Dec. 17, 1963 G. J. EASLEY ETAL 3,114,815

FLUID-BLAST CIRCUIT INTERRUPTER WITH IMPROVED CURRENT-TRANSFORMER HOUSING MEANS

Filed Nov. 18, 1959 5 Sheets-Sheet 1

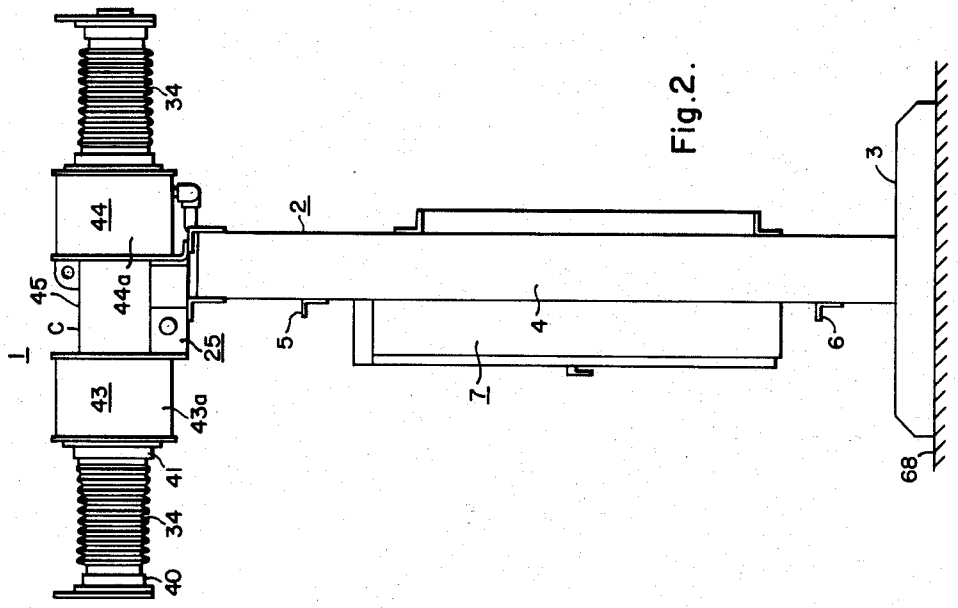


Fig. 2.

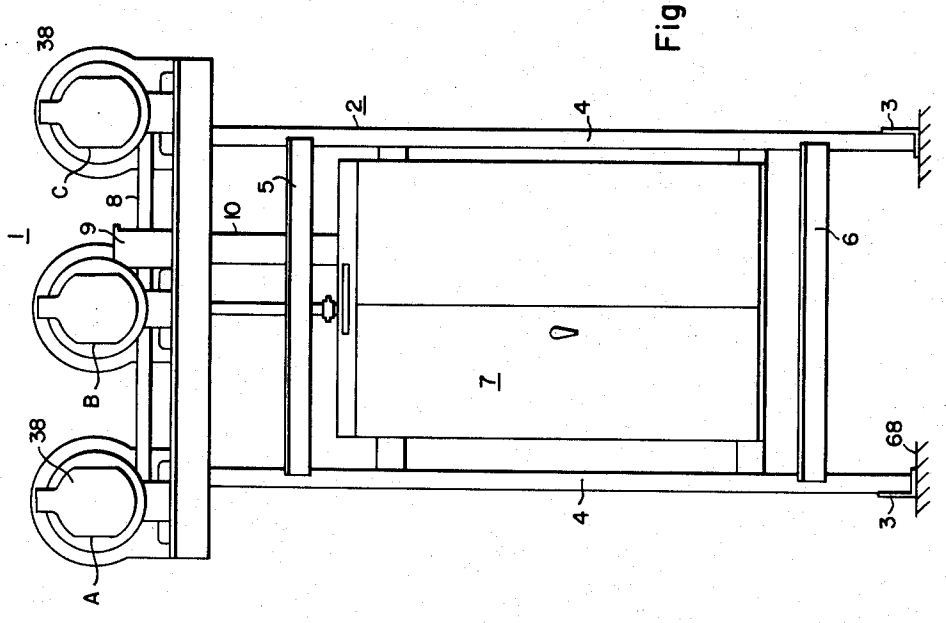


Fig. 1.

