

Nov. 4, 1958

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2,859,296

FLUID CYLINDER WITH CIRCUIT CLOSER

Filed Nov. 20, 1956

2 Sheets-Sheet 1

FIG. 1

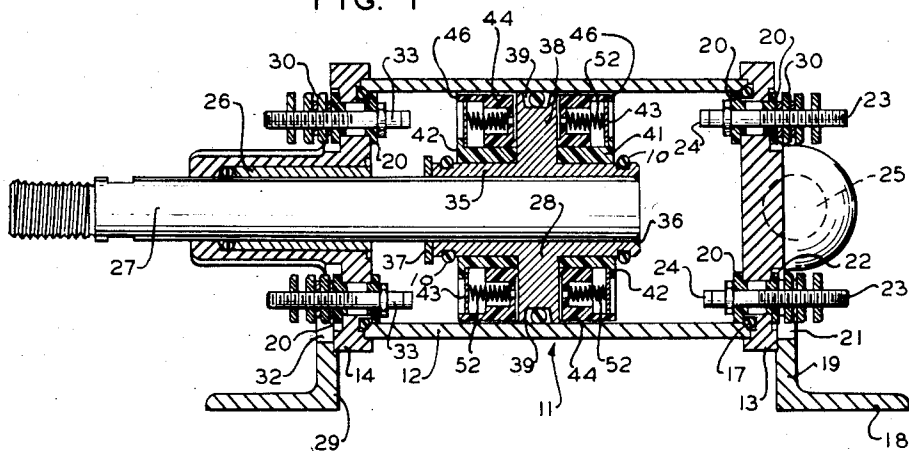


FIG. 2

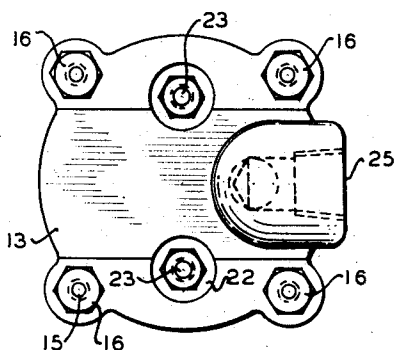


FIG. 3

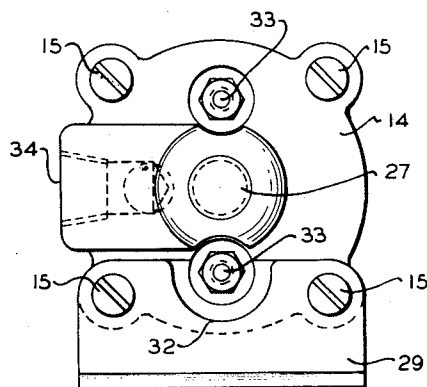


FIG. 4

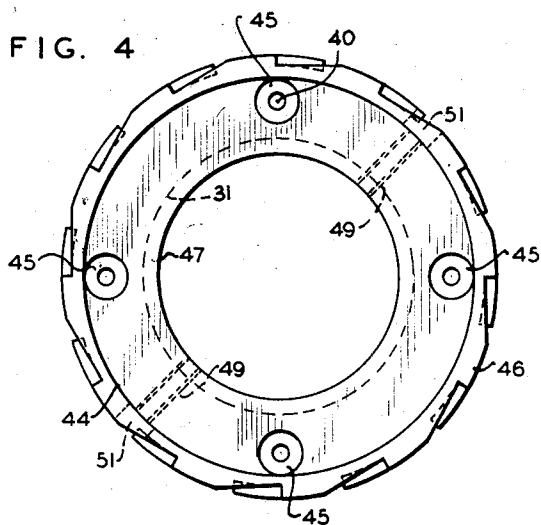
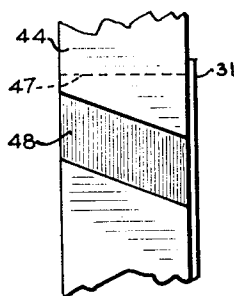


