger being adjustable to vary the point, longitudinally of the arm, at which it contacts the arm thereby to determine the range of pressure between closing and opening the switch.

8. An instrument of the class described comprising a Bourdon tube, an electrical switch including a movable actuator, and means for transmitting movement from the tube to the actuator, said motion-transmitting means including a finger fixed at one end to the tube tip and having a contact element at its other end engageable with the actuator, said finger being stiffly pliable thereby to permit the initial position of the contact element relative to the actuator to be varied.

9. An instrument of the class described comprising a Bourdon tube, an electrical switch including a movable actuator, and means for transmitting movement from the tube to the actuator, said motion-transmitting means including a finger fixed at one end to the tube tip, said finger having a screw-threaded aperture near its other end and an adjustable screw disposed in said aperture and constituting a contact element for engagement with the actuator, the axial adjustment of the screw being effective to determine the initial pressure at which the switch shall close, the finger being stiffly pliable whereby the contact screw may be moved bodily in a direction substantially perpendicular to its axis thereby to determine the range of pressure within which the switch will remain closed.

FRANK H. HOPKINS.