WITNESSES

Edmund C. Bassler

James T. Young

INVENTORS

Robert L. Hess, James M. Telford and Gilbert J. Easley

BY

Willard R. Crout

ATTORNEY

Dec. 17, 1963 G. J. EASLEY ETAL 3,114,815

FLUID-BLAST CIRCUIT INTERRUPTER WITH IMPROVED CURRENT-TRANSFORMER HOUSING MEANS

Filed Nov. 18, 1959

5 Sheets-Sheet 2

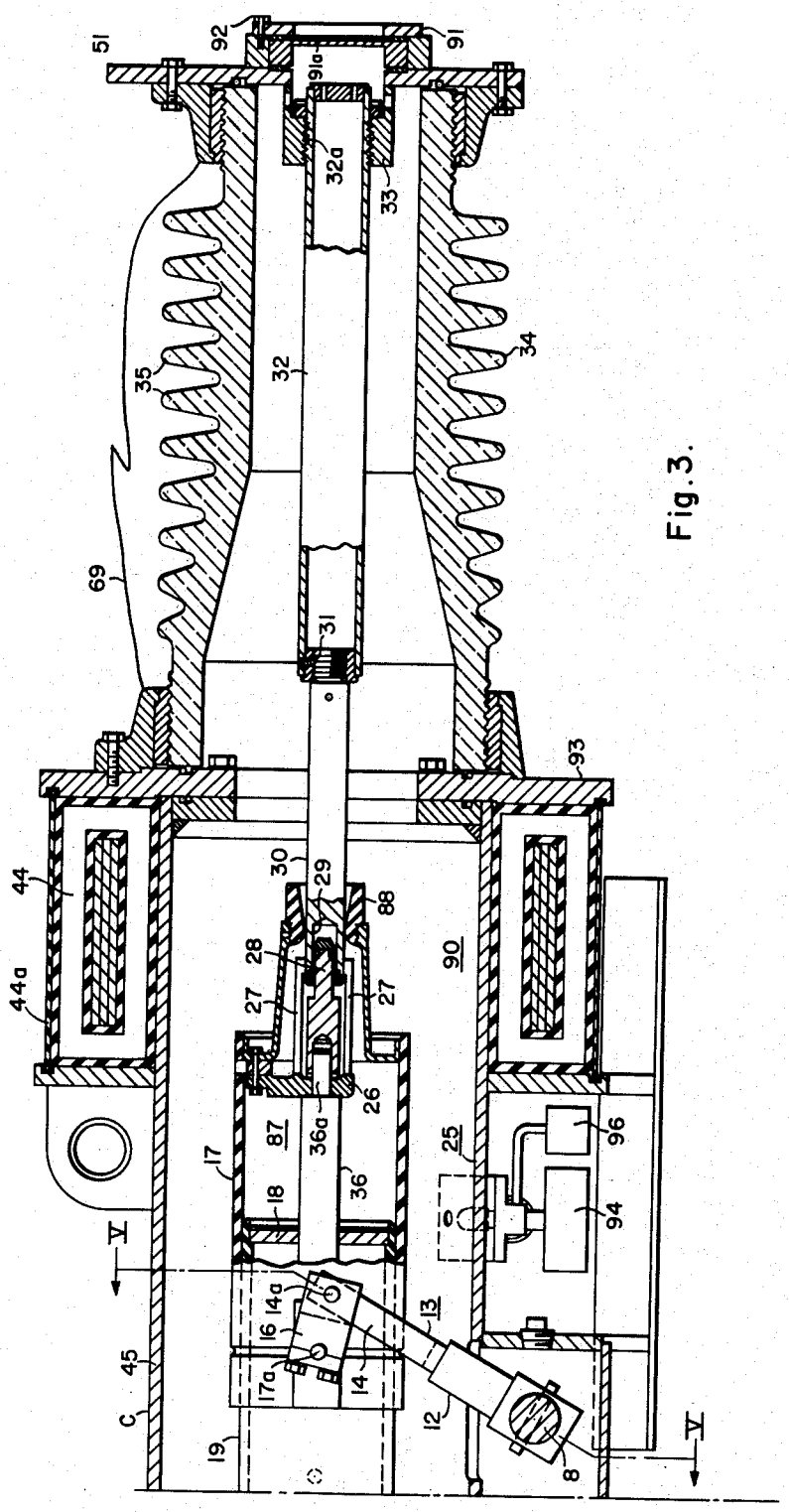


Fig. 3.

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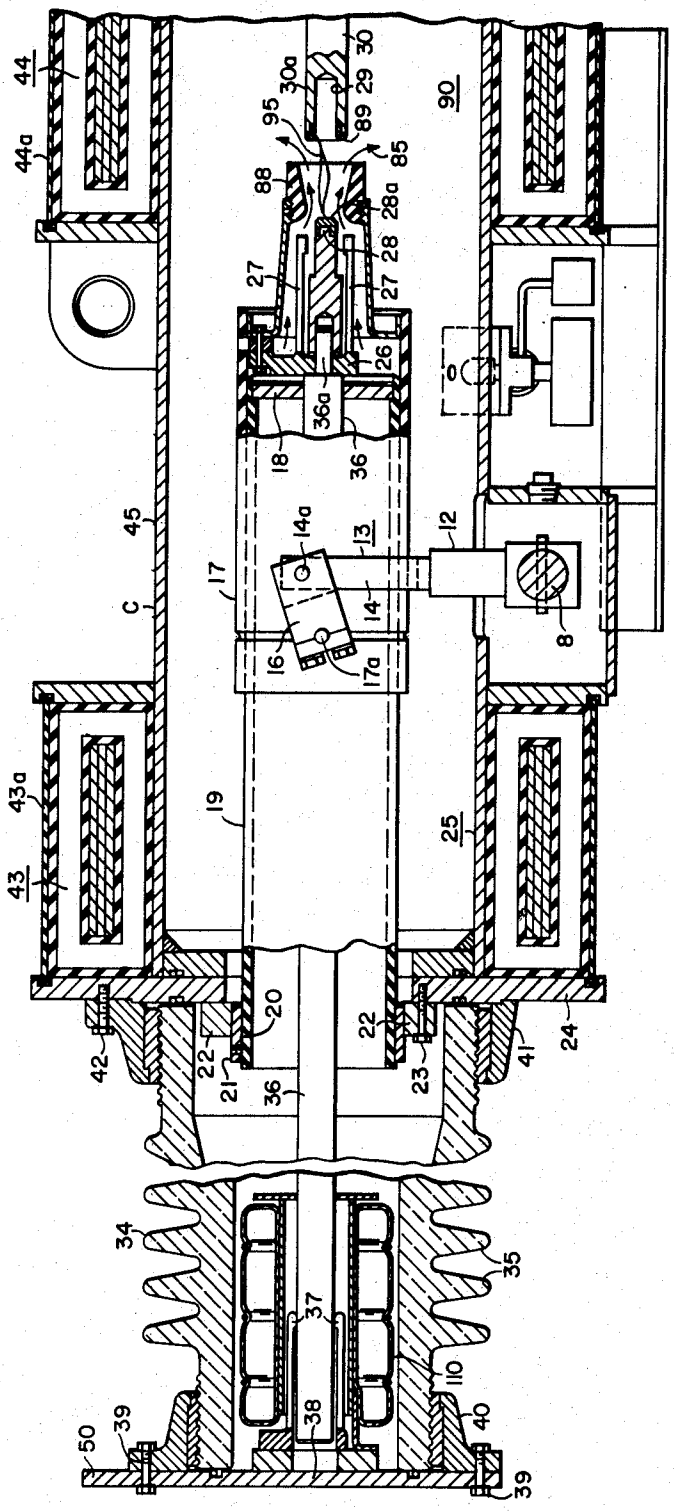


