United States Patent

[11] **3,555,225**

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[54] **FLUID-FLOW CIRCUIT INTERRUPTER WITH ARC-ASSISTED PISTON ACTION**
12 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **200/148,** 200/150
[51] **Int. Cl.** **H01h 33/70**
[50] **Field of Search** ..... 200/148 (Cursory), 148.1, 150E, 150G

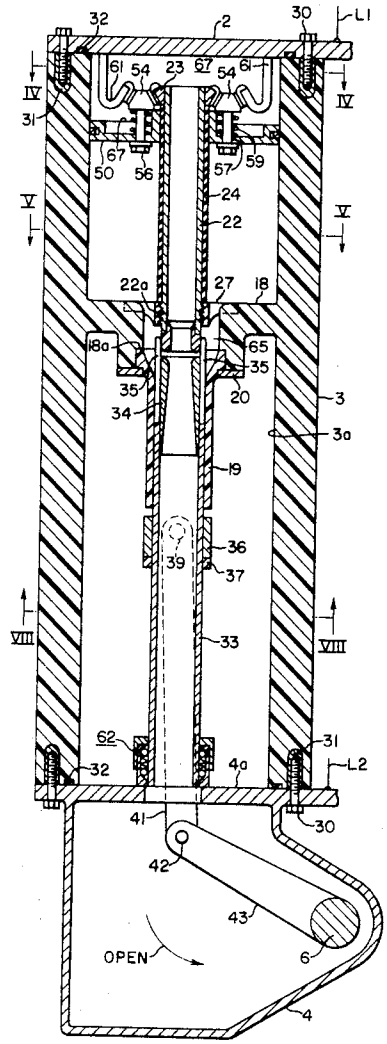
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ABSTRACT: A fluid-flow circuit interrupter of the piston type has a serially related pressure-generating arc to mechanically assist the fluid-driving motion of the piston member to offset the arcing pressure generated within the interrupting nozzle by the main current arc disposed therein. The fluid-driving piston is connected by piston rods to the movable contact structure and hence to the operating mechanism. The interrupting device functions to establish a main current arc between the separable main contacts and additionally a pair of serially related arcs, in electrical parallel, on the rear side of the fluid-driving piston to assist the latter in its fluid-driving motion by the pressure generated.



