United States Patent

Kane et al.

[15] **3,688,061**

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[54] **IMPROVED COMPRESSED-GAS CIRCUIT INTERRUPTER WITH SPLIT CURRENT-TRANSFORMER HOUSING FOR READY DISASSEMBLY**

[72] Inventors: **Richard E. Kane,** 1255 Holy Cross Dr., Monroeville, Pa. 15146; **Robert L. Hess,** 329 Delaware Ave., North Versailles, Pa. 15137

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[52] **U.S. Cl.** ..... **200/148 R,** 200/148 B

[51] **Int. Cl.** **H01h 33/54**

[58] **Field of Search** ..... 200/148 B, 148

[56] **References Cited**

UNITED STATES PATENTS

2,459,612	1/1949	Baker	200/148 B
3,284,602	11/1966	Friedrich et al.	200/148 B

FOREIGN PATENTS OR APPLICATIONS

1,231,477	9/1960	France	200/148
972,733	10/1964	Great Britain	200/148

Primary Examiner—Robert S. Macon

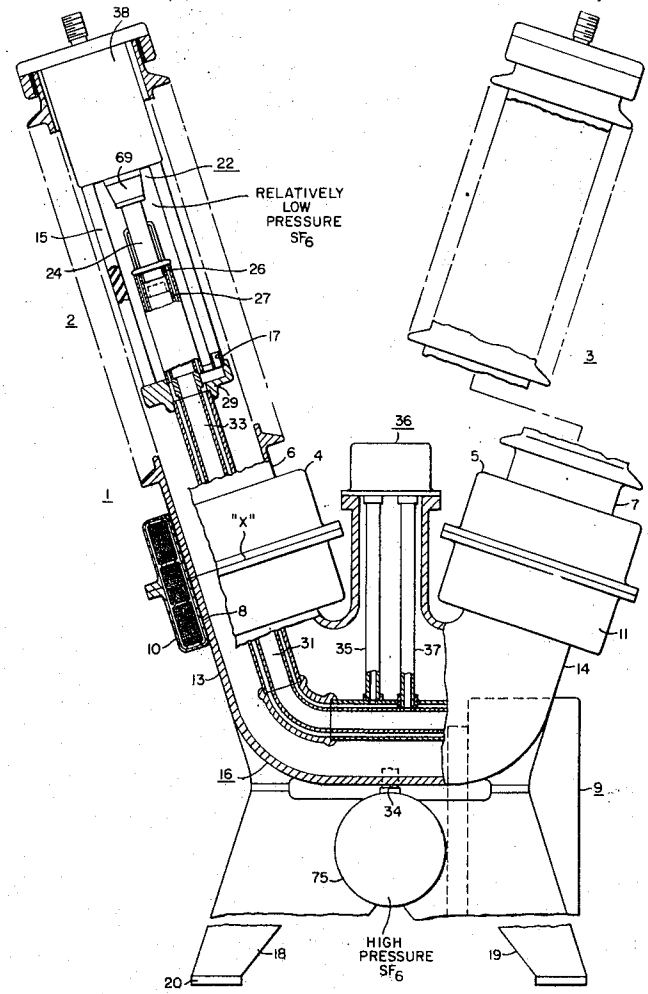
Attorney—A. T. Stratton, Clement L. McHale and Willard R. Crout