Fig. 4.

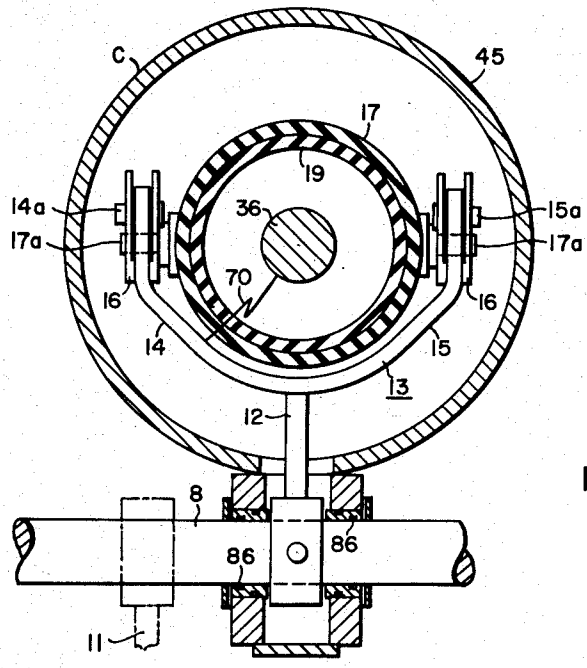
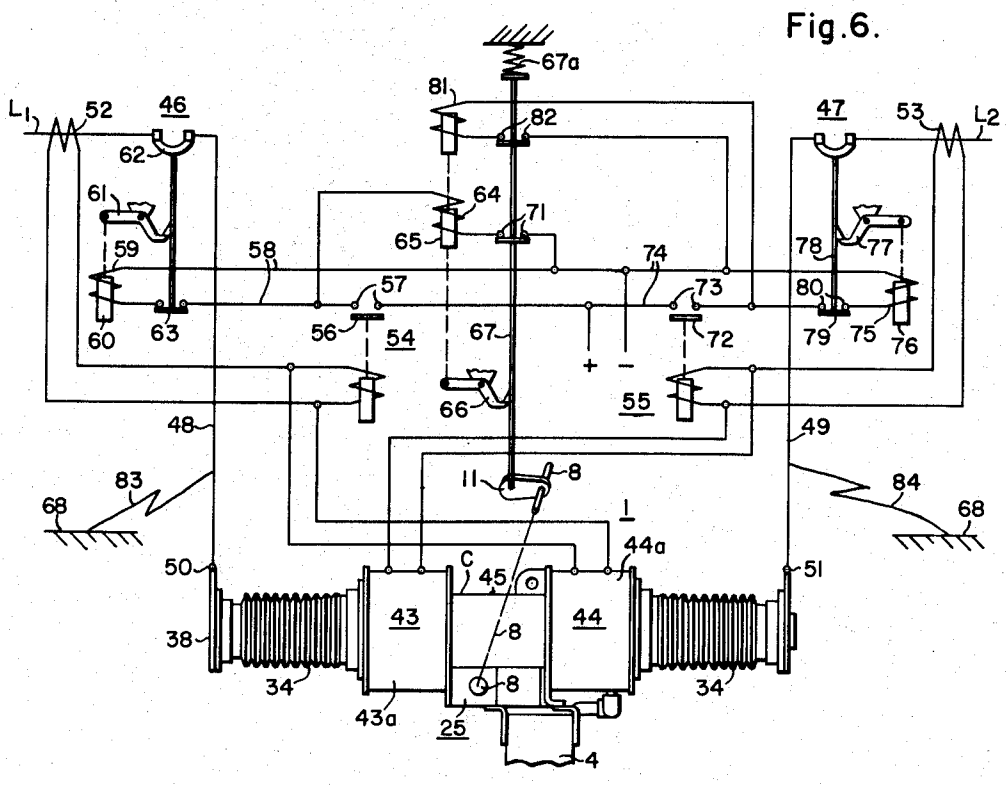