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SHEET 1 OF 3

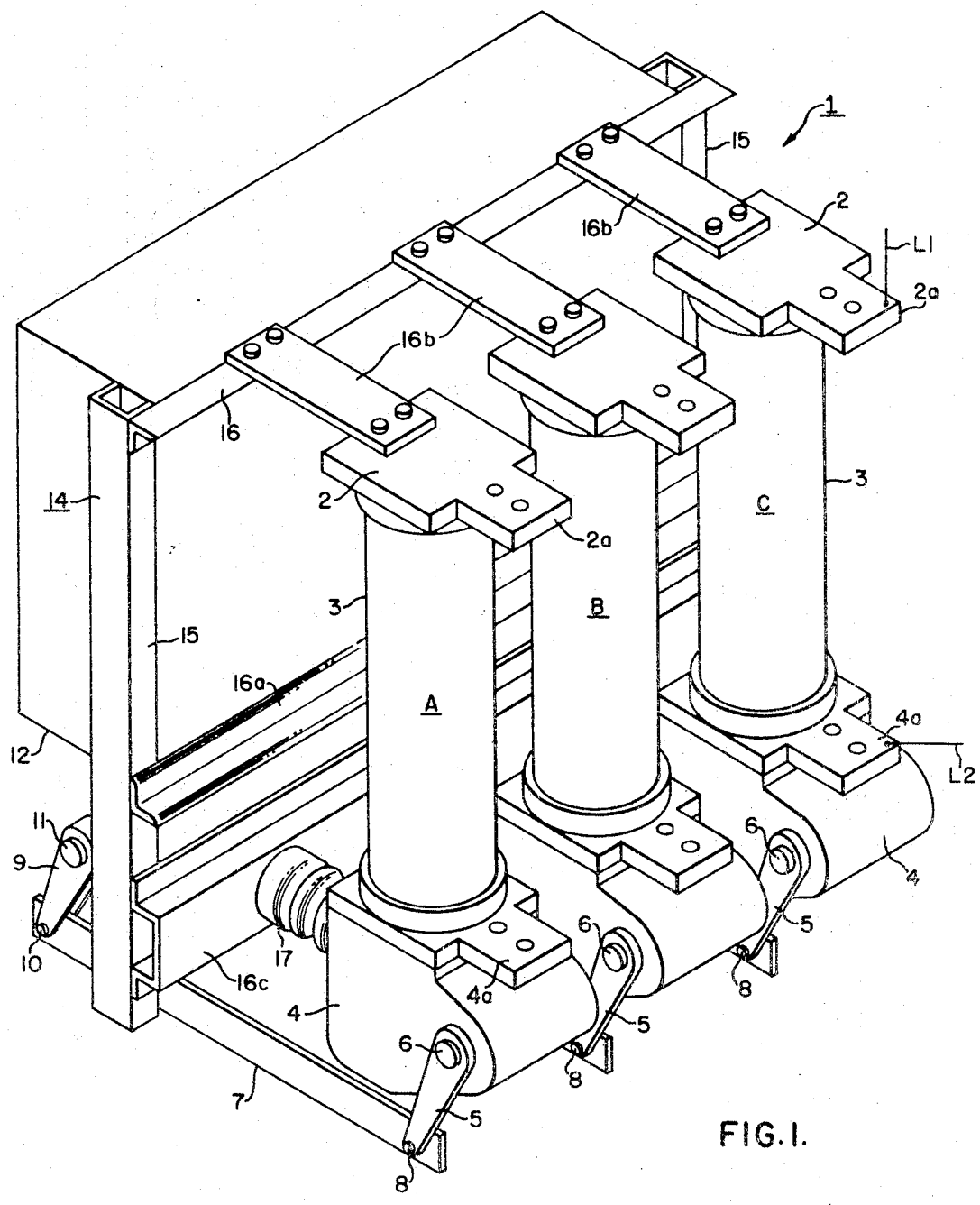


FIG. 1.

WITNESSES

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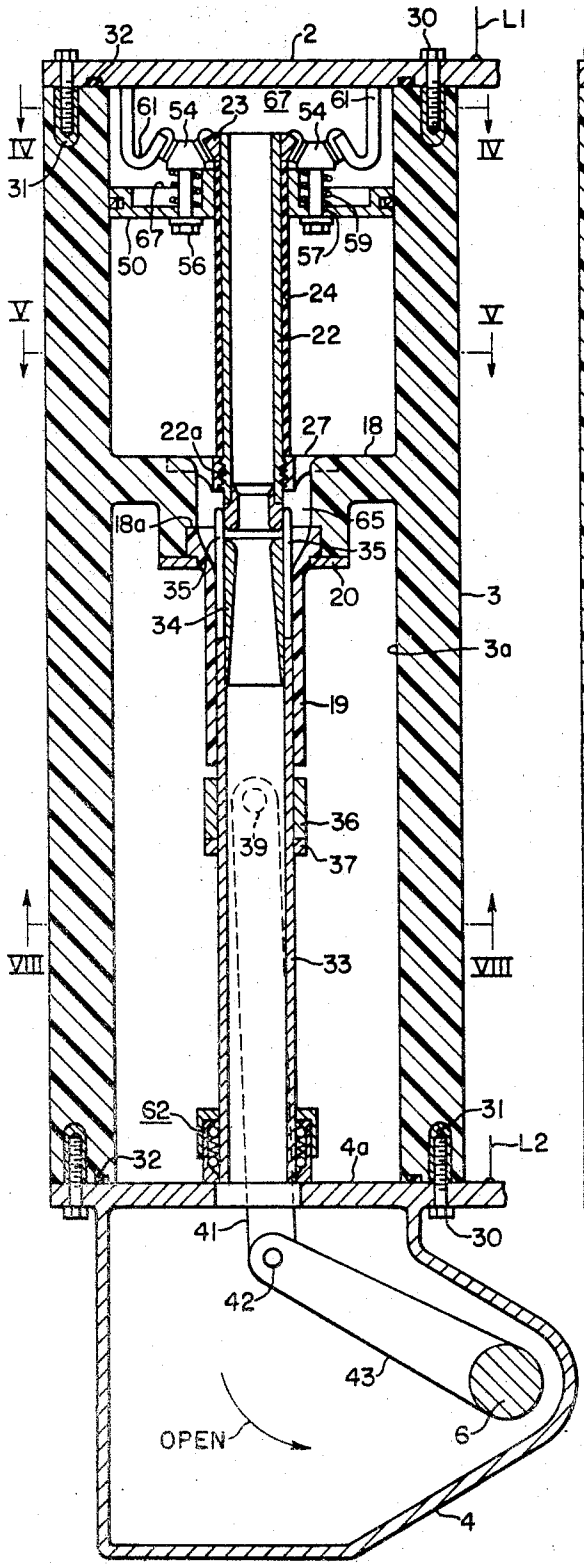