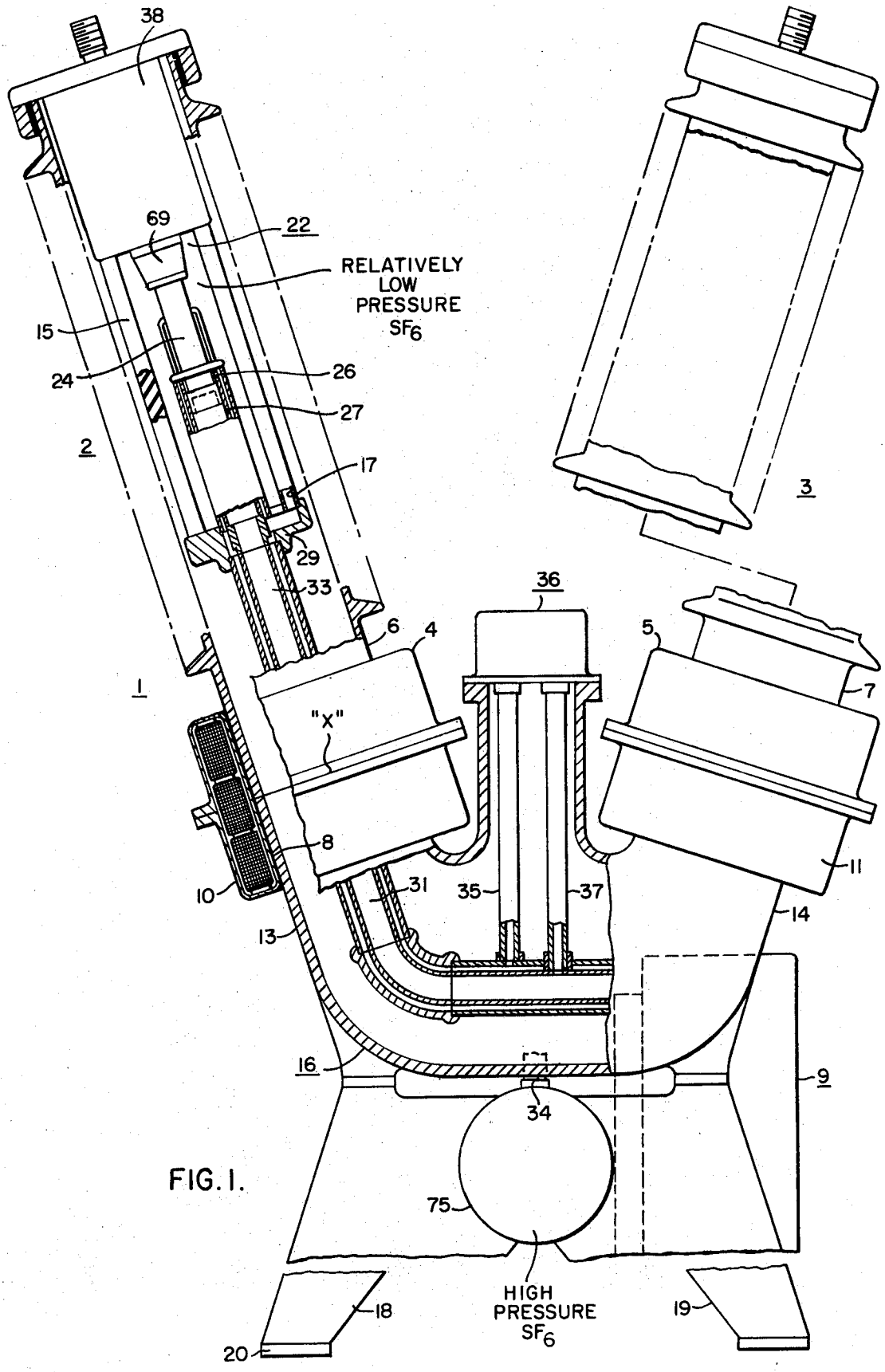
[57] **ABSTRACT**

A gas-blast circuit interrupter has a substantially V-shape with two insulating interrupter columns extending angularly upwardly away from a grounded generally V-shaped lower metallic supporting housing. The arrangement is such that a grounded split current-transformer housing is employed, one split current-transformer housing section being fixedly secured to the lower end of each interrupter column, and the other current-transformer housing section being fixedly secured to the upper tubular supporting portion of the lower generally V-shaped grounded supporting housing. By the clamping together of the two current-transformer housing sections, a ready attachment and detachment is effected for the quick assembly and disassembly of the circuit interrupter.

A blast-valve, stationary contact assembly and high-pressure reservoir is disposed, as an assembly, at the upper end of each of the two interrupter columns. A cooperable movable tubular contact, having a piston secured thereto, moves generally downwardly during the opening operation, with the high and low-pressure feed tubes to the operating cylinder being generally concentric, with a tubular line-conductor, which passes generally axially down the center of the interrupter column, and makes a U-bend within the lower generally V-shaped supporting metallic housing.