C
45
17
19
14a
36
15a
17a
17a
70
16
16
14
15
13
12
8
86
86
11

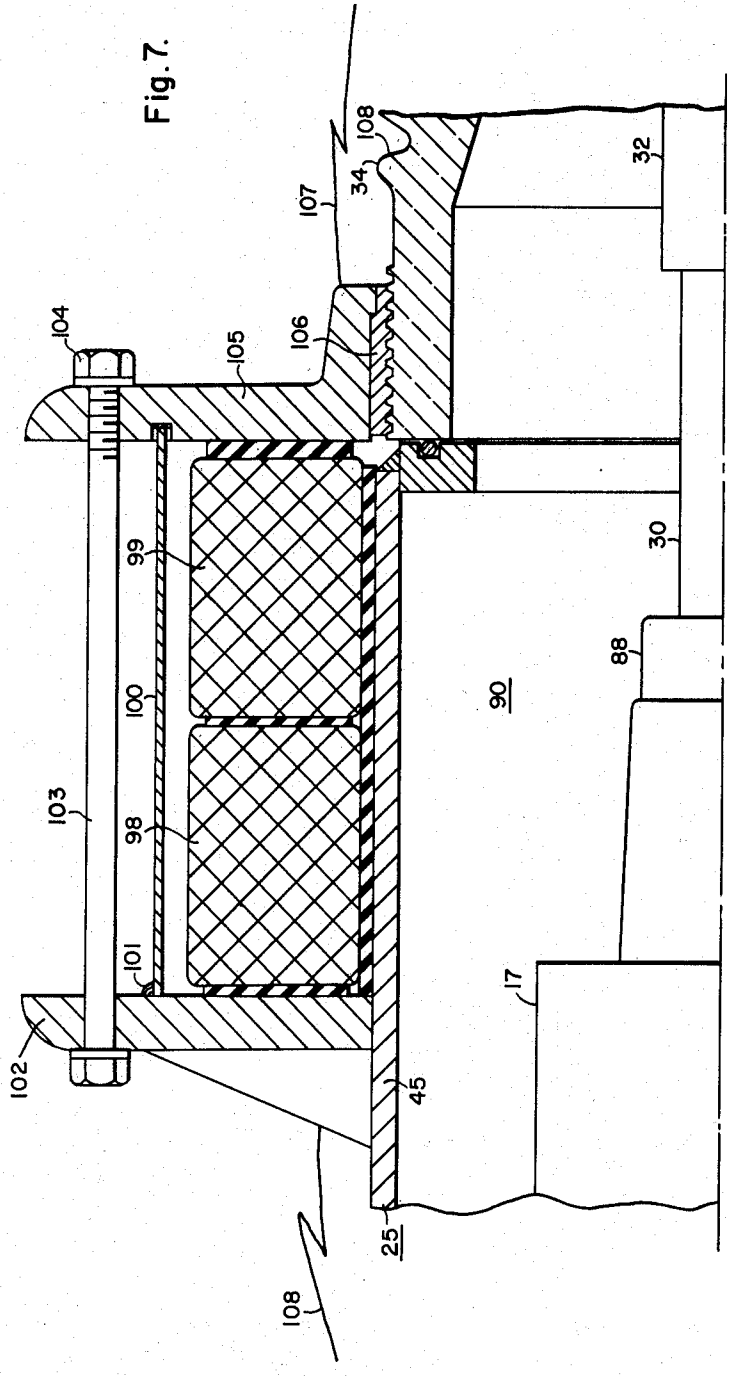
Fig.5.

Fig.6.


67a
81
82
L1
52
46
47
53
L2
62
61
64
71
65
59
58
74
78
77
57
73
80
60
63
56
54
67
72
79
75
76
+
−
55
66
48
49
11
8
83
84
68
68
1
44a
50
C
45
51
43
44
38
8
34
34
8
43a
25
4

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Fig. 7.



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3,114,815

FLUID-BLAST CIRCUIT INTERRUPTER WITH IMPROVED CURRENT-TRANSFORMER HOUSING MEANS

Gilbert J. Easley, Edgewood Borough, Robert L. Hess, North Versailles Township, Allegheny County, and James M. Telford, Penn Hills Borough, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Filed Nov. 18, 1959, Ser. No. 853,974
4 Claims. (Cl. 200—148)

This invention relates to fluid-blast circuit-interrupters, in general, and, more particularly, to improved arc-extinguishing structures, mounting arrangements and current-transformer housing means therefor.

In United States patent application filed September 15, 1959, Serial No. 840,133, by Robert E. Friedrich, Carl G. Lentjes, and George B. Cushing, and assigned to the assignee of the instant application, there is disclosed and claimed a fluid-blast circuit-interrupter of the puffer type, in which a relatively movable operating cylinder, carrying the movable contact structure, slides axially over a stationary hollow insulating pedestal having a relatively fixed piston attached thereto, to compress gas, and to force the compressed gas through an orifice structure to effect extinction of the arc drawn between the relatively movable contact and a cooperable stationary contact. It is a general object of the present invention to improve upon the circuit-interrupting structure of the aforesaid application, rendering the same particularly suitable for a simplified mounting construction, eliminating the terminal bushing, and employing a pair of current-transformer structures, between which any internal fault current flows to ground to obtain overlapping relay protection.

Another object of the present invention is to provide an improved simplified, puffer-type, circuit-interrupting structure, in which the number of parts are kept to a minimum, and assembly and disassembly operations are readily achieved.

Another object of the present invention is to provide an improved current-transformer arrangement, in which an insulating shield is employed to prevent the current-transformer being surrounded by a short-circuited turn of metal.

Another object of the present invention is to provide an improved fluid-blast-type of circuit-interrupter in which a pair of spaced current-transformers are arranged so that any fault occurring within the circuit-interrupting structure will pass to ground between the two current-transformers, and be reflected as an internal fault, causing thereby the tripping not only of the circuit-interrupter itself, but also the tripping of the remote circuit breakers connected to the considered circuit breaker.

Another object of the present invention is to provide an improved elongated circuit-interrupting structure in which the guiding functions for the movable contact assembly are facilitated, and the resulting structure is trouble-free in operation.