FIG. 5



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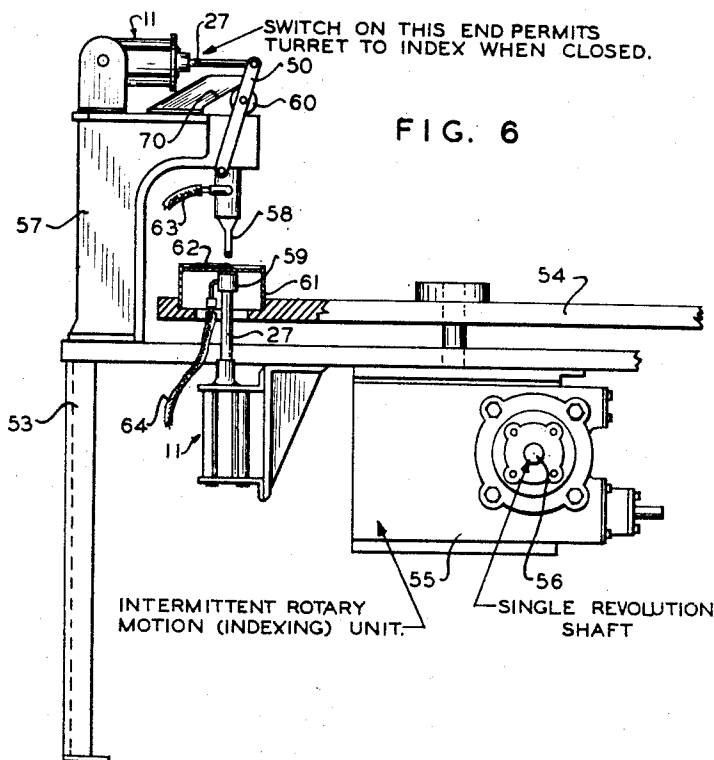


FIG. 6

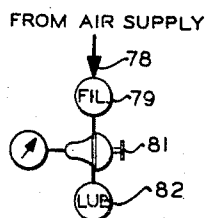
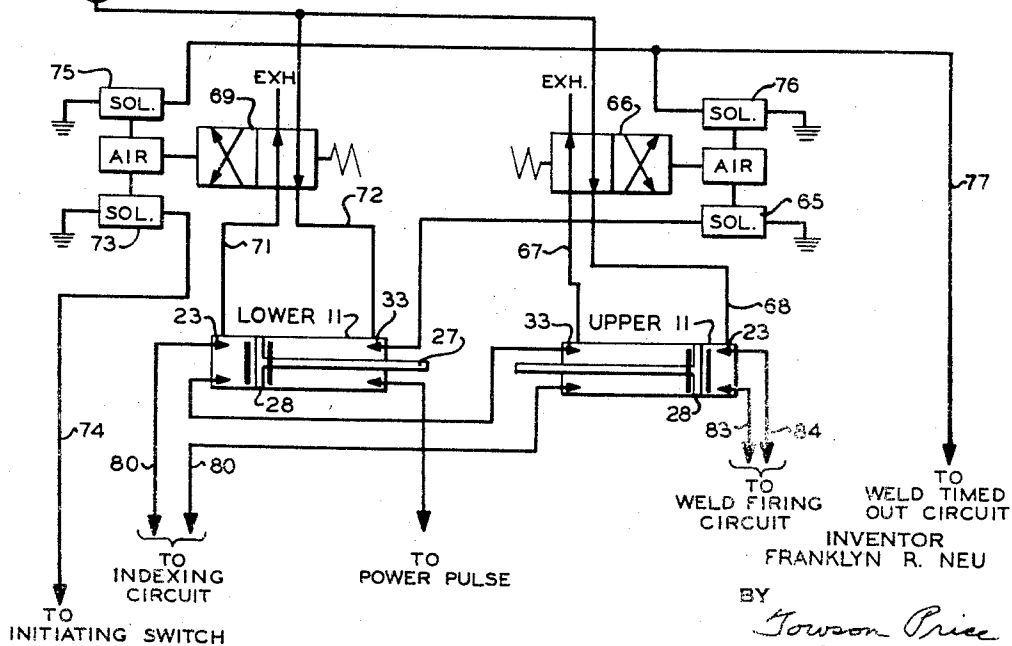


FIG. 7



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1

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FLUID CYLINDER WITH CIRCUIT CLOSER

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14 Claims. (Cl. 200—82)

This invention relates to circuit closers and, more particularly, to such including contacts enclosed in a cylinder in which a piston is operated by fluid means.