32
2
30
L1
61
54
23
67
IV
31
50
56
57
59
24
22
V
22a
27
18
18a
65
35
20
3
34
3a
19
36
39
37
VIII
33
62
31
L2
4a
41
42
43
OPEN
6
4

FIG. 2.

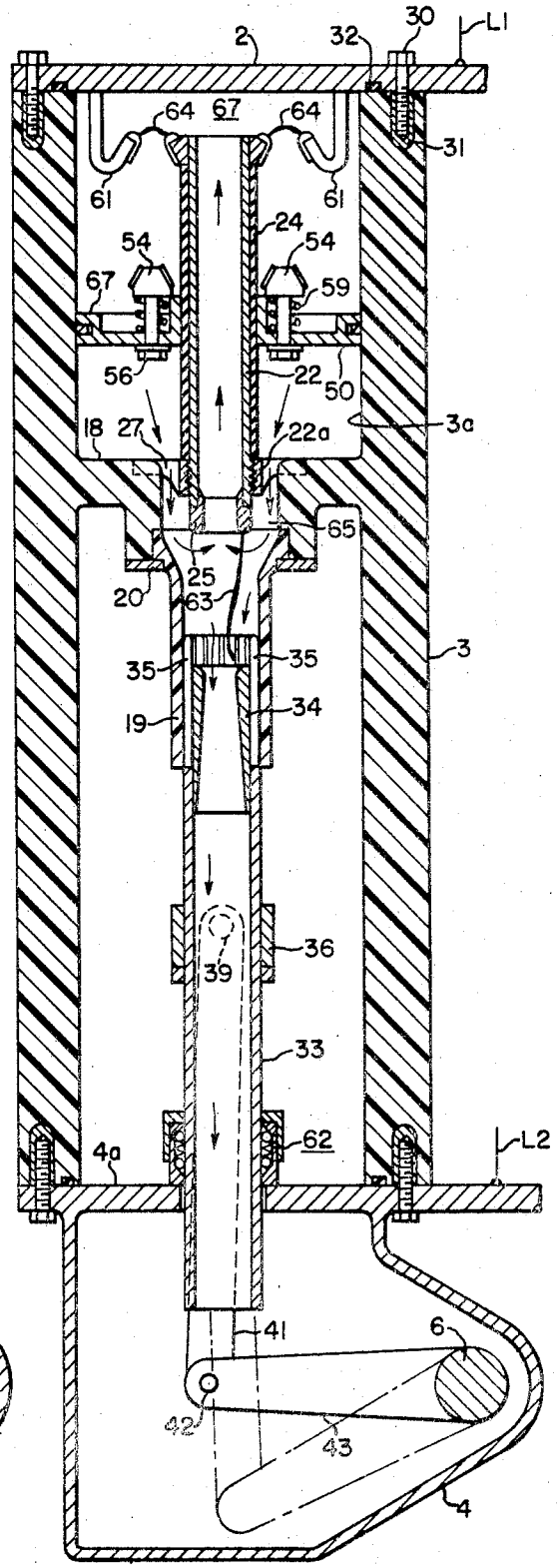

2
32
30
L1
64
67
31
61
24
54
59
56
22
50
18
27
22a
3a
65
25
20
63
3
35
34
19
36
39
33
62
L2
4a
41
6
42
43
4

FIG. 3.

FIG. 4.

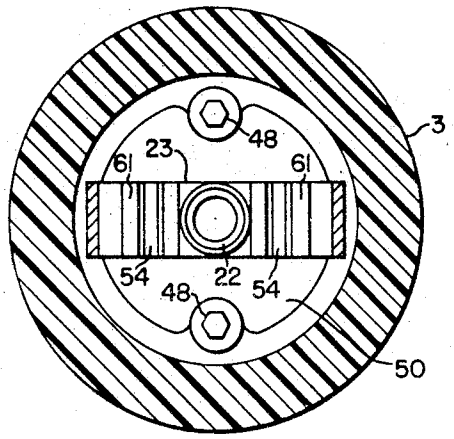


FIG. 5.