Yet a further object of the present invention is to provide an improved circuit-interrupter of the puffer-type, which is particularly suitable for the use of a high-dielectric-strength, effective, arc-extinguishing fluid, such as sulfur hexafluoride (SF_6).

Still a further object of the present invention is to provide an improved fluid-blast circuit-interrupter in which improved crank means are employed to effect the axial opening movement of the movable contact structure.

Another object of the present invention is to provide an improved circuit-interrupter in which the servicing and maintenance operations are readily achieved by the removal of only a few parts.

Another object of the present invention is to provide an improved simplified type of circuit-interrupter in which the movable contact structure, and the guiding support therefor, may readily be removed out of one end of the circuit-interrupting structure with a minimum of disassembly of parts.

Another object of the present invention is to provide an improved circuit-interrupter in which the adjustment of the parts is readily achieved.

Another object of the invention is to provide an improved gaseous-type of circuit-interrupter in which the enclosed gas is not only employed to create an arc-extinguishing blast of gas, but is also utilized as a gaseous dielectric medium between the high-voltage parts of the breaker and the grounded interrupter housing. As a result, a terminal-bushing construction is not necessary with associated organic insulation, which is subject to aging and possible eventual failure over a period of years.

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

FIGURE 1 is a front elevational view of a three-pole circuit-interrupting assemblage embodying the principles of the present invention;

FIG. 2 is a side elevational view of the circuit-interrupting assemblage of FIG. 1;

FIG. 3 is a fragmentary, enlarged, longitudinal, vertical sectional view taken through one of the three arc-extinguishing pole units, with the contact structure being illustrated in the closed-circuit position;

FIG. 4 is a similar fragmentary, longitudinal, vertical sectional view taken through the other end of the pole unit of FIG. 3, but illustrating the position of the contacts in the fully open-circuit position;

FIG. 5 is a vertical sectional view taken along the line V—V of FIG. 3;

FIG. 6 shows schematically the association with a single pole unit of remote protective circuit breakers and a differential protective relaying scheme for distinguishing between internal and external faults occurring at the pole unit; and,

FIG. 7 illustrates a modified type of current-transformer mounting arrangement to reflect porcelain flash-over faults associated with the circuit-interrupter as external faults, as contrasted with internal faults.

Referring to the drawings, and more particularly to FIGS. 1 and 2 thereof, the reference numeral **1** generally designates a three-pole circuit-interrupting assemblage, which is mounted at the upper end of a frame support **2**, the latter being welded to angle feet **3**, which may rest upon a suitable base. The reference letters A, B and C designate the three individual circuit-interrupting pole units, which are all identical in construction and operation.

FIG. 2 shows more clearly how the three circuit-interrupting pole units A, B and C, constituting a three-phase circuit-interrupter, are mounted at the upper end of the frame support **2**. The frame support **2** preferably includes a pair of upstanding channel members **4**, which have cross-braces **5**, **6** welded thereacross. Disposed between the uprights **4**, and positioned between the cross-braces **5**, **6** is a mechanism compartment **7**, housing a suitable operating mechanism, which effects simultaneous opening and closing movement of three identical pole units A, B and C of the circuit-interrupting assemblage **1**.

A rotatable operating shaft **8** mechanically interconnects the three pole units A, B and C. As well known by those skilled in the art, a crank-arm assembly **11** (FIG. 5) is employed within a compartment **9** (FIG. 1) and is pivotally connected to a pull-rod extending downwardly within an enclosing tube **10** to be connected to the operating mechanism enclosed within the mechanism compartment

7. Generally, the actuating mechanism disposed within compartment 7 may be of any suitable type, and is operated to effect upward thrusting motion of the operating rod within the tube 10 during the opening stroke. This action is facilitated by opening accelerating springs, not shown, also disposed within the vertical housing tube 10. A suitable operating mechanism, not shown, is provided to effect the closing of the circuit-interrupter and a charging of the aforesaid accelerating spring.

The operating mechanism may be of any desired type such as pneumatic, hydraulic, or may comprise a solenoid for effecting downward closing motion of the operating rod disposed within enclosing tube 10.

With reference to FIG. 5, it will be noted that the rotatable operating shaft 8 is keyed to an internally disposed operating crank-arm 12, which is welded to a forked member 13. The ends of the furcations, or arms 14, 15 of the resulting bifurcated crank-arm construction are pivotally connected by pins 14*a*, 15*a* (FIG. 3) to links 16 disposed externally of a movable puffer cylinder 17. Jutting laterally outwardly from diametrically opposite sides of the puffer cylinder 17 are a pair of pivot pins 17*a* to which the driving links 16 are connected. Thus, as viewed in FIG. 4, the counterclockwise rotation of the operating shaft 8 is effective to force the links 16 toward the left, and to effect leftward working motion of the operating puffer cylinder 17 over a stationary piston 18 secured to the right-hand end of a hollow insulating guide tube, or pedestal 19. As shown, the hollow insulating guide tube 19 is threadedly secured, as at 20, to a collar 21, which is secured to an annular mounting plate 22, the latter being bolted, by bolts 23, to a closure plate, or combined end support plate 24 of a grounded interrupter housing, generally designated by the reference numeral 25.

As illustrated in FIG. 3, the operating cylinder 17 carries a movable contact support 26, the latter having integrally formed movable main contact fingers 27 and is secured, by a stud portion 36*a*, of guide rod 36, to a centrally-located movable arcing electrode 28. The movable arcing electrode 28 engages within a hollow portion 29 of a relatively stationary rod-shaped contact 30.