In accordance with my invention, I include an electrical switch device or devices piston-operated in a cylinder, pneumatically or hydraulically. Its use is to provide a means for indicating that the piston has completed its extension or retraction, or both, as the case may be, by completing a circuit across two contacts with a contact ring. Such information is very often necessary and has heretofore required the mounting of supplemental switch gear or devices on such cylinders in such a manner as to convey the desired information.

An object of my invention is to provide contact means which project through the head or rod end of a cylinder, or both ends thereof, in which is operated a piston, so as to show by suitable circuits associated with said contact means when the piston reaches one or both ends of its cylinder.

Another object of my invention is to provide on the reciprocating piston in said cylinder, a contact ring which cooperates with said cylinder contact elements, which ring is resiliently held in operative position and movable, not only upon engagement with the cylinder contact elements, but also by the fluid which operates the piston in order to effect a quick breaking of the circuit.

A further object of my invention is to provide for mounting such a contact ring on the piston, so that during piston operation said ring rotates to thereby change the point of engagement between each cylinder contact element and said contact ring, to thereby prolong the life of the circuit breaker.

A still further object of my invention is to combine such a circuit closer with other apparatus to effect improved operating results.

These and other objects and advantages will become apparent from the following detailed description when taken with the accompanying drawings. It will be understood that the drawings are for purposes of illustration and do not define the scope or limits of the invention, reference being had for the latter purpose to the appended claims.

In the drawings, wherein like reference characters denote like parts in the several views:

Figure 1 is an axial sectional view, with parts in elevation, of a piston-operated circuit closer embodying my invention.

Figure 2 is an end elevational view from the right of the circuit closer of Figure 1.

Figure 3 is an end elevational view from the left of the circuit closer of Figure 1.

Figure 4 is an enlarged end elevational view of one of the elements of a rotating assembly of the piston.

Figure 5 is a fragmentary edge view of the rotating element of Figure 4.

Figure 6 is a diagrammatic view of apparatus with which circuit closers embodying my invention may be employed.

2

Figure 7 is a wiring diagram of the apparatus in Figure 6.

Referring to the drawings in detail, and first considering Figures 1 to 5 inclusive, there is shown an embodiment of my circuit closer 11, comprising a hollow cylindrical member 12 to which is secured for completion a head or blind end portion 13 and a rod end portion 14, as by means of longitudinally extending bolts 15 and associated nuts 16. Suitable packing means 17 (such as so-called Parker O rings) may be provided between the hollow cylindrical portion 12 and the end portions 13 and 14.

The head end portion 13 of the cylinder has mounting means 18 secured thereto as by suitable means, such as said bolts 15. Said mounting means 18, in the present embodiment, is illustrated as an angle iron, the connected flange 19 of which is cut away, as indicated at 21, to avoid interfering with the lower of two apertures 22 through said head end portion to receive stationary contact elements 23 providing components for an electrical switch. These metal, desirably brass elements 23 are mounted in and insulated from the head end portion 13, as by each passing through and cooperating with insulating washers 20 to close the apertures 22. Each contact element 23 may have an inner enlarged or shouldered portion engaging its inner washer 20 and an outer nut 30 which fits a threaded outer portion and may be tightened to hold the inner and outer washers in place over the apertures 22. One end of each, that is, the desirably silver tipped inner end 24, comprises a contact surface on the interior of the cylinder, and the other or outer end of each may carry lead wire securing nuts and provide a point at which an electrical connection can be made on the exterior of the cylinder. The head end 13 of the cylinder is also provided with a port 25 for the admission and exhaust of fluid, such as compressed air or liquid.

The rod end 14 of the cylinder carries a preferably bronze bushing 26 in which the rod 27 of the contained piston 28 reciprocates. It also has mounting means, such as the angle iron 29 secured to the rod end portion as by suitable means, such as the bolts 15, and similarly cut away, as indicated at 32, to avoid interfering with the application of contact elements 33, which if employed may be similar to those in the head end, designated 23, and similarly mounted. The rod end member 14 of the cylinder is also provided with a suitable port 34 for the admission and exhaust of operating fluid.

