

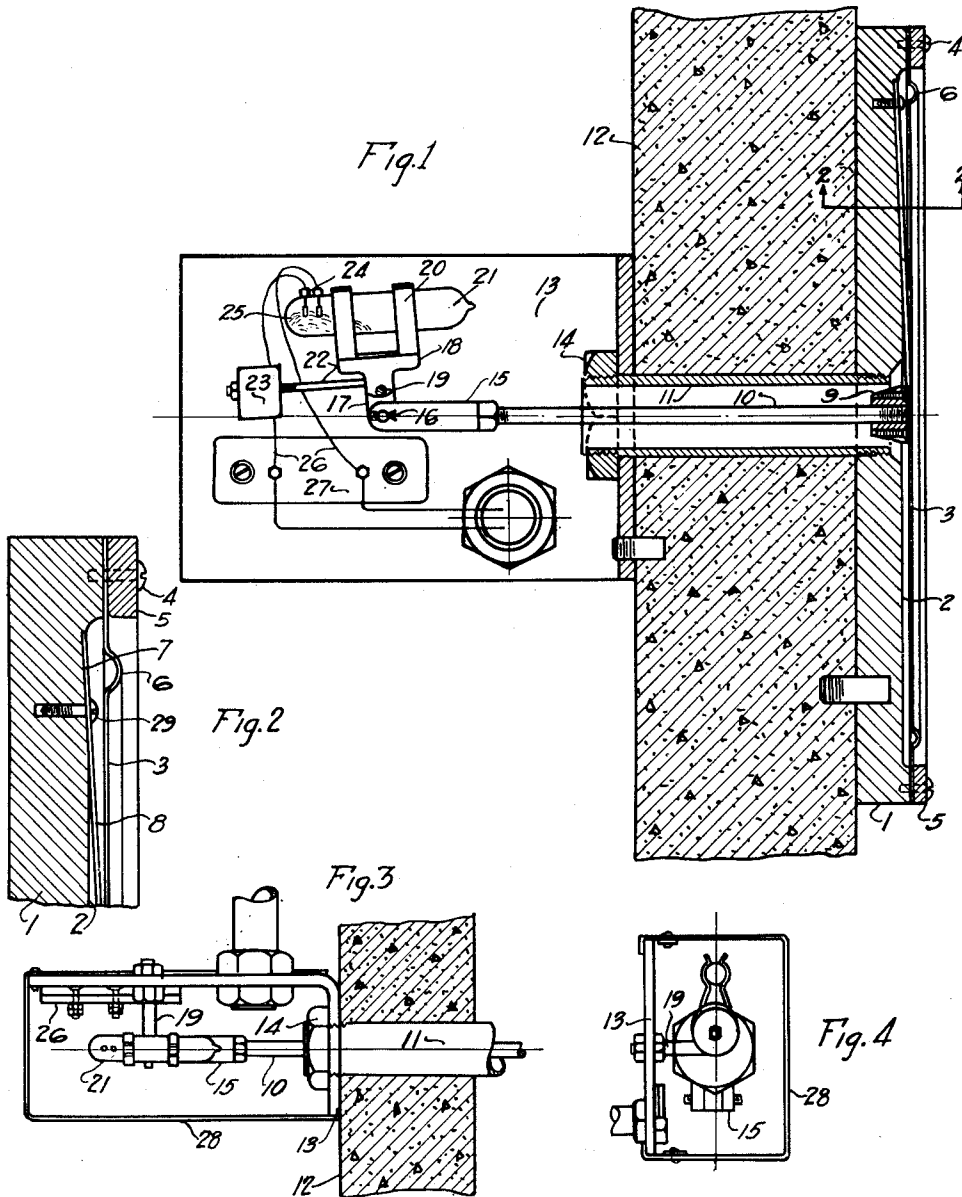
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CIRCUIT CLOSER

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CIRCUIT CLOSER

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The present invention relates to circuit closers and more particularly to a diaphragm operated circuit closer for use in connection with bins or tanks for the storage of bulk materials, to close or open electrical circuits when the stored material reaches desired levels. The circuit closer may be used, for instance, in bins for the storage of pulverized coal, cement, starch and similar materials, to open or close circuits including signal devices and to operate elements of material conveyors.