The relatively stationary rod-shaped contact 30 is fixedly secured, as at 31, to a conducting support tube 32, the latter being adjustably secured within a mounting boss 33, disposed at the right-hand end of the circuit-interrupting pole unit.

It will be noted that jutting outwardly in opposite directions from the centrally disposed interrupter housing 25 are a pair of identical insulating casings 34, preferably composed of a suitable weather-proof material, such as porcelain. Corrugations 35 may be formed along the external surface of the porcelain casing 34 for providing an increased surface breakdown path.

As shown in FIG. 3, it will be observed that the movable contact support 26 is threadedly secured, by the stud portion 36*a*, to the conducting guide rod 36, which is guided at its left-hand end, as viewed in FIG. 4, by a plurality of resilient fingers 37, which carry current therefrom to a terminal plate 38.

The terminal plate 38 is fixedly secured by bolts 39 to an annular mounting flange 40, cemented to the left-hand end of the left-hand porcelain casing 34. The right-hand end of the left-hand casing 34 similarly has cemented thereto an annular mounting flange 41, which is bolted by bolts 42 to the closure plate 24 of the interrupter housing 25.

A pair of current-transformers 43, 44 are provided in spaced relation externally of the tubular portion 45 of the grounded interrupter housing 25. They are so arranged that any internal breakdown, or internal fault condition occurring within the circuit-interrupter pole unit will pass to ground between them, to be reflected as an internal fault condition, and, consequently, will result in a tripping of the remote circuit breakers 46, 47, respectively connected, by line connections 48, 49 to the terminals 50, 51 as more clearly shown in FIG. 6 of the drawings. Thus, the line L_1 passes through the circuit breaker 46, the circuit-interrupter pole unit, and through the other remote circuit breaker 47 to the remote line L_2. Current-transformers 52, 53 are associated with the lines L_1, L_2 and measure the current passing through circuit-interrupters 46, 47, respectively.

A pair of differential protective relays 54, 55 are provided, their windings being connected in parallel with the secondary windings of the current-transformers 52, 44 and 43, 53, respectively, as illustrated in FIG. 6 of the drawing.

When the differential relay 54 picks up to close the bridging contact 56 across the stationary contacts 57, a tripping circuit 58 is made up, to energize the coil 59 of a tripping magnet 60, which releases a latch 61 to permit opening of the movable bridging contact 62 of the remote circuit-interrupter 46.

Tripping the circuit-interrupter 46 open results in the opening of an auxiliary set of contacts 63, which de-energizes the tripping circuit through coil 59. As shown in FIG. 6, the tripping circuit 58 also energizes a solenoid 64 to move an armature 65 upwardly, which results in releasing the latch 66 to permit opening of the circuit-interrupting pole unit 1. More specifically, an operating rod 67 is shown as being biased in an opening direction by an accelerating spring 67*a* to effect opening, rotative counterclockwise motion of the operating shaft 8. Upon tripping the breaker, the winding 64 is de-energized by the opening of a set of contacts 71, which open upon opening motion of the circuit-interrupter pole unit.

Similarly, the differential relay 55 is operative to pick up a bridging contact 72, which bridges a pair of stationary contacts 73, and makes up a tripping circuit 74. The tripping circuit 74 energizes a trip winding 75, which moves an armature 76 upwardly and releases a latch 77 to effect opening of the remote circuit-interrupter 47.

The opening of the circuit-interrupter 47 results in downward movement of an operating rod 78 associated therewith which effects opening of an auxiliary bridging contact 79 from a pair of stationary contacts 80 to de-energize the winding 75.

In addition, the tripping circuit 74 also energizes a coil 81, which releases the latch 66 in a manner as previously explained, to effect opening of the circuit-interrupter pole unit. Auxiliary contacts 82, associated with the operating rod 67 of the circuit-interrupter pole unit, effect, upon opening of the circuit-interrupter pole unit, de-energization of the tripping solenoid 81.

Should an external fault condition occur from the line 48 to ground 68, as indicated by the reference numeral 83, and assuming that the current flows from the line L_1 toward the line L_2, it will be obvious to those skilled in the art that only the differential relay 54 is picked up, the differential relay 55 remaining de-energized. The result of the foregoing condition is that only the circuit-interrupter pole unit and interrupter 46 are opened, with the remote circuit-interrupter 47 remaining closed, which is desirable.

If the current flows from the direction of the line L_2 toward the line L_1, and a fault condition occurs externally of the circuit-interrupter pole unit, as at the location 83, again the differential relay 54 will be picked up by the measurement of current from the current transformer 44, and no current being indicated in the secondary winding of the current-transformer 52. On the other hand, since the current-transformer windings 43, 53 measure the same fault current, the differential relay 55 will not be picked up. Similar conditions would arise should an external fault take place at the location 84, that is, opening of only one differential relay, this time differential relay 55, differential relay 54 remaining de-energized. As a result of this action, only the circuit-interrupters 1 and 47 would open, circuit-interrupter 46 remaining closed, which is desirable.

Assume, however, that an internal fault condition takes place, such as designated by the reference numeral **69** in FIG. 3, or **70** in FIG. 5, which the breaker **1** is unable itself to clear. As mentioned previously, the fault current in such cases will flow to ground **68** (FIG. 1) between the two current-transformers **43**, **44**. This arises because of the fact that each of the current-transformers **43**, **44** has an external insulating cover **43***a* and **44***a*, which compels any fault current, such as the fault current **69** to flow to ground **68** between the two current-transformers **43**, **44**. As well known to those skilled in the art, such a passage of fault current between the two current-transformers **43**, **44** will effect the energization of both differential protective relays **54**, **55**, regardless of the direction of current flow, and will, consequently result in the tripping of all the breakers, namely, circuit-interrupters **1**, **46** and **47**.