The piston 28 is, in the present embodiment, formed with an elongated hub portion 35 secured to the inner end of the piston rod 27 as by means of welding 36. There is desirably disposed a washer 37 between the rod end of this hub portion and the adjacent rod end portion 14 of the cylinder. Extending annularly from the central portion of the hub 35 is the piston proper 38, having an outwardly opening peripheral groove 39 which carries suitable packing means such as a Parker O ring. Mounted on one or both sides of the piston proper, and rotatable on the piston hub portion (or portions) is (or are) a contact ring assembly (or assemblies). Inasmuch as these assemblies, if two as illustrated in Figure 1, are identical, only one will be described.

Rotatably mounted on one or both end portions of the hub 35, in the illustrated embodiment, is a contact-assembly retaining ring 41, desirably formed of Bakelite or other suitable insulating material. Each is formed generally double-L shape in axial section, as viewed in Figure 1, that is, it has an outstanding peripheral flange 42 which overlies an enclosed annular contact member 43. Each is retained on its part of the hub 35 by suitable means 10 disposed in illustrated grooves in the hub 35 beyond the contact ring assemblies. These retaining means may be so-called Parker O rings. The contact

members 43 are desirably formed of Phosphor bronze or other durable metallic conductive material. Associated with each retaining ring 41, and encircling its contact ring 43, is a contact support ring 44, desirably also formed of Bakelite or other suitable insulating material. Each contact support ring is formed with a series of outwardly opening pockets 45, disposed between its peripheral flange 46 and its interior bore 47 for holding the inner ends of contact-ring-retaining springs 52. These springs are desirably of the helical compression type made from music wire. They act between the inner surface of the transverse wall of each contact support ring 44 and the adjacent or inner surface of its annular contact ring 43, to resiliently urge or bias said contact ring against the flange 42 of the contact retaining ring 41. Each contact support ring 44 is tightly mounted on the contact retaining ring 41, so as to rotate therewith on the hub 35 of the piston 28.

The peripheral surface of the contact support ring 44 is provided with a series of outwardly opening grooves or flutes 48, which extend generally diagonally or helically along said surface, as shown most clearly in Figure 5. The circumferentially-spaced walls of each flute are desirably disposed normal to the tangent, and the inner wall defining the flute is desirably parallel to the tangent. The (or each) contact support ring 44 is also desirably provided with at least a pair of radially extending apertures 49, threaded to receive set screws 51 for holding said support ring in place and immovable with respect to the (or its) contact retaining ring 41.

By virtue of the before-disclosed construction, it will be seen that each contact ring assembly is mounted on the hub of the piston in such a manner that it is captive longitudinally with respect to the piston, but free to rotate about the axis thereof. In operation, reciprocation of the piston brings first one and then the other contact ring 43 (if two are employed) in contact with the corresponding insulated feed-through contacts 23 and 33, at the final portions of the piston strokes. Thus, a closed electrical path is provided that may indicate that the piston has completed its stroke, in one direction or the other.

As the piston starts its return stroke, several things occur. If a compressible fluid is introduced into a switch-carrying end of the cylinder, a difference in pressure exists between the contact side and the spring side of the contact ring 43, to move said ring within the contact ring assembly against the pressure of the contact ring springs 52. This relative movement of the contact ring with respect to the piston provides a quick opening of the electrical contact that is independent of, but complementary to, the piston speed. By virtue of the flutes or grooves 48, the compressible fluid initially introduced into the switch carrying end of the cylinder, and flowing in or through these flutes, and on into the spring-enclosing cavity, exerts pressure on walls normal to the tangent and induces rotary motion in the contact ring assembly on the hub of the piston, thereby exposing a different area of the contact ring 43 to the insulated feed-through contacts 23 or 33, as the case may be, on each subsequent operation of the piston, which provides for longer contact life. In order to insure exhaust of the fluid from the spring-enclosing cavity, in preparation for the above action, as well as to provide the desired passages to facilitate such action and minimize friction against such turning, I slightly relieve, say less than .01 inch, the inner or piston-adjacent wall of each contact support ring 44, leaving an annular boss or hub portion 31 for engaging said piston. I also provide small apertures 40, desirably concentric with the pockets 45, through said relieved wall.