The invention relates in general to an improvement in the circuit closer shown in the patent to Thomas, 1,578,563, granted March 30, 1926, and comprises a diaphragm responsive to the pressure of materials delivered to or stored in a bin and connecting elements for actuating one or more switches arranged on or near the outer wall of the bin. The diaphragm actuated switches of the prior art have the disadvantage of failure from loss of elasticity of the diaphragm due to the effect of pressure applied or heat when hot materials are delivered directly from pulverizers or the like. Fire and explosion hazards exist, when due to failure and leakage, combustible dust mixtures of powdered coal, starch and similar materials develop in the presence of switches or other elements of electrical circuits.

In accordance with the present invention, a diaphragm in the form of a disc is tightly secured by means of a retaining ring to a disc-shaped base casting having a counter-sunk, flat face lying in a plane parallel and close to the inner surface of the diaphragm. The diaphragm is provided with an annular corrugation near its periphery to impart greater flexibility and to permit movement of substantially the entire surface, due to material pressure, into contact with the adjacent face of the base, which forms an abutment to limit the motion of the diaphragm.

In view of the very limited motion and the complete support of the diaphragm in its inward position regardless of the degree of material pressure against it, the material forming the diaphragm will not be stretched

to a permanent "set" and elasticity is retained. There is no danger of fracture which would permit dust mixtures to form in the switch housing. If the diaphragm should be heated above its annealing temperature and should its normal elasticity be lost, a spring and counter-weight described hereinafter will force it to return to its normal position when material pressure is relieved.

The diaphragm reacts at its center upon the end of a connecting rod held in contact with it by a leaf spring which also tends to force the diaphragm outwardly. The connecting rod passes centrally through a tube secured in an aperture in the center of the base casting and terminates in a yoke pivotally connected to a switch support carrying one or more switches of the mercury contact type.

The switch support is mounted on a fixed pivot and is so arranged that the limited motion of the connecting rod will swing the switch through a relatively wide arc. An adjustably mounted counter-weight is arranged at the rear and connected to the switch support in order to return the latter and to react through the connecting rod to force the diaphragm to the normal position as material falls below its level.

In use, these circuit closers may be installed at various levels in the bin, with the lower units being arranged with the diaphragm assembly carried inwardly on its tubular support to conform to the probable slope of the stored material, as "pipes" are often formed after some of the materials have been withdrawn. The switch elements are normally used for various purposes, including the operation of signal lamps; branch line valves of pneumatic conveyors and pulverized material pumping systems; and connected in circuit with the overload relay of the magnetic starters in conveyor motor control circuits.

For the sake of simplicity, a single mercury contact type switch will be shown and described, but it is to be understood that a plurality of such switches may be arranged on the switch support and that one or more

may be oppositely arranged to close circuits while others will remain open.

For a better understanding of the invention, reference is made to the accompanying drawing, in which

Fig. 1 is an elevation partly in section with the switch cover removed,

Fig. 2 is a detail of the diaphragm and associated elements in line 2—2 of Fig. 1,

Fig. 3 is a plan view of the switch housing with the cover removed, and

Fig. 4 is a rear elevation on line 4—4 of Fig. 3.

Referring now to the drawing, the invention is seen to consist of a base casting 1 in the form of a disc, provided with a flat, counter-sunk face 2 forming a close abutment to limit the inward motion of a diaphragm 3 of phosphor-bronze spring steel or equivalent elastic and flexible material. The diaphragm 3 is secured to the base casting by means of machine screws 4 and a retaining ring 5. In order to increase elasticity, the diaphragm is provided with an annular corrugation 6 near its periphery in order that the diaphragm may move inwardly and abut flatly throughout substantially its entire area against the face 2 of the base casting. It will be noted that the diaphragm is continuous, without perforations for bolts or machine screws in the effective portion of its surface.

The base casting 1 is preferably provided with a slot 7 to receive a leaf spring 8 secured by a machine screw 29, the function of the slot being to retain the spring at or within the plane of the face 2 to avoid injury to the diaphragm in its innermost position. The spring 8 extends to the center of the counter-sunk face 2 where it centers and is secured to the head 9 of the connecting rod 10, the latter passing centrally through a tube 11 secured at 12 in an appropriate central aperture in the base casting.

The tube 11 extends through a wall 12 intended to represent the wall of a bin or tank for the storage of bulk materials such as powdered coal and cement.

