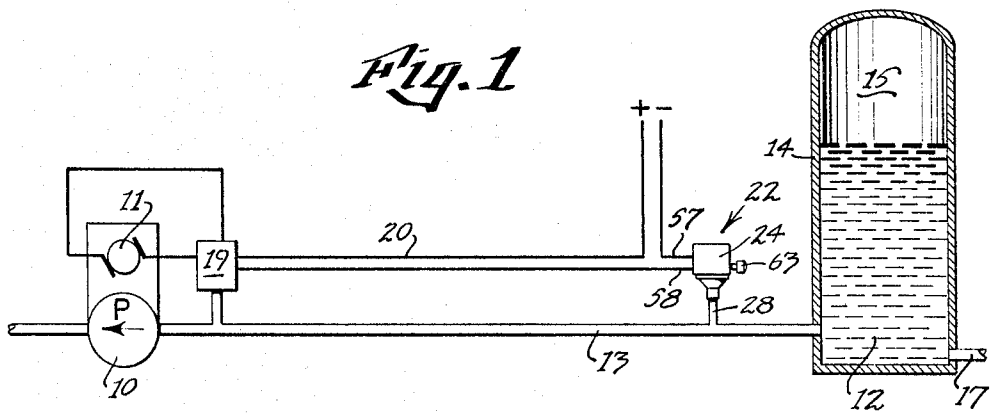
Oct. 11, 1966 H. L. SMITH 3,278,704

PRESSURE-ACTUATED CIRCUIT BREAKER

Filed Sept. 14, 1964 2 Sheets-Sheet 1

Fig. 1



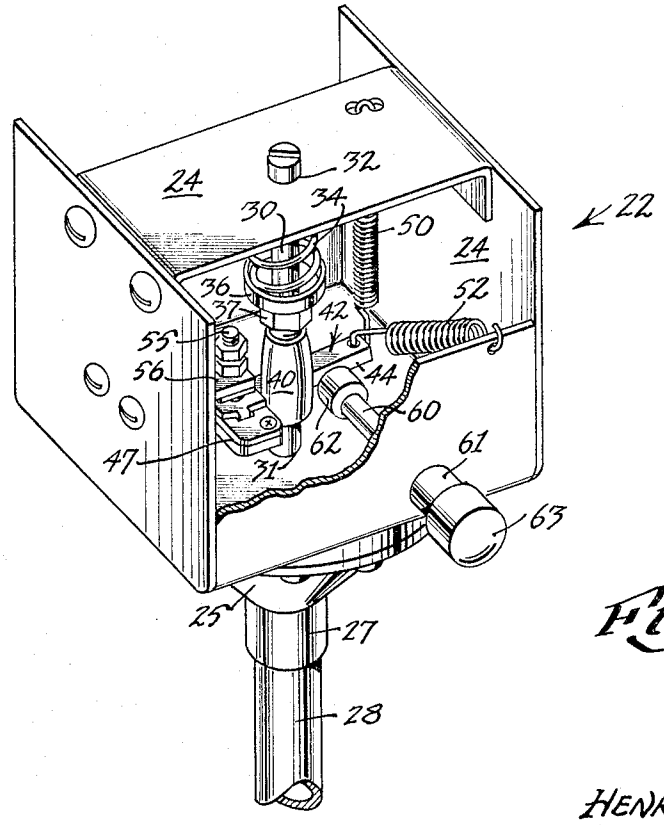


Fig. 2

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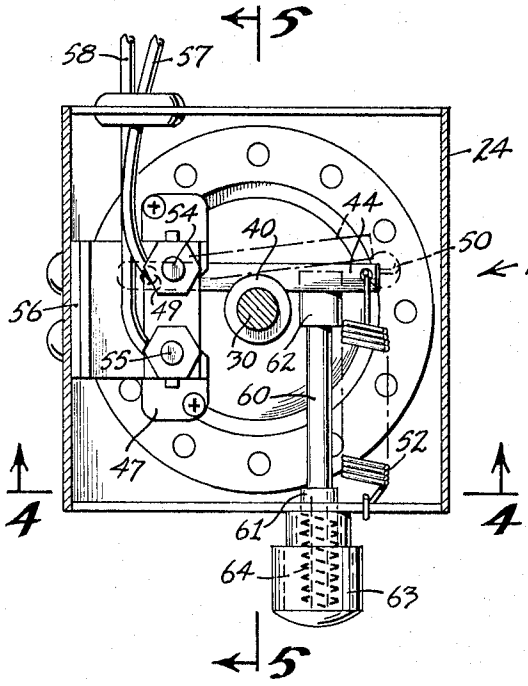