Referring now to Figure 6 of the drawing, there is illustrated a machine for welding opener keys to cans, comprising a supporting frame 53 on which is rotatably mounted a spider 54 intermittently operated by means of indexing mechanism 55, including a single revolution shaft 56. The power means for this mechanism may be a

Diehl type J power transmitter. Mounted on the support 53, as on a suitable pedestal 57, is an upper welding electrode 58 operated by the piston rod 27 of an upper cylinder 11, constructed in accordance with my invention. Inasmuch as the specific mechanism between the piston rod 27 and the electrode 58 is not part of the invention, it is not here described in detail. It suffices to say that it may involve a rod 50, extending from the piston rod 27 to the vertically reciprocable member which carries the electrode 58, with its ends respectively pivotally connected to said rod and reciprocable member. The connecting rod 50 desirably has a roller 60 pivotally mounted thereon and riding on a cam 70 supported on the pedestal 57. Thus retraction of the piston rod 27, causes downward movement of the electrode 58.

Similarly there is a lower cylinder 11, embodying my invention, and having a rod 27, which carries the lower electrode 59 which engages the under surface of a can 61, while the upper electrode 58 engages a key 62 positioned on the upper surface of said can and which is to be welded thereto. The electrodes 58 and 59 have flexible power conveying leads 63 and 64 respectively extending thereto.

Referring now to Figure 7, there is shown a diagram of the wiring for effecting operation of the mechanism of Figure 6. The upper cylinder 11 and the lower cylinder 11 are connected, as illustrated, so that the head end contact elements 23 of the lower cylinder 11 are in series with the rod end contact members 33 of the upper cylinder 11, and both are in series with the leads 80 of the indexing circuit. The rod end contact elements 33 of the lower cylinder 11 are in series with the power pulse circuit controlling solenoid 65, which in turn controls an air or fluid valve 66, desirably a four-way solenoid momentary-contact pilot-operated valve of the Bellows "Electroaire" type.

Such valves are commercial and so need only be briefly described. The one major part is a light-weight stainless steel piston that travels in a bronze cylinder block. This piston is engaged with and shifts a shear-type slide valve. In each end of the cylinder is a sealed control unit which uses a small 8-volt solenoid. When either one of the solenoid control units is energized by a momentary electrical contact, the solenoid plunger retracts just enough to open a small port in the end cap of the valve housing. This momentary opening permits sufficient air to escape to upset the normal air pressure balance within the valve. Thus the full force of the incoming high-pressure air is directed against the opposite side of the valve piston, shifting the slide valve and restoring the normal air balance. The valve remains in that shifted position until the opposite solenoid control valve is momentarily energized by an electrical impulse, again upsetting the air pressure balance and reversing the valve. Thus it is the air pressure that does the actual work of shifting the slide valve. The small solenoids act only as "triggers" to release and direct high-pressure air against the valve piston.

The valve 66 is connected by air lines 67 and 68 extending respectively to the rod end and the head end of the upper cylinder 11, so that operation of the valve 66 in turn effects corresponding operation of the piston 28 in the upper cylinder 11. The lower cylinder 11 is likewise controlled from a similar valve 69, but having an air line 71 therefrom to the head end of said cylinder, and an air line 72 to the rod end thereof. The solenoid 73 of the valve 69 is controlled from an initiating switch (not shown), which is operated by a cam (not shown) on the shaft 56 by a circuit through line 74. The solenoids 75 and 76 of the valves 69 and 66, respectively, are operated in parallel through line 77 from the weld timed out circuit. Air is supplied to the valves 66 and 69 in parallel from the main air line 78 through a filter 79, pressure regulator 81, and lubricator 82.

The operation of the key-to-can welder with reference

5

to the diagram of Figure 7 is as follows. During indexing of one can at the welding position, the piston in the lower cylinder 11 is retracted (as illustrated) and the piston in the upper cylinder 11 is extended, (as illustrated in Figure 6), the machine having indexed a head with a can 61 into the welding position illustrated in Figure 6. The initiating switch is closed momentarily by a cam on the shaft 56 and, immediately thereafter the indexing unit is uncoupled from its power source. This closure of the initiating switch energizes, through line 74, the solenoid 73 of the valve 69 and permits the pilot air to move the main valve spool or piston so that the blind or head end of the lower cylinder 11 is under pressure and the rod end of said cylinder is open to exhaust.