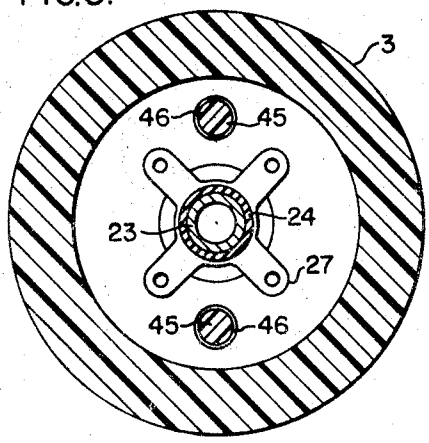


FIG. 7.

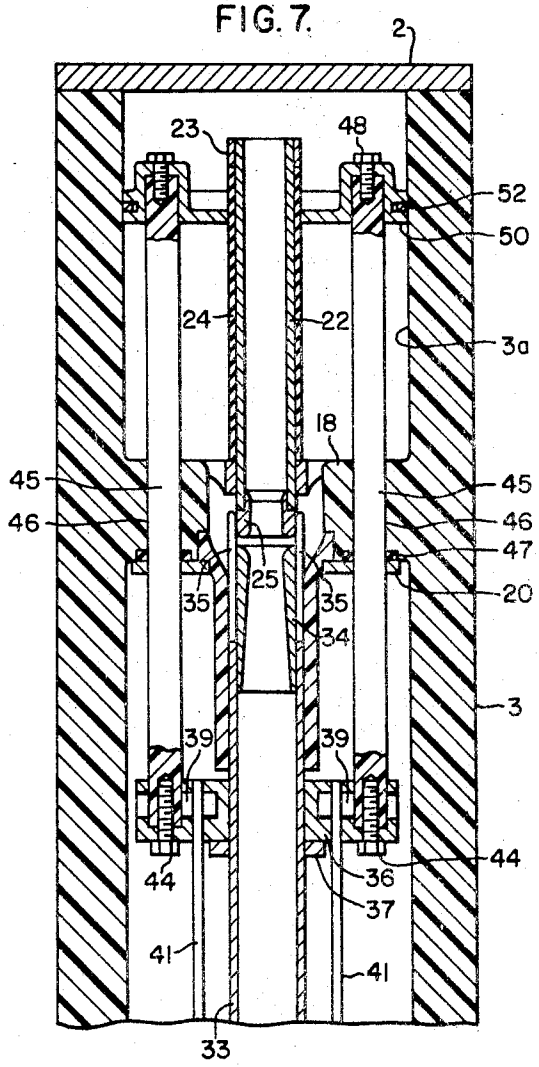
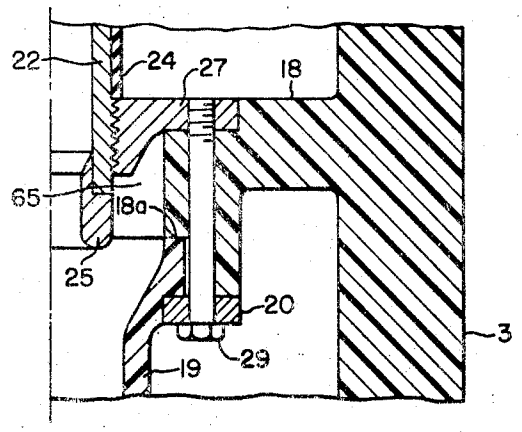


FIG. 6.



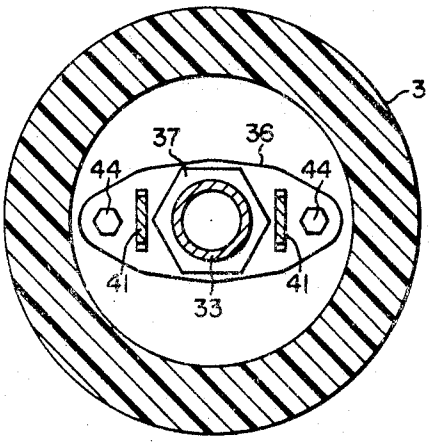


FIG. 8.

FLUID-FLOW CIRCUIT INTERRUPTER WITH ARC-ASSISTED PISTON ACTION

CROSS REFERENCES TO RELATED APPLICATIONS

Applicants are not aware of any related pending patent applications pertinent to the present invention.