Fig. 3

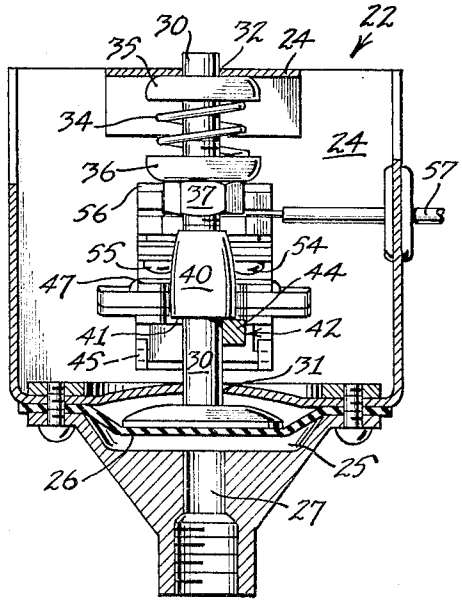

Fig. 5

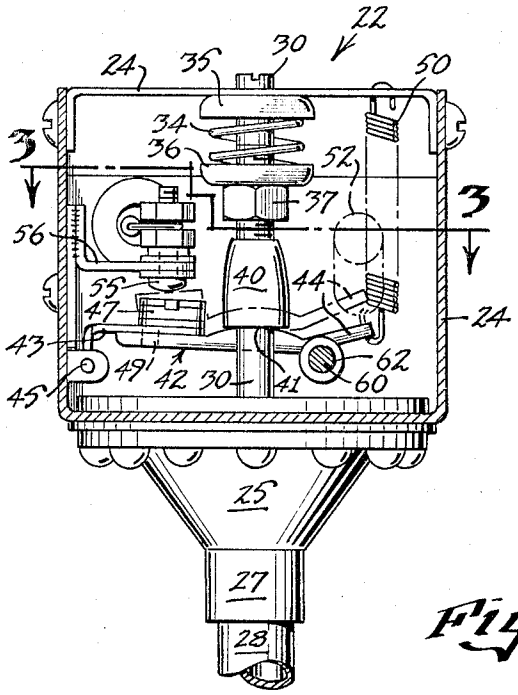

Fig. 4

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PRESSURE-ACTUATED CIRCUIT BREAKER

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4 Claims. (Cl. 200—83)

This invention relates to a pressure-actuated circuit breaker, and more particularly, to a circuit breaker for automatically opening an electrical circuit in a system controlling fluid flow, when the fluid pressure is reduced below a predetermined value.

One object of this invention is to provide a pressure-actuated circuit breaker particularly adapted for use in a water system for stopping the pump when the water pressure falls below a predetermined value.

Another object of this invention is to provide a pressure-actuated circuit breaker adapted to stop a pump before it loses its prime and before any water lubricated parts in the pump are damaged.

Another object of this invention is to provide a pressure-actuated circuit breaker adapted to open a circuit when the pressure in a fluid flow system is too low, and is further provided with manual means for re-closing the circuit even while the pressure is too low.

A further object of this invention is to provide a pressure-acuated circuit breaker for automatically stopping a pump when the water pressure drops below a predetermined value, and a manually operated device for restarting the pump at pressures below the predetermined value.

Further objects and advantages of the invention will be apparent from the following description taken in conjunction with the drawings, wherein:

FIG. 1 is a schematic view of the invention employed in a water system for controlling an electric pump;

FIG. 2 is a perspective view of the circuit breaker with parts broken away;

FIG. 3 is a section of the circuit breaker taken along the line 3—3 of FIG. 4;

FIG. 4 is a section taken along the line 4—4 of FIG. 3; and

FIG. 5 is a section taken along the line 5—5 of FIG 3.