The rod 27 of said lower cylinder 11 then extends and positions the lower electrode 59 on the bottom of the can 61. When said rod is fully extended, the switch contacts 33 on said rod end are closed. This directs a pulse of electrical energy to activate the solenoid 65 of the valve 66 long enough to permit pilot air to move the main valve spool or piston so that the rod end of upper cylinder 11 is under pressure and the blind or head end of said cylinder is open to exhaust. The piston 28 in said upper cylinder 11 then retracts (to the position of Figure 7) and brings the upper electrode 58 into contact with the key 62, which has been placed on the can by another mechanism. The welding apparatus employed may be a Raytheon Model 1 LS head adapted for the particular purpose, with the upper cylinder 11 taking place of the conventional foot-operated pedal.

When the upper cylinder 11 is fully retracted, it bridges the contact elements 23 on its head end and fires the weld timer through lines 83 and 84. The weld timer consists of a means of controlling the amount of time the welding transformer is energized after it receives the firing signal, and the amount of time it is necessary to keep the electrode on the work after the welding operation, in order that the welded joint may solidify.

After this cooling period, a contact in the weld timer closes and energizes the solenoids 75 and 76 of the valves 69 and 66, respectively, to reverse the main valve spools and cause the rod of the lower cylinder 11 to retract and that of the upper cylinder 11 to extend. When the pistons in these cylinders have completed their strokes, the switch including contact elements 23 in the head end of the lower cylinder 11 and the switch including contact elements 33 in the rod end of the upper cylinder 11 are closed, and signal the indexing circuit that it can proceed to index another head, to carry a can and key into the welding position for a repetition of the operation.

From the foregoing disclosure it will be seen that I have not only provided a fluid cylinder with a circuit closer or closers, which not only may be used for indicating when the enclosed piston reaches the head or rod end of its stroke, that is, after traveling in one direction, in the other direction, or at the terminations of said travels in both directions, but which is combinable with other devices, such as solenoid-controlled air valves, for controlling complicated automatic operations.

Having now described my invention in detail in accordance with the patent statutes, those skilled in this art will have no difficulty in making changes and modifications in the individual parts or their relative assembly in order to meet specific requirements or conditions. Such changes and modifications may be made without departing from the scope and spirit of the invention, as set forth in the following claims.

I claim:

1. A piston adapted for use in a circuit closer comprising a piston proper and a hub portion extending longitudinally therefrom, a contact ring assembly rotatably journaled on said hub portion, said assembly consisting of a contact ring, an insulating support partially housing said ring and opening away from said piston proper,

6

and a plurality of compression springs biasing said ring outwardly against said support.

2. A piston adapted for use in a circuit closer comprising a piston proper, a hub portion extending longitudinally therefrom, and electrical contact means journaled on said hub portion and formed at its periphery with a series of outwardly opening flutes extending in a generally diagonal manner therealong.

3. A piston adapted for use in a circuit closer comprising a piston proper and a hub portion extending longitudinally therefrom, a contact ring assembly journaled on said hub portion, said assembly consisting of a contact ring, an insulating support for said ring, an insulating keeper for said ring and with said support defining an annular pocket opening away from said piston proper, and a plurality of compression springs housed in said pocket and biasing said ring outwardly against said keeper, the peripheral portion of said contact ring assembly being formed with a series of outwardly opening grooves, said grooves extending diagonally along the peripheral surface of said assembly.

4. A circuit closer comprising a cylinder, a piston slidable in said cylinder, a hub for said piston, and a contact ring assembly comprising a contact ring resiliently biased from and mounted for longitudinal movement with respect to said piston, and insulating means partly housing said ring, while opening away from said piston.

5. A circuit closer comprising a cylinder, a piston slidable therein and having a hub, and electrical contact means journaled on said hub and formed at its periphery with a series of outwardly opening flutes extending in a generally helical manner therealong.

6. A circuit closer comprising an elongated cylinder having opposed end ports adapted for connection to intake and outlet conduits, a piston slidable in said cylinder, a hub for said piston, electrical contact elements mounted in the end of said cylinder adjacent said hub, and a contact ring assembly comprising a contact ring resiliently biased from and mounted for longitudinal movement with respect to said piston, and insulating means partly housing said ring, while opening away from said piston, and longitudinally immovable but carried by and free to rotate about said piston hub, whereby upon the admission of compressed fluid to the cylinder, the fluid expands and pushes the contact ring toward the piston against its bias to effect a quick breaking of engagement with the electrical contact elements.