BACKGROUND OF THE INVENTION

When puffer type circuit interrupters are used to interrupt relatively high fault currents, such as from 15,000 amperes up, for example, the arcing pressure generated within the interrupting region is applied to the driving face of the puffer piston, so that excessive energy is required to mechanically drive the fluid-driving piston and force the compressed interrupting gas to flow through the main arc for arc extinction. This, to a certain extent, has been solved with magnetic assist coils, as described in several patent applications, such as Ser. No. 576,740 filed Sept. 1, 1966, by Russell E. Frink and William H. Fischer, and Ser. No. 576,616 filed Sept. 1, 1966, now U.S. Pat No. 3,524,958 by Russell E. Frink both applications assigned to the assignee of the present invention. It is a distinct purpose of the present invention to provide another approach to this difficult problem, which is simpler and less costly to use.

SUMMARY OF THE INVENTION

In accordance with a preferred embodiment of the invention, there is provided an elongated insulating casing or housing structure, interiorly of which is disposed a movable fluid-driving piston connected to the movable main contact structure, and hence to the operating mechanism. The fluid-driving piston carries a pair of bridging contacts, which in the closed circuit position of the device, electrically engage a pair of stationary contacts, which are connected in the main circuit. During the opening operation, the mechanically provided opening motion of the fluid-driving piston and the main movable contact additionally causes the separation of the bridging contacts secured to and movable with the fluid-driving piston. This causes the establishment of a pair of pressure-generating arcs, electrically in parallel, and disposed on the rear side of the fluid-driving piston, so as to assist the fluid-driving piston by the generation of pressure on its rear side. This has the advantage of counteracting the excessive arcing back pressure which may be encountered in the stationary interrupting orifice structure adjacent the main current arc.

A general object of the present invention is the provision of an improved piston-type fluid-flow circuit interrupter in which the arcing pressure generated at the separable main contact structure is counteracted by a serially related arc, which assists in the fluid-driving motion of the piston member.

Still a further object of the present invention is the provision of a low cost, fluid blast type of circuit interrupter in which piston motion is assisted by a pressure-generating arc.

Still a further object of the present invention is the provision of an improved low cost puffer type fluid-flow circuit interrupter, in which the mechanically driven piston motion is accelerated by a pair of electrically parallel arcs disposed on the rear side of the fluid-driving piston so as to mechanically assist the same to overcome the arcing pressure generated at the main movable contacts.

Further objects and advantages will readily become apparent upon reading the following specification, taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a perspective view of a three-pole circuit interrupter embodying the principles of the present invention, the contact structure being illustrated in the closed-circuit position;

FIG. 2 is a longitudinal vertical sectional view taken through one of the interrupting assemblies of FIG. 1, the contact structure being illustrated in the closed circuit position;

FIG. 3 is a view similar to that of FIG. 2, but illustrating the disposition of the several parts at an intermediate point in the opening operation, illustrating the establishment of the serially related arcs;

FIG. 4 is a detailed sectional view taken substantially along the line IV–IV of FIG. 2;

FIG. 5 is a sectional view taken substantially along the line V–V of FIG. 2;

FIG. 6 is a fragmentary detailed view showing a mounting construction;

FIG. 7 is a fragmentary longitudinal sectional view taken substantially at right angles to the views of FIGS. 2 and 3, illustrating the piston rod mounting arrangements; and

FIG. 8 is a sectional view taken substantially along the line VIII–VIII of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, and more particularly to FIG. 1 thereof, a reference numeral 1 generally designates a three-pole fluid-blast circuit interrupter comprising three spaced pole assembles A, B and C. As will be apparent from FIG. 1, each pole assembly includes, generally, an upper end plate 2, a generally upstanding cylindrical housing 3, and a lower end plate and mechanism housing 4. Disposed exteriorly of the mechanism housing 4 is a drive crank 5 affixed to an operating shaft 6, and a generally horizontally reciprocally movable insulating operating rod 7 is pivotally secured to the external operating crank 5, as at 8, and is connected to a drive crank 9 through a pivotal connection 10. The three drive cranks 9, only one of which is shown, are affixed and rotatable with an operating drive shaft 11, which is connected to a suitable mechanism 12, which constitutes no part of the present invention, and may be of the type set forth in U.S. Pat. No. 3,183,332, issued May 11, 1965, to Russell E. Frink and Paul Olsson, and assigned to the assignee of the present invention.

