July 6, 1948. A. C. BOISSEAU ET AL 2,444,765

ELECTRIC CIRCUIT BREAKER

Filed Dec. 27, 1944 3 Sheets-Sheet 1

Fig.1.

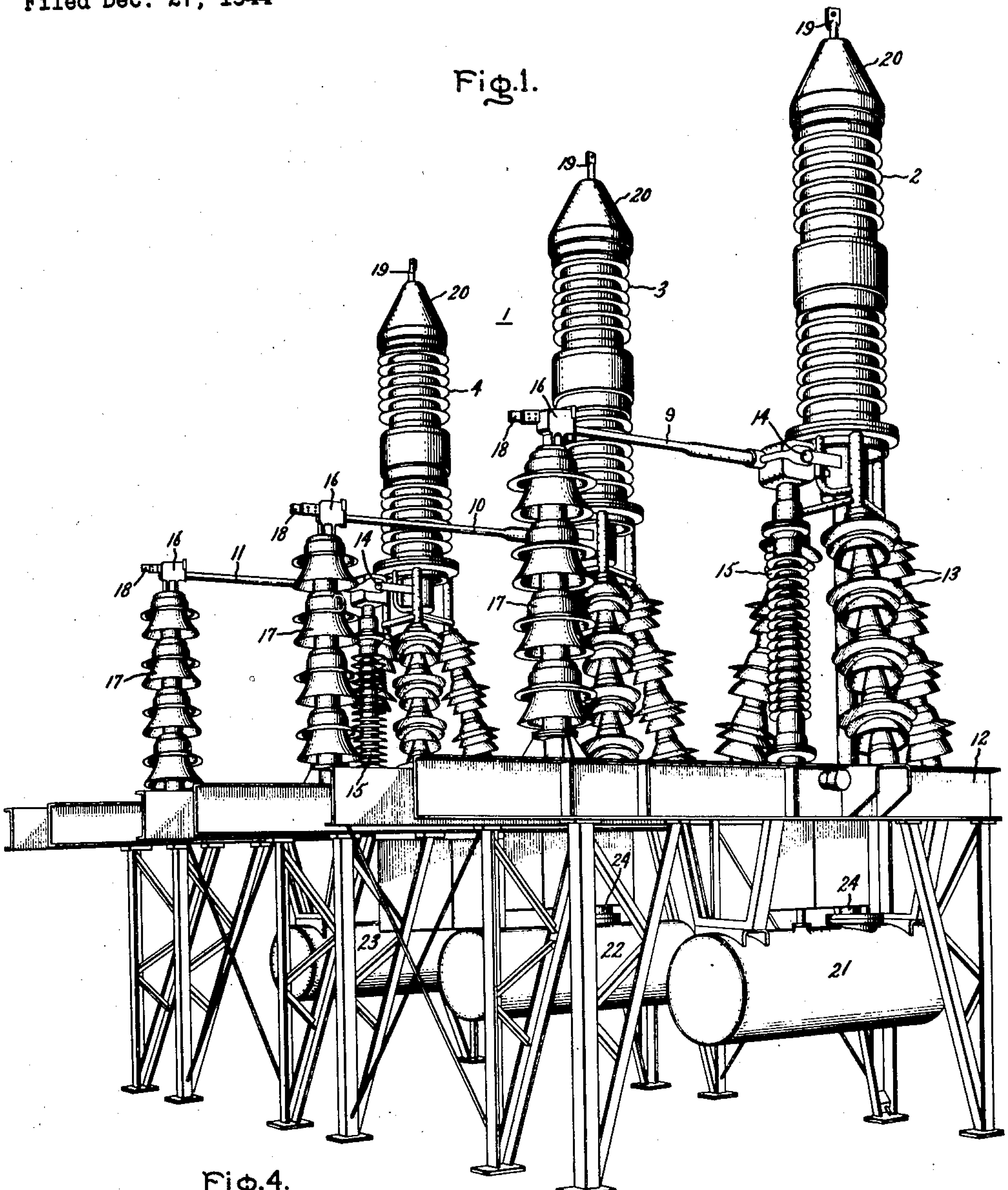

Fig.4.