6 Claims, 7 Drawing Figures

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69
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RELATIVELY LOW PRESSURE SF_6
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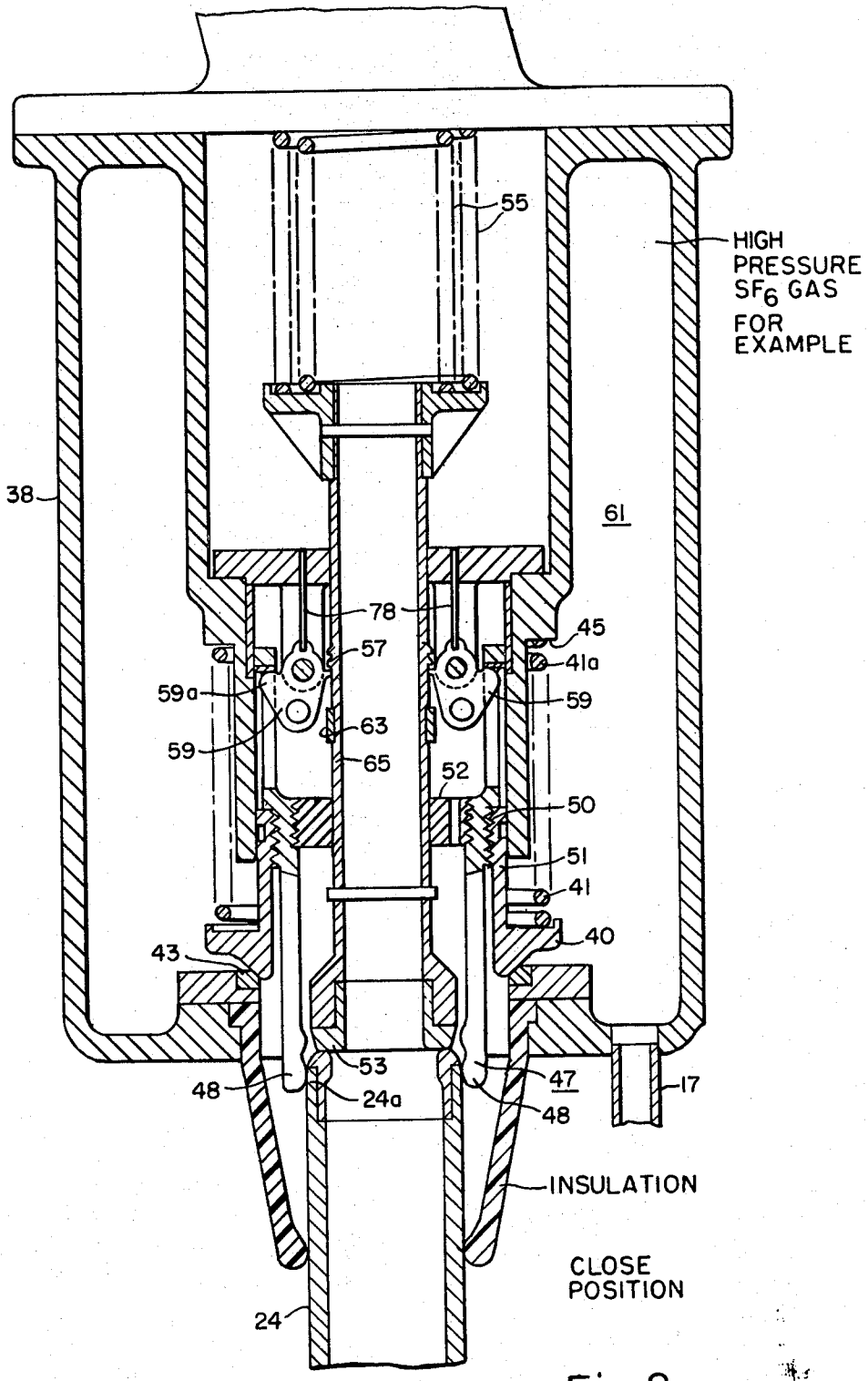
24
26
27
2
17
29
33
36
6
4
5
7
1
"X"
8
10
31
35
37
11
13
14
16
9
34
75
HIGH PRESSURE SF_6
18
19
20
3

FIG. 1.


55
HIGH PRESSURE SF_6 GAS FOR EXAMPLE
38
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59
63
59
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52
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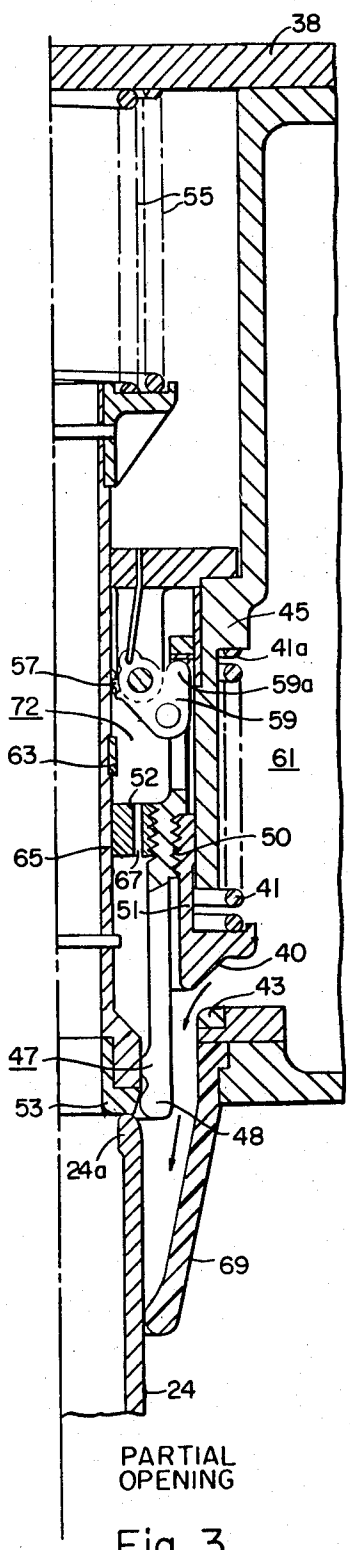
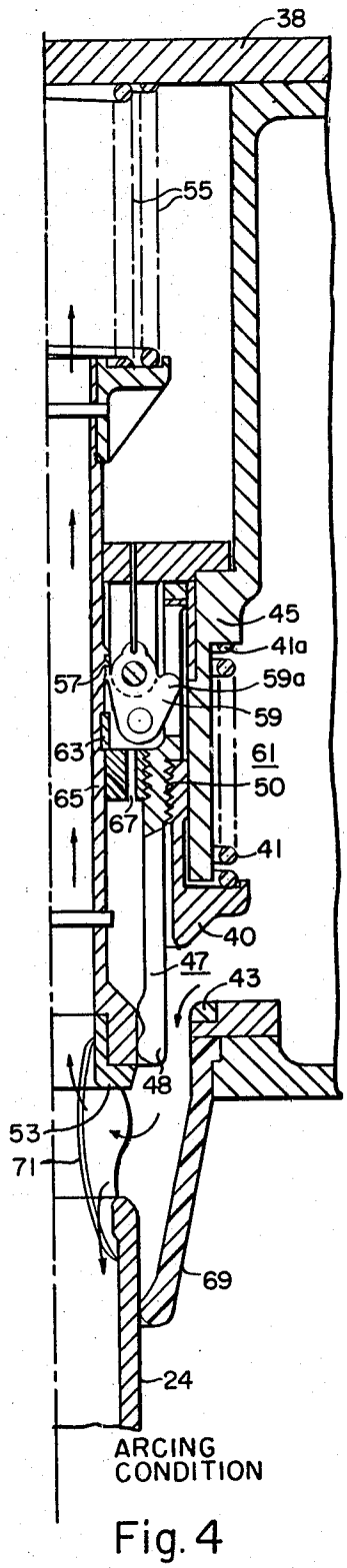
40
43
53
47
17
48
24a
48
INSULATION
CLOSE POSITION
24