It will be apparent from FIG. 1 that a suitable supporting grounded framework 14 is utilized comprising vertical channel members 15 with interbracing structural steel members 16, 16*a* having horizontally extending insulating support straps 16*b* secured thereto, which assist in supporting the interrupting assembles assemblies. Additionally, lower insulator supports 17 may be employed extending generally horizontally from a channel support member 16*c*, the latter being affixed to the vertical support channels 15.

FIGS. 2 and 3 more clearly illustrate the internal construction of each of the interrupting assemblies. With reference to FIG. 2, it will be noted that the insulating casing 3 is preferably a cast resin cylinder, which is cast with an inwardly projecting annular ring 18. Fitted into a recess 18*a* in the annulus 18 is a Teflon gas guide tube 19 which is retained in this position by the clamp ring 20. A stationary contact tube 22 has a contact foot 23 (FIG. 4) brazed to its upper end and is protected by a Teflon tube 24. The stationary contact tube 22 supports an orifice stationary contact 25 and has a portion 22*a* threaded into a support spider 27. The support spider 27 is attached to the annulus 18 by four bolts 29 (FIG. 6) which also retain the clamp plate 20.

FIG. 2 shows in more detail that the cylinder 3 is closed by the end plate 2 which carries line terminal L1, and by the lever box casting 4 which carries line terminal L2. These members are attached to casing 3 by the bolts 30 which thread into inserts 31 U.S. are cast into the tube 3. Pressure-tight seals are effected by the ring gaskets 32. A moving contact tube 33 is provided which has an internal flow guide 34 movable therewith and slides in the insulating gas guide tube 19. The conducting moving contact tube 33 carries moving contact fingers 35 which engage the stationary contact 25 in the closed position shown in FIG. 2. The moving contact tube 33 makes electrical contact with an end plate portion 4*a* of the lever box casting 4 through the sliding ball contact arrangement 62, as disclosed in U.S. Pat. No. 3,301,986.

A yoke member **36** is threaded to the contact tube **33** and locked by jam nut **37**. Note FIG. **8** in this connection. Attached to the yoke **36** by the captive pins **39** is a pair of metallic operating rods **41**, which are attached by the pins **42** to a bifurcated lever **43**.

The lever **43** is rotated about the shaft **6**, which is brought out through a seal in the side of the lever box **4** and rotated by a crank **5** connected to the mechanism as previously explained.

Attached to the yoke **36** by bolts **44** is a pair of insulating piston rods **45**. These rods pass through apertures **46** in the annulus **18**, and leakage is prevented by the seal rings **47**, which are retained by the clamp plate **20**. Attached to the opposite ends of the rods **45** by bolts **48** is a movable driving piston **50**. The piston **50** slides in the upper cylindrical portion **3***a* of casing **3** above the annulus **18**, and gas leakage is stopped by the piston ring **52**.

Referring to FIG. **2**, two pairs of movable bridging wedge contacts **54** are attached to the driving piston **50** by bolts **56** sliding in holes **57** through the piston **50**. These wedge contacts **54** are biased upwardly by the compression springs **59**. In the breaker closed position shown in FIG. **2**, two bridging contacts **54** bridge the gap between the contact foot **23**, and contact members **61** which are electrically connected to and supported by the upper end plate **2**.

In the breaker closed position, the current path is from terminal **L1** to plate **2** to contacts **61**, to movable wedge contacts **54** to contact foot **23**, to contact tube **22**, to moving contact tube **33**, to sliding ball assembly **62**, to lever box **4** to terminal **L2**. Rotation of shaft **6** in a counterclockwise direction moves links **41** downwardly, which through the yoke **36** moves contact **33**, insulating rods **45**, and driver puffer piston **50** downwardly. Arcs are drawn between contacts **25** and **34**, as indicated by **63**, and between contacts **54** and **61**, which quickly assumes the shape shown at **64**. The piston **50** drives the gas contained in the cylinder **3***a*, through the main interrupting arc **63**, where its temperature is raised to of the order of 10,000° K which results in a tremendous pressure rise. The pressure causes the gas to flow upwardly through the inside of tube **22**, and downwardly through the inside of moving contact tube **33**, and unfortunately back through the entrance passage **65** and into the cylinder interior **3***a*, which thereby resists the downward driving motion of the piston **50**. This is alleviated to a certain extent by the gas passing through the tube **22**, but the arcs **64** add heat to the gas above the piston **50** and likewise raise its pressure in the region **67** thus counterbalancing the pressure in the cylinder **3***a*. It should also be pointed out that since arcs **64** are in series with arc **63**, the overall interrupting capacity of the device is increased.