Reference may be had to United States patent application filed March 31, 1958, Serial No. 725,286, now United States Patent 3,032,689, issued May 1, 1962, to Benjamin P. Baker and Robert F. Karlicek, and assigned to the assignee of the instant application, for a theoretical discussion of overlapping differential protective relay operation in distinguishing between external faults, which the breaker can clear, and internal faults, which the breaker cannot clear and require opening of both remote breakers.

By way of retrospect, during the opening operation, the mechanism disposed interiorly within the mechanism compartment **7** is effective to cause, through the linkage disposed within enclosing tube **10**, rotative opening movement of the operating rod **8** and extending between the three pole units A, B and C.

The counterclockwise rotative opening motion of the operating shaft **8**, as viewed in FIGS. 2 and 3, is transmitted interiorly of the interrupter housing by way of gas-tight seals **86** (FIG. 5) to effect counterclockwise, rotative, opening motion of the bifurcated crank-arm **12**.

As viewed in FIG. 3, the counterclockwise opening rotative motion of the bifurcated crank-arm **12** results, through the linkage **16**, in leftward opening movement of the outer operating puffer cylinder **17** over the inner stationary tubular pedestal **19**, which supports the fixed piston **18**. The result of this relative movement is compression of a suitable arc-extinguishing fluid, such as sulfur hexafluoride (SF_6) gas, within the compression chamber **87** (FIG. 3). The raising of the gas pressure within the compression chamber **87**, defined by the operating puffer cylinder **17** and the stationary piston **18**, results in the ejection of compressed arc-extinguishing gas past the movable contact support **26**, and out through the orifice **88**, carried by the movable puffer cylinder **17**, as indicated by the arrows **85** in FIG. 4.

Although FIG. 4 shows the fully open-circuit position of the circuit-interrupter **1**, nevertheless, for purposes of illustration, the established arc **95** has been indicated as well as the direction of the fluid blast.

The contact fingers **27** first separate from the outer sides **30***a* of the tip portion of the stationary rod contact **30**, and subsequently the arcing electrode **28** moves out of the recess **29** to effect drawing of the arc **95** between the tip extremity **28***a* and the arc-resisting stationary ring portion **89** of the stationary rod contact **30**. This arc **95**, shown in FIG. 4, is blasted by a flow of compressed sulfur-hexafluoride gas issuing from the compression chamber **87** and passing through the orifice **88**. Arc-extinction rapidly follows, and in the fully open-circuit position of the interrupter **1**, as indicated in FIG. 4, the position of the several parts is such that a stationary rod contact **30** is disposed externally of the movable orifice **88**.

It will be observed that during the opening motion, the puffer cylinder **17** is guided over the stationary inner pedestal tube **19**. In addition, the guide rod **36**, movable with the movable contact structure, is guided by the guide and contacting fingers **37**, shown in FIG. 4.

During the closing operation, the operating shaft **8**, as viewed in FIG. 3, is rotated in a clockwise direction. This effects through the linkage **16**, rightward closing travel of the outer puffer operating cylinder **17** and movable contact structure to result in closing of the contact structure, and a drawing of compressed gas from the region **90** into the region **87** interiorly of the operating cylinder **17**. Since this is fresh gas and is uncontaminated, the interrupter **1** is in a suitable condition for a subsequent reopening operation, if this is necessary.

The circuit-interrupting structure **1**, disclosed in FIG. 3, is particularly suitable for a moderate-rating circuit-interrupter, say operable on a circuit extending up, say, through 69 kv. By employing suitable dimensions higher voltages may be interrupted, and it is to be understood that the invention is not restricted to the lower voltages. Merely for purposes of illustration is the invention shown applied to a 46 kv. circuit-interrupter. Preferably, an effective arc-extinguishing fluid or gas, such as sulfur hexafluoride (SF_6) gas, at several atmospheres pressure, is disposed interiorly within the interrupting unit. The puffer-type interrupter, which is employed, is highly effective and is simple in operation. The sulfur hexafluoride (SF_6) gas is used for both the dielectric medium and for the interrupting medium. It is to be noted that the present interrupter has a centrally disposed, grounded interrupter housing **25** with symmetrical, identical, gas-filled porcelains **34** to form the bushings. In addition, it is to be noted that the current-transformers **43**, **44** are disposed outside of the casing **25**, defined partially by the tubular portion **45**, and use an insulated cover **43***a* or **44***a* for the outside transformer casings to prevent the current-transformers **43**, **44** being surrounded by a short-circuited turn of metal. Being isolated from the pressure tank **25** eliminates the need for gas-tight seals for leads for connection to the current-transformers **43** or **44**.

The outer operating cylinder **17**, being connected to the operating lever **12** by means of the connecting rod links **16**, permits the interrupter **1** to be disconnected from the operating lever **12** when the bushing casing **34** is removed from the left-hand end of the interrupter housing **25**.

Relatively stationary contact adjustment is made by turning a threaded stationary contact rod **32**, as at **32***a*, within the mounting boss **33**. This may be done, of course, following removal of the cover plate **91** following unscrewing of the bolts **92**.

A particular advantage of the circuit-interrupting assemblage **1** is that the mechanism compartment **7** hangs under the circuit-interrupter, making the whole unit adaptable for either pole or frame mounting.