Fig. 2



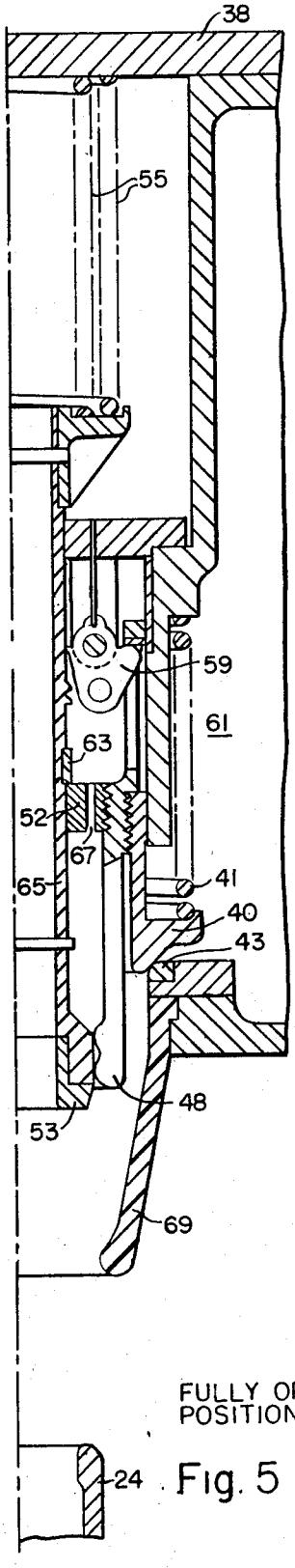
PARTIAL OPENING

Fig. 3



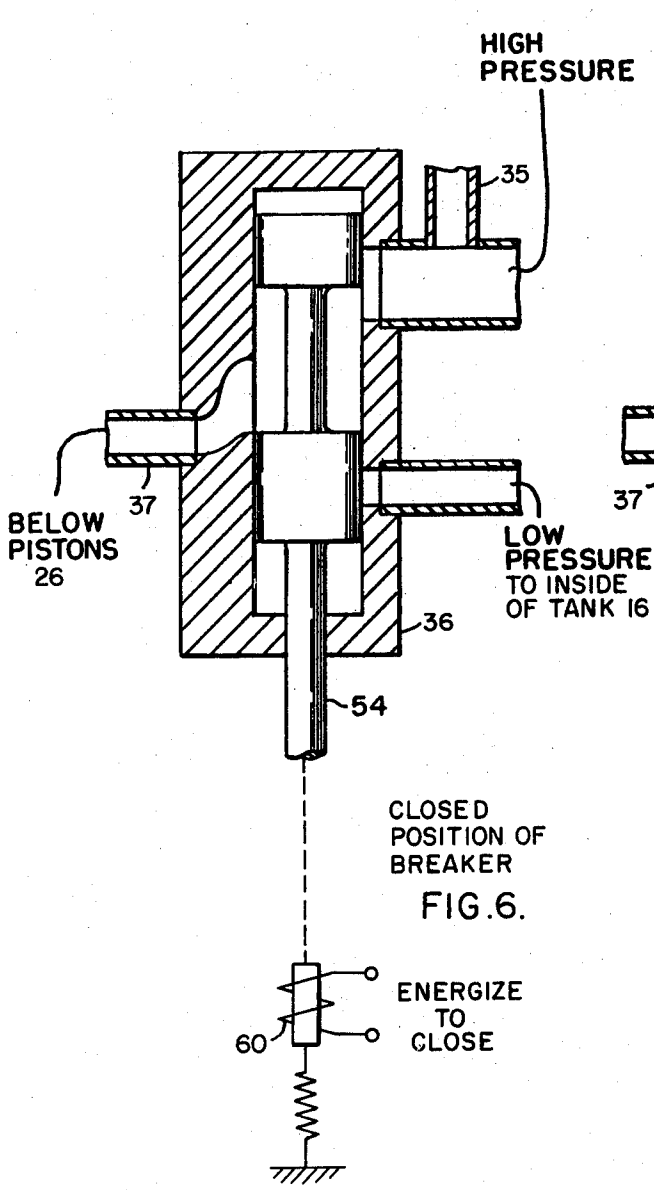
ARCING CONDITION

Fig. 4



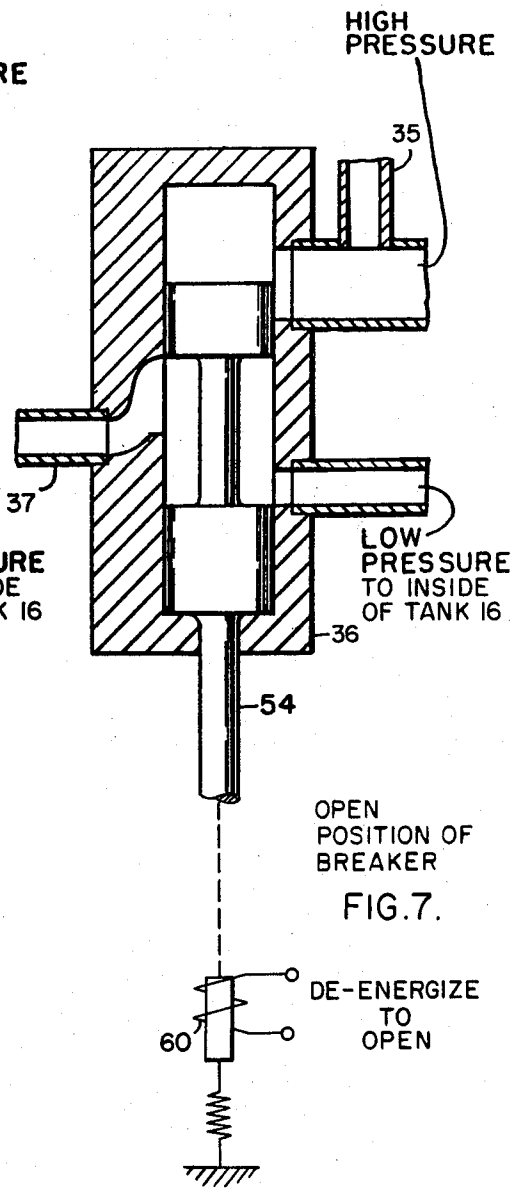
FULLY OPEN POSITION

Fig. 5



CLOSED POSITION OF BREAKER

FIG.6.



OPEN POSITION OF BREAKER

FIG.7.

IMPROVED COMPRESSED-GAS CIRCUIT INTERRUPTER WITH SPLIT CURRENT-TRANSFORMER HOUSING FOR READY DISASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATIONS

Reference is made to United States patent application filed Dec. 9, 1968, Ser. No. 782,365 entitled Compressed-Gas Circuit Interrupter, by Richard E. Kane and Frank L. Reese, and assigned to the assignee of the instant application. Also, reference may be made to United States patent application Ser. No. 813,441, filed Apr. 4, 1969, by Richard E. Kane and Robert L. Hess and Ser. No. 4485, filed Jan. 21, 1970, by Richard E. Kane and Robert L. Hess, also assigned to the same assignee.

BACKGROUND OF THE INVENTION

It is well known to provide a dual-pressure compressed-gas circuit interrupter in which a high-pressure gas is released from a high-pressure gas reservoir through an insulating orifice, or interrupter chamber, and through the interior of a movable tubular contact. U.S. Pat. No. 3,154,658 issued Oct. 27, 1964 to Robert G. Colclaser, Jr. and Russell N. Yeckley illustrates such a construction. To effect a saving of space, and to provide a construction which eliminates the use of a heavy metallic tank, it is desirable to use insulating interrupter columns, such as shown in the aforesaid patent application Ser. No. 782,365, by Kane and Reese. However, for certain ratings, it is desirable to avoid the use of a high-pressure gas within the general interior of the interrupter chamber, and to utilize what is known in the art as an "upstream" blast-valve type of interrupter, which controls the blasting of gas through the arc and into a generally low-pressure region. U.S. Pat. No. 3,154,658 illustrates such an overall interrupting arrangement.

SUMMARY OF THE INVENTION

For certain applications, and for certain ratings, it is desirable to provide a compact, generally lightweight compressed-gas circuit interrupter construction having a mounting arrangement in which rapid assembly and disassembly operations may be readily achieved. It is, accordingly, a general object of the present invention to provide an improved dual-pressure compressed-gas type of circuit interrupter of the "upstream" variety, in which a blast of high-pressure gas is released through the arc and into a generally low-pressure surrounding region.