The important feature in this interrupter, which we consider to be of the utmost novelty, is the addition of pressure-generating arcs **64** to the upper side **67** of the driving piston **50** to counterbalance the pressure created in the cylinder interior space **3***a* by the main interrupting arc **63**, thus making it possible to operate the device with a normal-sized mechanism of relatively low power.

From the foregoing description it will be apparent that we have provided an improved low cost piston type circuit interrupter in which the mechanical fluid-driving motion of the piston **50** is assisted by the establishment of one or more serially related arcs **64**, which are disposed on the rear side of the fluid-driving piston and assist its downward driving motion.

Although there has been illustrated and described a specific structure, it is to be clearly understood that the same was merely for the purpose of illustration, and that changes and modifications may readily be made therein by those skilled in the art, without departing from the spirit and scope of the invention.

We claim:

1. A fluid-blast circuit interrupter including a longitudinal insulating casing having an intermediate inwardly extending flange portion, a tubular orifice member secured to said flange portion and accommodating motion of a movable tubular exhausting contact, stationary contact means including a tubular contact cooperable with the aforementioned movable hollow contact to establish a main current arc within said orifice means, piston means including a movable driving piston mechanically connected to the movable hollow contact, and said piston means carrying a movable pressure-generating contact to establish a serially related pressure-generating arc disposed on the rear side of the piston means to assist in the fluid-driving motion of the piston means.

2. The combination according to claim **1**, wherein the stationary hollow exhausting contact exhausts to the rear side of the piston means.

3. The combination according to claim **1**, wherein the piston means is annular and slides over the stationary hollow contact, and carries a pair of bridging contacts to establish a pair of electrically parallel arcs in series with the main current arc to assist in the fluid-driving motion of the piston means.

4. The combination according to claim **1**, wherein at least one piston rod extends through the inwardly extending flange portion of the casing to mechanically interconnect the piston means and the hollow movable contact.

5. A fluid-blast circuit interrupter including means defining an elongated insulating casing having an intermediate inwardly extending supporting flange portion, a tubular orifice member secured to said flange portion, terminal closure means closing one end of said casing and supporting a pair of stationary contacts, a hollow stationary contact supported by said flange portion and carrying a pair of stationary cooperating contacts, an annular piston slidable over said stationary hollow contact and carrying a pair of bridging contacts therewith, a movable tubular contact always remaining within said orifice member and mechanically operated by an operating mechanism disposed adjacent the other end of said insulating casing, and the arrangement operating to provide arc assisted piston movement during the opening operation to force gas to flow through said orifice member and in opposite directions through the separable hollow main contacts.

6. A fluid blast circuit interrupter including a relatively stationary contact and a cooperable movable contact separable to establish a main current arc, orifice means for guiding fluid flow into engagement with said main current arc, means defining a pressure-generating chamber, pressure-generating contact means disposed within said pressure-generating chamber including a relatively stationary pressure-generating contact and a relatively movable pressure-generating contact separable to establish a pressure-generating arc within said pressure-generating chamber, means defining an operating cylinder and a movable piston member movable therein to force fluid under pressure through said orifice means and into engagement with the main current arc to effect its extinction, means positively mechanically connecting the movable piston member to the movable contact, said piston member carrying the movable pressure-generating contact therewith, the pressure-generating chamber being disposed on the rear side of the movable piston member, the pressure-generating arc being established on the rear side of the movable piston member within the pressure-generating chamber to thereby assist its fluid-driving motion.

7. The combination according to claim **6**, wherein the movable pressure-generating contact structure comprises a pair of bridging contacts which establish in parallel two arcs to assist in the fluid-driving motion of the piston means.

8. The combination according to claim **6**, wherein an insulating longitudinal casing is provided having an inwardly extending supporting flange portion for supporting said orifice means.

9. The combination according to claim **6**, wherein the movable main contact does not withdraw out of the orifice means.

10. The combination according to claim **9**, wherein the movable main contact is tubular.

11. The combination according to claim **6**, wherein both the relatively stationary and the movable main contacts are both tubular.

12. The combination according to claim 6, wherein the relatively stationary main contact is tubular and vents to the rear side of the fluid driving piston.