A valve assembly may be associated with the grounded interrupting casing **25** to feed sulfur-hexafluoride (SF_6) gas into the interrupter casing. A pressure gauge **94** may be employed which is visible downwardly so that a station attendant may check the pressure conditions within the interrupter casing. A low-pressure switch **96** may be utilized to effect opening of the interrupter **1** upon the occurrence of low-pressure conditions, or to sound an alarm.

A rupture diaphragm **91***a* may be employed to rupture upon excess pressure due to an internal fault and thereby prevent shattering of the porcelain casings **34**. An activated alumina "getter" **110** may be used to absorb moisture and decomposed arc products.

From the foregoing description, it will be apparent that there has been provided an improved, simplified type of circuit-interrupter embodying few parts, which may be readily assembled and disassembled. Accessibility for service and maintenance is provided, it merely being necessary to remove one of the two porcelain casings **34** from the end plates **24**, **93** of the interrupter housing **25**. By employing a rotatable operating shaft **8**, the gas-tight

seals 86, illustrated in FIG. 5, are small and compact. Such ring-type seals 86 have proved, in practice, to be highly effective.

It will be noted that no terminal bushing, having organic insulation, is employed which might age and deteriorate through years of service. The enclosed gaseous medium, such as sulfur hexafluoride, is used not only for an effective arc-extinguishing blast of gas but also for dielectric strength between the high-voltage parts and the outer grounded interrupter casing 25. It is self-healing in the event of breakdown.

FIG. 7 illustrates a modified current-transformer mounting arrangement in which the surrounding current-transformers 98, 99 are surrounded by a conducting shield 100. The shield 100 may be welded, as at 101, to a mounting flange 102. Bolts 103 and nuts 104 clamp a second mounting flange 105 into position, the latter being cemented at 106 to the left-hand end of the insulator 34.

The current-transformer mounting arrangement, illustrated in FIG. 7, is suitable for those utility customers who desire all porcelain casing flash-over faults associated with the circuit-interrupter 1 to be reflected as external faults, as contrasted with internal faults. Any fault current, such as represented by the fault condition 107, flashing over the surface 108 of the porcelain casing 34 on one side of the breaker 1, will pass to ground independently of the current-transformers 98, 99. Since current-transformers 98, 99 are unaffected by such a fault condition 107, only a single remote breaker, such as breaker 47 on the same side of breaker 1, is affected together with the circuit-interrupter 1. The other remote breaker 46 on the other side of breaker 1 remains closed, which may be desirable in some circumstances.

In a similar manner, a flashover 108 on the other side of breaker 1, as indicated in FIG. 7, will cause opening only of breaker 1 and remote breaker 46, the breaker 47 remaining closed.

Thus the circuit-interrupter of the present invention may be arranged to have all faults associated therewith reflected as internal faults to open all breakers 1, 46, 47 by the arrangement according to FIG. 6. Or, as mentioned, where it is desirable to prevent opening of the remote breakers 46, 47 as much as possible, then the current-transformer arrangement of FIG. 7 may be employed, where interrupter 1 and only one of the two remote breakers 46, 47 open, keeping the rest of the system connected.

Although there have been shown and illustrated particular types of circuit-interrupting structures, it is to be clearly understood that the same were 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 as our invention:

1. A fluid-blast circuit-interrupter including an upright grounded frame support, a cylindrically-shaped, horizontally-extending, grounded, metallic interrupter housing extending substantially at right angles to said upright frame support and supported thereby, a pair of oppositely-extending insulating hollow cylindrical casings secured to opposite ends of said cylindrically-shaped interrupter housing, a line terminal disposed at the outer end of each horizontally-extending insulating casing, a pair of spaced current-transformers surrounding the grounded interrupter housing and supported thereby and having outer at least partially insulated concentrically-arranged current-transformer housing means so that any fault condition associated with the circuit-interrupter will pass to ground between the two current-transformers and be reflected as an internal fault condition, said current-transformer housing means including as an inner portion thereof said metallic interrupter housing, an end support plate closing one end of said current-transformer housing means and disposed adjacent one end of the metallic interrupter housing, a stationary horizontally-extending pedestal guide cylinder having a fixed piston secured adjacent one end thereof and disposed substantially concentrically within said cylindrically-shaped metallic interrupter housing, means securing said guide cylinder adjacent the other end thereof to said end support plate so that upon removal of the end support plate from the metallic interrupter housing the pedestal guide cylinder will be removed therewith as well as exposing said current-transformer housing means, a movable operating puffer cylinder carrying a movable contact and orifice slidable over said horizontally-extending guide cylinder and guided thereby, a rod-shaped stationary contact extending along one of said hollow insulating casings interiorly thereof and cooperable with said movable contact, a reciprocally movable conducting guide rod connected to said movable contact and extending through the other hollow cylindrical casing, and guiding current transfer means conductively engaging the outer portion of said guide rod to transfer current therefrom to the respective line terminal, whereby upon removal of said end support plate exposing said concentrically-arranged current-transformer housing means the pedestal guide cylinder, puffer operating cylinder, and movable contact will be removed therewith for inspection and possible replacement.

2. The combination of claim 1, wherein the hollow casings and the interrupter housing are filled with a high-dielectric-strength gas comprising sulfur hexafluoride (SF_6).

3. The combination of claim 1, wherein rotatable operating crank means extending within the interrupter housing are employed to effect reciprocal movement of the puffer operating cylinder.

4. The combination of claim 1, wherein the current-transformer housing means includes a separate spaced housing for each of two current transformers and each housing has an end plate associated therewith.

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