7. A circuit closer comprising a cylinder with electrical contacts in one end, a piston slidable therein and having a hub toward the contact-containing end of the cylinder, and electrical contact means journaled on said hub and formed at its periphery with a series of outwardly opening flutes extending in a generally helical manner therealong, whereby upon the admission of compressed fluid to the cylinder, said fluid acts in the flutes to effect a turning of the contact means so that a different area is exposed for the next engagement with said contacts.

8. A circuit closer comprising an elongated cylinder having opposed end ports adapted for connection to intake and outlet conduits, a piston slidable in said cylinder, a rod for said piston, electrical contact elements mounted in an end of said cylinder, one end of each of which comprises a contact surface on the interior of the cylinder and the other end a point at which electrical connections can be made on the exterior of the cylinder, a contact ring assembly carried by said piston, said assembly consisting of a contact ring, an insulating support for said ring, an insulating keeper for said ring and with said support defining an annular pocket opening toward the adjacent end of said cylinder, a plurality of compression springs housed in said pocket and pressing said ring outwardly against its keeper, means mounting said ring assembly with respect to said piston so that it is generally immovable longitudinally but free to rotate about said rod, the peripheral portion of said contact ring assembly

being formed as a series of outwardly opening flutes each defined by two walls normal to the tangent and one parallel to the tangent at the periphery of said cylinder, said flutes extending in a generally helical manner along the peripheral surface of said assembly whereby, upon the admission of compressed fluid to the cylinder, the fluid expands into the pocket and pushes the contact ring inward against the action of the springs to effect a quick breaking of engagement with the electrical contact elements, and said fluid acts in said flutes to effect a turning of the contact ring assembly, so that a different area of said ring is exposed for the next engagement with said contacts.

9. A circuit closer as defined in claim 8, in which the piston has an elongated hub extending both ways therefrom, one of said contact ring assemblies is carried on each of said hub extensions, and there is a pair of electrical contact elements mounted in each end of the cylinder for cooperation with the contact rings of said assemblies.

10. In combination, a pair of circuit closers as defined in claim 9, means connecting the contact elements in one end of one of said circuit closers in series with the contact elements in one end of said other circuit closer and an indexing circuit, means connecting the contact elements in the other end of the first-mentioned circuit closer in series with a power pulse circuit for performing a desired operation, means connecting the other contact elements of the other circuit closer in series with a weld firing circuit for performing a desired welding operation, and fluid control valve means governed by a weld timed out circuit and operatively connected to said circuit closers.

11. A circuit closer comprising a cylinder with electrical contacts in one end, a piston slidable therein and having a hub toward the contact-containing end of the cylinder, an electrical contact means journaled on said hub and formed at its periphery with means whereby upon the admission of actuating fluid to the cylinder, said fluid effects a turning of the contact means so that a different area is exposed for the next engagement with said contacts.

12. A piston adapted for use in a circuit closer com-

prising a piston proper and a hub portion extending longitudinally therefrom, a contact ring assembly journaled on said hub portion, said assembly consisting of a contact ring, an insulating support for said ring, an insulating keeper for said ring and with said support defining an annular pocket opening away from said piston proper, and a plurality of compression springs housed in said pocket and biasing said ring outwardly against said keeper.

13. The invention as defined in claim 12, in which there is a cylinder, the piston proper moves therein and has a hub portion which extends both ways therefrom, a contact ring assembly is carried on each of said hub extensions, and there is a pair of electrical contact elements mounted in each end of the cylinder for cooperation with the contact rings of said assemblies.

14. In combination, a pair of piston-enclosing cylinders as defined in claim 13, means connecting the contact elements in one end of one of said cylinders in series with the contact elements in one end of said other cylinder and an indexing circuit, means connecting the contact elements in the other end of the first-mentioned cylinder in series with a power pulse circuit for performing a desired operation, means connecting the other contact elements of the other cylinder in series with a weld firing circuit for performing a desired welding operation, and fluid control valve means governed by a weld timed out circuit and operatively connected to said cylinders.

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