It is an additional object of the present invention to provide a high-power high-speed circuit interrupter of compact dimensions, which has a novel feed-tube locating arrangement supported on the line conductor, which extends and interconnects the two serially related arc-interrupting units.

Yet a further object of the present invention is the provision of an improved dual-pressure compact type of circuit interrupter in which the movable contact is pressure-operated, and the actuating means therefor is of simplified and compact construction.

Still a further object of the present invention is the provision of an improved interrupting unit in which the supporting elements therefor may be used for the supply of high-pressure gas into the high-pressure reservoir chamber.

Still another object of the present invention is the provision of an improved current-transformer mounting arrangement for a high-power circuit interrupter.

Another object of the present invention is the provision of an improved high-power compressed-gas circuit interrupter of simplified construction, and involving few parts paralleling the high voltage in the open-circuit position of the interrupter.

According to a preferred embodiment of the invention, a generally V-shaped circuit-interrupter arrangement is utilized having insulating interrupter columns, the lower ends of which are attached to current-transformer housing sections. The columns are detachably secured to current-transformer housing sections fixedly secured to upstanding grounded metallic supporting tubular portions of a lower generally V-shaped supporting metallic base casing, which is preferably at ground potential. A generally V-shaped line-conductor tube extends through the interrupter, and supports concentrically thereabout pressurized feed tubes for effecting the opening and closing operation of movable contacts, which are desirably piston-actuated.

The movable contacts, which are preferably tubular, coact with stationary contact structures, which are disposed at the upper ends of the insulating interrupter columns in association with insulating arcing chambers, which serve to direct the high-pressure gas flow against the arc.

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 is a sectional view, partially in side elevation, of a compressed-gas circuit interrupter embodying the principles of the present invention, the contact structure being illustrated in the closed-circuit position;

FIG. 2 is an enlarged vertical sectional view taken through the blast-valve and contact housing of the device, 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 in an intermediate portion of the opening operation, before arcing has taken place;

FIG. 4 is a view similar to FIG. 3, but illustrating the blast-valve open, the arc drawn, and the gas blast in the process of extinguishing the arc;

FIG. 5 shows the fully open-circuit position of the contact structure with the blast valve closed; and

FIGS. 6 and 7 illustrate two positions of the control-valve spool.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, and with particular reference being directed to FIG. 1, it will be observed that there is provided a generally V-shaped compressed-gas circuit interrupter, generally designated by the reference numeral 1. As shown, the circuit interrupter 1 comprises two insulating columns 2, 3 having current-transformer housing sections 4, 5 fixedly

secured to the lower ends 6, 7 thereof, as by a suitable cement 8, for example. The cooperating current-transformer housing sections 10, 11 are fixedly secured, as by cement, to upstanding tubular supporting portions 13, 14 of a lower grounded metallic generally V-shaped base casing, generally designated by the reference numeral 16, and supported by upstanding support pedestals 18, 19. The latter may rest upon a foundation 20. A control and gas system housing 9 may be suitably attached to the metallic casing 16.

Within each of the upstanding interrupter columns 2, 3 there is provided a circuit-interrupter unit, generally designated by the reference numeral 22, and comprising a movable tubular contact 24 having a piston 26 secured thereto at its lower end. The actuating piston 26 for each movable tubular contact 24 reciprocally moves within an operating cylinder, generally designated by reference numeral 27, and supported upon a lower end adaptor plate 29. Interconnecting the two end plates 29 is a tubular pressurized line current conductor 33, which extends generally centrally through the lower grounded metallic casing portion 16, and additionally supports an inner insulating feed tube 31 at alternating high and low pressure. The latter is pneumatically connected, by way of tube 35, to a control valve, generally designated by the reference numeral 36, and illustrated more clearly in FIGS. 6 and 7 of the drawings.

The casings 2 and 3 preferably contain a low-pressure arc-extinguishing gas, such as sulfur-hexafluoride (SF_6) gas, for example, at a pressure of, say 60 p.s.i.

Situated at the extreme upper end of each interrupter casing 2, 3 is a combined blast-valve and stationary contact housing 38, more clearly illustrated in FIGS. 2–5 of the drawings. It will be observed that there is provided a movable blast-valve 40, which is biased by a compression spring 41 to the closed position against a blast-valve seat 43, as shown in FIG. 5. The blast-valve spring 41 has its left-hand end 41a seated upon an annular metallic support 45. Fixedly secured to the movable blast-valve 40 is a relatively stationary contact assembly 47, comprising a plurality of circumferential contact fingers 48, provided, for example, by slotting a stationary contact tube, the latter being threaded, as at 50, to the blast-valve support 51. As shown in FIG. 2, the stationary contact fingers 48 make contacting engagement with the upper extremities 24*a* of the movable tubular contacts 24.