The switch assembly comprises a support 13 abutting and secured to the outer wall of the bin by a locknut 14 at the end of the tube 11. The connecting rod terminates in a yoke 15 pivoted at 16 to a short, downwardly depending member 17 of a switch support 18, the latter being arranged on a fixed pivot 19. Clips 20 retain one or more switches 21 of the mercury contact type. The switch is arranged on a greater radius than that between the pivots 16 and 19 in order that the limited motion of the connecting rod and associated elements will open or close the switch quickly. Secured to the switch support 18 above the pivot 19 is a rod 22 provided with screw threads for the adjustment of a counter-weight 23 which serves to return

the switch to its opposite position when the material level falls and the diaphragm returns to its normal, outward position. The weight also serves to keep the connecting rod 10 in contact with the diaphragm and to force the latter outwardly should it lose its elasticity.

The switch is shown with the contacts 24 closed by the globule of mercury 25 with the diaphragm in the outward position, as this is the normal position of a signal switch to prevent false indications when circuits are accidentally broken or signal lamps are burned out.

Suitable flexible leads 26 are connected to a terminal block 27 and the entire assembly is protected by a removable cover 28 against the admission of dust.

The operation of the device is as follows:

As the material rises in the bin, the diaphragm 3 is forced inwardly with substantially its entire area resting upon and in contact with the flat face 2 of the base casting. The diaphragm reacts against the leaf spring 8 and the connecting rod 10 to impart motion to the switch support 18. When pressure is relieved, the elasticity of the diaphragm, the spring 8 and the effect of the counter-weight 23 return the diaphragm to its normal position.

I claim:

1. A circuit closer actuated by the pressure of bulk materials, comprising the combination of a flexible diaphragm responsive to pressure of the materials, the diaphragm being secured at its edge to a base casting, the latter having a counter-sunk face forming an abutment to limit the movement of the diaphragm, a supporting tube secured in a central aperture in the base casting and arranged to pass through the wall of a bin for the storage of materials, a switch housing secured to the outer end of the tube for enclosing a pivotally mounted electrical switch support, the electrical switch being of the mercury contact type arranged on the switch support, a connecting rod pivotally connected to the switch support below the pivot of the latter and supported centrally within the tube and in contact with the diaphragm by means of a leaf spring secured to the inner face of the base casting and a counter-weight secured to the switch support above its pivot to force the switch and the diaphragm to return to a normal position after movement by pressure against the diaphragm and release thereof.

2. A circuit closer actuated by the pressure of bulk materials, comprising the combination of an elastic, flexible diaphragm, responsive to pressure of the materials, the diaphragm being secured at its edge to a base casting and provided with an annular corrugation near its periphery to increase its elasticity, the base having a flat, counter-sunk face lying in a plane parallel and closely ad-

5 jacent to the diaphragm to support substantially the entire effective area of the diaphragm, and to limit the latter to a slight movement, a supporting tube secured in a
10 central aperture in the base casting and arranged to pass through a wall of a receptacle for the storage of materials, a switch housing secured to the outer end of the tube, a pivotally mounted electric switch arranged within the housing, a connecting rod arranged
15 centrally within the tube and pivotally connected to the switch at one end and retained at its opposite end in contact with the center of the diaphragm by means of a spring, and
20 a counter-weight secured to the switch above and beyond the pivot of the latter to maintain the connecting rod in contact with the diaphragm and to force the latter outwardly when pressure of materials is relieved.

25 3. A circuit closer actuated by the pressure of bulk materials, comprising the combination of an elastic, flexible diaphragm, responsive to the pressure of the materials, the diaphragm being secured at its edge to a base
30 casting and provided with an annular corrugation near its periphery to increase its elasticity, the base casting having a flat counter-sunk face lying in a plane parallel and closely adjacent to the diaphragm to support substantially the entire effective area of the diaphragm and to limit it to a slight inward
35 movement, a supporting tube arranged to pass through a wall of a receptacle for the storage of materials and secured in a central aperture in the base casting, a switch housing secured to the outer end of the tube, a pivotally mounted electric switch arranged within the housing, a connecting rod arranged
40 within the tube, pivotally connected to the switch on a shorter radius from its pivot than the radius of the switch so that a limited motion of the connecting rod will open or close the switch, the opposite end of the connecting rod being held centrally in contact with the
45 diaphragm by means of a spring and a counter-weight secured to the switch above and behind the pivot to maintain the end of the connecting rod in contact with the diaphragm and to force the latter outwardly when the
50 pressure of materials is relieved.

In witness whereof I have signed this specification.

EDWARD W. SPRAGUE.