Referring now to the drawings in more detail, FIG. 1 discloses a pump **10**, driven by an electric motor **11** for pumping water **12** through a line or pipe **13** into a tank **14**. The tank **14** is shown as having a head of compressed air **15** for exerting pressure upon the water **12**. As the water **12** is drawn off through the outlet line **17**, the pressure of the air **15** and the water **12** is gradually reduced. The pressure regulating control device **19** in the electrical circuit **20** is designed to stop the motor **11** and shut-off the pump **10** when the pressure in the line **13** exceeds a predetermined maximum value such as 40 p.s.i., and for starting the motor **11** to operate the pump **10** when the pressure in the line **13** drops below a predetermined minimum value, such as 20 p.s.i. The water system and controls thus far described are conventional, and widely used in rural areas where water is supplied to homes from wells.

It is the purpose of this invention to provide a novel pressure-actuated circut breaker **22** designed to open the electrical circuit **20** to stop the motor **11** and shut off the pump **10** when the pressure in the line **13** drops below the minimum operative pressure of the control device **19**. In a conventional system where the cut-in pressure is 20 p.s.i. and the cutout pressure is 40 p.s.i., the device **22** is designed preferably to open the circuit **20** when the pressure is reduced approximately 10 p.s.i. below the minimum cutting pressure of the device **19**. For example, it is conceivable that conditions could arise in the system where the pump **10** will continue to run indefinitely without building up the pressure in the tank **14**. Where the water is drawn from a well, the well could run dry with the pump **10** still operating until it is burned out and has damaged all its water lubricated parts. It is one of the purposes of this invention to prevent such occurrences by stopping the pump at these damaging low-water pressures.

As best disclosed in FIGS. 2–5, the circuit breaker **22** comprises a housing or casing **24** having a pressure chamber **25** in the bottom thereof. A flexible diaphraghm or membrane **26** is secured in the chamber **25** to expand upwardly upon an increase of pressure in the chamber **25** and to collapse downwardly upon a decrease in pressure. The chamber **25** communicates with the water line **13** through the passage **27** and the pipe **28**.

Firmly secured to and adapted to reciprocate axially up and down in the housing **24** is a stem **30**. The stem **30** is guided axially through a lower aperture or bearing **31** and an upper aperture or bearing **32** in the housing **24**.

A spring **34** is coiled around the upper portion of the stem **30** and extends between a pair of cupped spring retainers **35** and **36** through which the stem **30** is adapted to freely reciprocate. However, the upper spring retainer **35** is adapted to bear against the top wall of the casing **24** and the bottom retainer **36** is adapted to bear against a nut threadedly engaging a portion of the stem **30** for adjustment of the strength of the spring **34**.

Spaced below the adjusting nut **37** is an enlarged annular cam or shoulder **40**, fixed to and coaxial with the stem **30**, and having a slightly greater diameter. The shoulder **40** has a flat bottom surface **41** adapted to operatively engage and actuate the switch lever **42**. The lever **42** includes two sections or arms **43** and **44**. The first lever section **43** is pivotally mounted at one end on the casing **24** about a pivot pin **45** whose axis is normal to the axis of the stem **30**. The other end of the first lever section **43** carries a movable electrical switch contact bridge or bar **47**, which is adapted to swing in a vertical plane with the lever section **43**. One end of the second lever section **44** is pivotally connected to the first lever section **43** by a pin **49** whose axis is normal to the axis of the pivot pin **45**, so that the second lever section is adapted to swing in a plane normal to the pivotal plane of the lever section **43**. In its normal operative position, the second lever section **44** extends across and against the stem **30** as best disclosed in FIG. 5, and beneath and in engagement with the flat shoulder surface **41**.

The free end of the lever section **44** is connected to the lower end of the switch spring **50**, the upper end of which is connected to the top wall of the housing **24**. The switch spring **50** is biased to pivot the lever **42** about the pivot pin **45** upwardly.

The free end of the lever section **44** is also connected to one end of a trigger spring **52**, the other end of which is secured to the front wall of the housing **24** and normally biases the lever section **44** toward engagement with the stem **30**.

A pair of switch contacts **54** and **55** are stationarily mounted on a bracket **56** fixed to the side wall of the housing **24**, to position the contacts **54** and **55** in the pivotal path of the bridge **47**. The contacts **54** and **55** are connected to leads **57** and **58** respectively, in the circuit **20**. Thus, as long as the pressure in chamber **25** is above the predetermined actuating pressure, such as 10 p.s.i., then the position of the stem **30**, shoulder **40** and lever **42** is such that the bridge **47** is engaging the contacts **54** and **55** to close the circuit **20** and maintain the normal operation of the pump **10**, as disclosed in phantom in FIG. 4. When the pressure in the water line **13** has dropped below the predetermined actuating pressure of

the circuit breaker **22**, the pressure is transmitted to the chamber **25** causing the diaphragm **26**, stem **30** and shoulder **40** to drop to the solid line position disclosed in FIGS. 4 and 5. The depression of the shoulder **40** pivots the entire lever **42** including the bridge **47** downwardly to dis-engage the contacts **54** and **55** to open the circuit **20** and stop the motor **10**.