A movable arc-horn follower 53 makes abutting engagement with the end extremity 24*a* of the movable tubular contact 24, and is biased in the opening direction of the movable tubular contact 24 by a battery of compression springs 55. A rack 57 is attached to, and movable with, the arc-horn follower support 53 and serves, during the opening operation, to engage a rotatable latch 59 to effect a counterclockwise rotative motion of the latter. The latch 59 carries a lug portion 59*a*, which serves to initiate opening of the movable blast-valve 40. The blast-valve 40, when open, utilizes the high-pressure gas within the region 61 to continue its opening operation independently of the latch 59. As a result, the blast valve 40 will move upwardly, as shown in FIG. 4, whereas the arc-horn follower 53 will move downwardly being biased in this direction by the biasing springs 55. A stop portion 63, secured to the arc-horn follower support tube 65, engages an abutment 52 carried by the blast-valve 40, and abuts the latter during the initial portion of the opening operation, as shown in FIG. 4. When this occurs, due to the pressure conditions, the arc-horn follower 53 will reverse its downward direction, and be carried upwardly by the blast-valve 40 despite the biasing action exerted by the springs 55. The blast-valve 40 and the arc-horn follower 53 will then move to their entirely retracted upward position, as illustrated in FIG. 4 of the drawings. At this time, the arc 71 will be blasted by high-pressure gas issuing from the high-pressure reservoir 61.

Due to the provision of one or more pressure-equalizing openings 67, the pressure will pass therethrough and equalize between the chambers 61, 72, thereby permitting the springs 55 to overcome the gas pressure and retract the blast-valve 40 downwardly to its closed position, and also causing the arc-horn follower support tube 65 to move to its fully extended position, as illustrated in FIG. 5. The breaker 1 is then in a fully open circuit position.

By way of recapitulation, FIG. 1 illustrates the breaker being shown in the closed position. It is held closed with high-pressure sulfur-hexafluoride (SF_6) gas acting on the bottom of the piston 26, which overcomes the pressure on the top because of the differential areas. A latch, or catch (not shown) can be provided to mechanically hold the contacts 24 in this closed position, if desired. To open the circuit breaker 1 the control valve 36 is electrically operated, reversing the port 37 within the valve 36 from high to low pressure. This dumps the high pressure on the bottom of the moving contact piston 26, driving the piston 26 and moving contact 24 downwardly, and out of the relatively stationary contact fingers 48. Within the blast valve and contact housing 38, a spring-biased arc horn 53 follows the downward travel of the moving contact 24 for a short distance. This downward motion is transferred, by means of a latch 59, as shown in FIG. 3, to the blast-valve 40, which then opens and dumps high-pressure gas from the chamber 61 through the orifice 69 extinguishing the arc 71.

The blast-valve chamber 72 is designed so that after a short period, the pressure is equalized on either side of the valve 40 through the openings 67. Having more area on top of the valve 40 now exposed to high pressure from chamber 61 and additionally being biased by a spring 41, the valve 40 now closes, thereby stopping gas flow through the orifice, or interrupter chamber 69 and thus conserving high-pressure gas.

To close the circuit breaker 1, the control-valve port 7 is reversed electrically. This puts high pressure on the bottom of the piston 26, and because of the differential area on the top to bottom of the piston 26, the piston and moving contact 24 is forced upwardly into the contact fingers 48, thereby closing the circuit breaker 1, as shown in FIG. 2.

FIG. 2 shows the general arrangement of the parts of the operator with the breaker 1 in the closed position. The moving contact 24 is engaged within the finger contacts 48, and the spring-biased follower 53 is in abutting contact with the tip 24*a* of the moving tubular contact 24. The blast-valve 40 is closed. The latches 59 are in their neutral position, and held in this position by

the wire spring rods 78. FIGS. 3–5 shows the sequence of the opening operation of the various parts. When the breaker 1 is starting its opening cycle, the moving contact 24 is extracted, or lowered from the contact fingers 48. Being spring loaded, as by springs 55, the contact follower 53 moves downwardly with the moving tubular contact 24. This movement of the contact follower 53 rotates the latch assemblies 59 by means of teeth 56 (FIG. 8) on the body of the follower 65 engaging the latches 59. This rotation of the latches 59 lifts the blast valve 40 off its seat 43, and moves it in the opposite direction of the contact follower and moving contact, that is in an upward direction, as viewed in the drawing. The contact fingers 48 move upwardly with the blast valve 40 as one unit. The second contact hump or stop 52, behind the tip of the finger contact 48 provides a contact point of abutment for engagement with the contact follower 53. Thus, the arcing, during interruption, is confined to the tip of the moving contact 24 and contact follower 53, which are therefore lined with arc-resistant material. Once the blast-valve 40 is unseated, the high-pressure gas behind, or below it causes the blast-valve 40 to move rapidly upwardly to its fully open position, as shown in FIG. 4. The areas exposed to high pressure are arranged such as to have a total force applied to them greater than that of the low-pressure side plus the spring loads 41, 55 of the contact follower 53 and the blast-valve 40. As the blast-valve 40 is moving upwardly to its fully open position, it engages the stop 63 on the contact follower 53 and moves the follower 53 upwardly in the same direction as the blast-valve 40. The latches 59 are so designed as to allow the teeth 56, on the follower 53, to ratchet over them in the opposite direction. FIG. 4 shows the blast-valve 40 in its fully open position.