In the event that it is desired to operate the pump **10** even though the pressure in the line **12** is below the actuating pressure, an overrule plunger **60**, reciprocably mounted in the bearing **61** in the front wall of the housing **24** is depressed. The operative end **62** is adapted to engage the front edge of the lever section **44**, as disclosed in FIGS. 3 and 4. A manual button or handle **63** is formed on the opposite end of the plunger **60** outside the housing, and is normally biased outwardly by the spring **64**. When the button **63** is depressed or pushed against the housing **24**, the operative end **62** of the plunger **60** thrusts the lever section **44** pivotally about the pin **49**, away from the stem **30** and outwardly from beneath the shoulder **40**, and against the tension of the spring **52**. When the lever section **44** clears the shoulder **40**, the switch spring **50** pulls the lever **42** upwardly until the bridge **47** again engages the contacts **54** and **55** to close the circuit **20**. When the plunger button **63** is released, the lever section **44** is biased against the side of the shoulder **40** by the trigger spring **52**, but is no longer subject to the control of the shoulder **40** or the pressure membrane **26**.

Of course, when the pressure in water line **13** builds up again, the membrane **26** gradually thrusts the stem **30** and shoulder **40** upwardly. When the flat shoulder surface **41** rises above the top of the lever section **44**, the trigger spring **52** will again retract the lever section **44** beneath the shoulder **40** to render the circuit breaker **22** automatic and subject to the pressure in the line **13**.

Although this circuit breaker **22** is particularly designed and disclosed for use with a water pump and a water circulating system, it will be understood that the circuit breaker **22** may be employed with other types of fluid pressure control systems, such as a safety device for a water heater or an air compressor.

It will be apparent to those skilled in the art that various changes may be made in the invention, without departing from the spirit and scope thereof, and therefore, the invention is not limited by that which is shown in the drawings and described in the specification, but only as indicated in the appended claims.

What is claimed is:

1. A circuit breaker comprising:

(a) a housing,

(b) a stem mounted for longitudinal axial movement in said housing,

(c) a pressure responsive member connected to one end of said stem for thrusting said stem toward the opposite end upon an increase in pressure,

(d) spring means biasing said stem toward said one end,

(e) an actuating shoulder fixed on said stem,

(f) a lever,

(g) first means pivotally mounting said lever on said housing transversely of said stem so that said lever normally extends across said stem and in engagement for axial movement with said shoulder,

(h) spring means biasing said lever into engagement with said shoulder,

(i) a movable electrical contact carried by said lever,

(j) a stationary electrical contact mounted on said housing in the pivotal path of and normally engaging said movable contact,

(k) said contacts being dis-engaged when said pressure responsive member senses a pressure below a predetermined value,

(l) second means connected to said first means and mounting said lever to pivot transversely of said stem toward and away from engagement with said shoulder, and

(m) means mounted in said housing movable to thrust said lever transversely away from engagement with said shoulder to permit said contacts to engage regardless of the value of said pressure.

2. The invention according to claim **1** in which said first means comprises a lever section forming an extension of said lever, said movable contact being mounted on said lever section, said lever section being mounted on said housing to pivot about a first axis normal to the axis of said stem, said second means comprising a second pivotal axis normal to said first axis.

3. The invention according to claim **1** in which said movable means to thrust said lever comprises a plunger rod axially movable through said housing and having an end engaging said lever, said plunger rod being mounted to reciprocate in the plane of transverse pivotal movement of said lever, and spring means biasing said lever toward said stem.

4. The invention according to claim **3** in which the spring means biasing said lever into engagement with said shoulder comprises a first spring having one end connected to said housing and the other end connected to said lever to bias said lever axially of said stem toward said opposite end, and said spring means biasing said lever toward said stem comprises a second spring having one end connected to said housing transversely of said stem and the other end connected to said lever.

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