As the high-pressure gas from the blast valve chamber 61 slowly equalizes on the other side 72 of the valve 40 by means of the small gas-communication hole 67, the springs 55 on the follower 53 and springs 41 biasing the blast-valve 40 downwardly overcome the equalized pressure, and move the blast-valve 40 and contact follower 53 as a unit downwardly to the closed position, as shown in FIG. 5. This is the closed position of the blast-valve 40 and final extended position of the contact follower 53, when the breaker 1 is in the fully open position. When the breaker 1 is again closed, the moving contact 24 engages the contact follower 53 and moves it upwardly to its reset, or breaker-closed position, as shown in FIG. 2.

To effect a closing operation of the device, the solenoid 60 is energized and effects operation of the control valve 36 to place high-pressure gas below the pistons 26. This will force the movable tubular contacts 24 upwardly into contacting engagement with the relatively stationary contact structures 47, thereby completing the electrical circuit through the circuit breaker 1. The closed circuit position of the device is illustrated in FIGS. 1 and 2 of the drawings.

It will be apparent from the described construction that the insulator columns 2, 3 have affixed flanged housings 4, 5 forming half of the current-transformer cases 11 and 12, and are bolted and sealed to the cooperating tank flange housings 10, 11, which constitute the other half of the transformer cases 12. Within the insulator columns 2, 3 there are mounted the blast valve and contact housings 38, moving contact and piston assemblies 27, feed tubes 17 and support tubes 15. Within the lower tank 16, concentric tubes 31, 33 are mounted and supported from insulating tubes fixed to the tank 16 at the control-valve mounting flange. The concentric tubes 31, 33 within the tank 16 are joined, and further supported by tubes to the adapter and mounting flange 29, which mounts on support rods 15 connected to the blast-valve housing 38. Thus connected, the tubing forms gas-flow paths to the piston and blast-valve. The outside tube 33 serves as the line current conductor also. Gas within the concentric tubes 31, 33 is controlled by the electrical control valve 36, which is mounted to the tank 16 and is fed by piping 34 from the high-pressure reservoir 75 (FIG. 1).

From the foregoing description, it will be apparent that there has been provided an improved and simplified type of compact circuit interrupter 1, which is of the dual-pressure type and takes up very little space. The mounting construction of the movable contact and piston is facilitated by the particular supporting arrangement described. It will be observed that the insulator interrupter columns 2, 3 may be unbolted at the point "X" and moved upwardly independently of the movable contact assembly 24. Dismantlement and assembly are thereby rapidly achieved.

By the provision of the concentric tubes 31, 33, the outer one of which being the pressurized line current conductor tube 33, a compact and highly efficient construction is obtained.

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 as our invention:

1. A circuit breaker comprising, in combination:
   a. means defining a lower grounded metallic-base support;
   b. a pair of split lower-disposed current-transformer casing sections secured to upstanding supporting metallic portions of said base support;
   c. a pair of upper-disposed arc-extinguishing assemblages having insulating casings;
   d. arc-extinguishing means disposed interiorly within each of said insulating casings;
   e. said arc-extinguishing means comprising a two-part interrupter, the upper part being firmly affixed to said upper insulating casing and a lower part being firmly affixed to said lower-disposed base support;
   f. mating upper-disposed split current-transformer casing sections secured to the lower ends of said pair of insulating casings;
   g. means for detachably securing said upper-disposed split current transformer casing sections to said lower-disposed casing sections during assembly of the circuit breaker, whereby said assembly forces cooperable interengagement between the two parts of said interrupter; and,
   h. at least one current transformer disposed within said split current-transformer casing sections.

2. The combination according to claim 1, wherein a stationary-contact housing having a stationary contact is supported within and removable with each arc-extinguishing assemblage.

3. The combination according to claim 2, wherein a high-pressure reservoir chamber is within each stationary contact housing.

4. The combination according to claim 3, wherein a piston-operated movable contact cooperates with the stationary contact.

5. A compressed-gas circuit breaker comprising, in combination:

a. means defining a lower generally V-shaped grounded metallic base;

b. a pair of arc-extinguishing assemblages detachably mounted to said metallic base and each having a pressure-operated movable contact associated therewith;

c. operating cylinders for the movable pistons associated with the movable contacts;

d. an outer metallic tubular line conductor pressurized at all times and an inner concentrically arranged control pipe alternately pressurized and exhausted extending therethrough;

e. said outer metallic tubular line conductor electrically interconnecting the two arc-extinguishing assemblages together in electrical series;

f. whereby the constantly pressurized condition of the outer metallic tubular line conductor resists fragmentation of the inner-disposed control pipe.

6. The combination of claim 5, wherein a control-valve assembly is situated between the arc-extinguishing assemblages to actuate the moving pistons for the movable contacts.

* * * * *