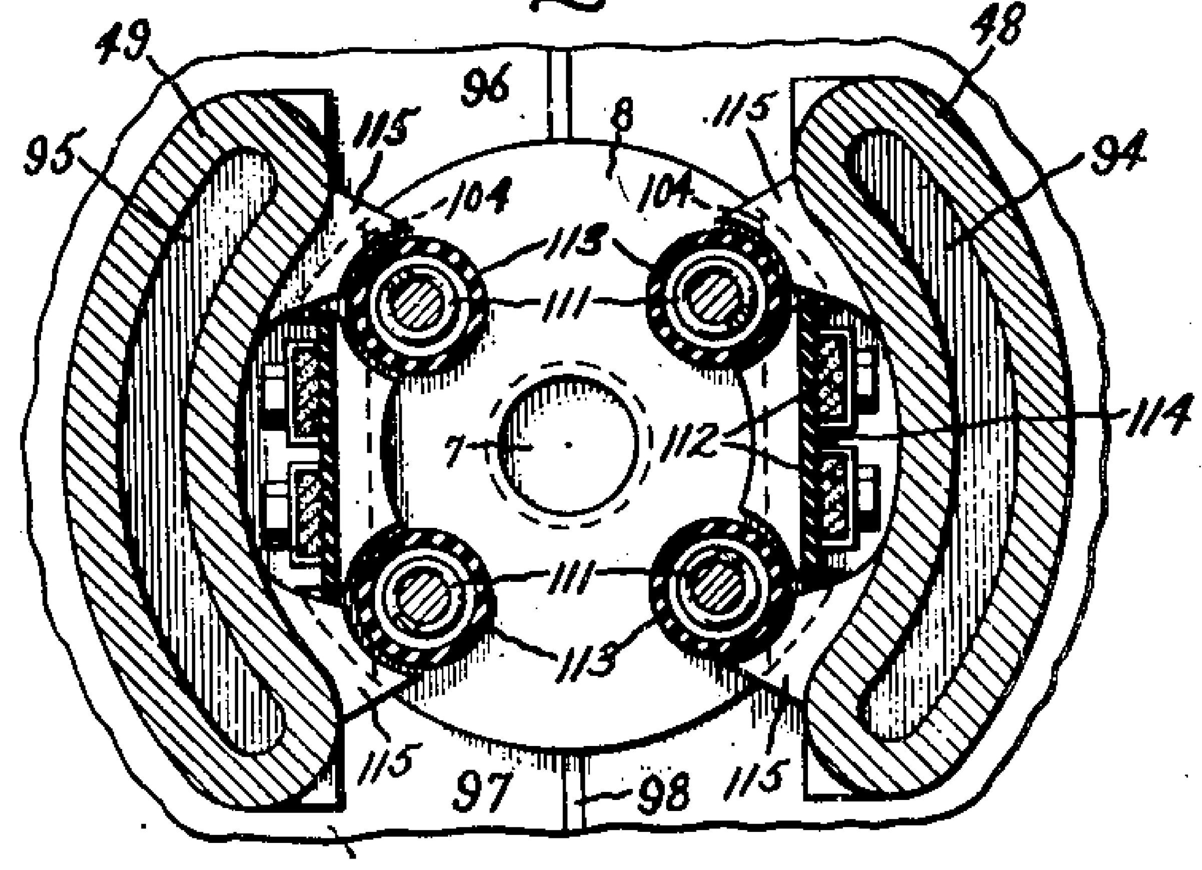

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Fig. 2.

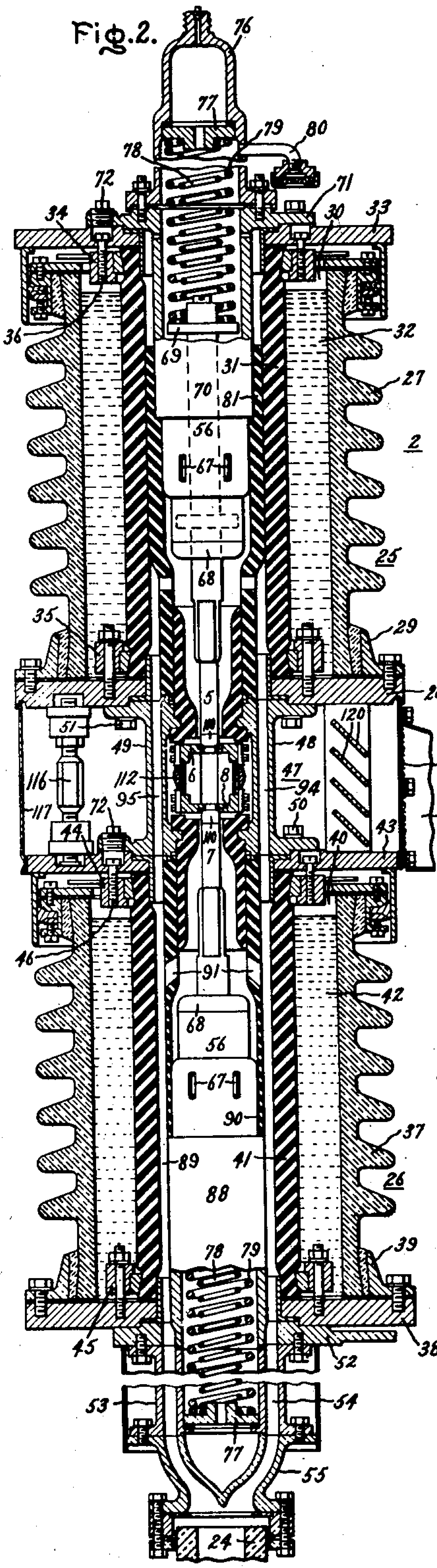

Fig. 3.

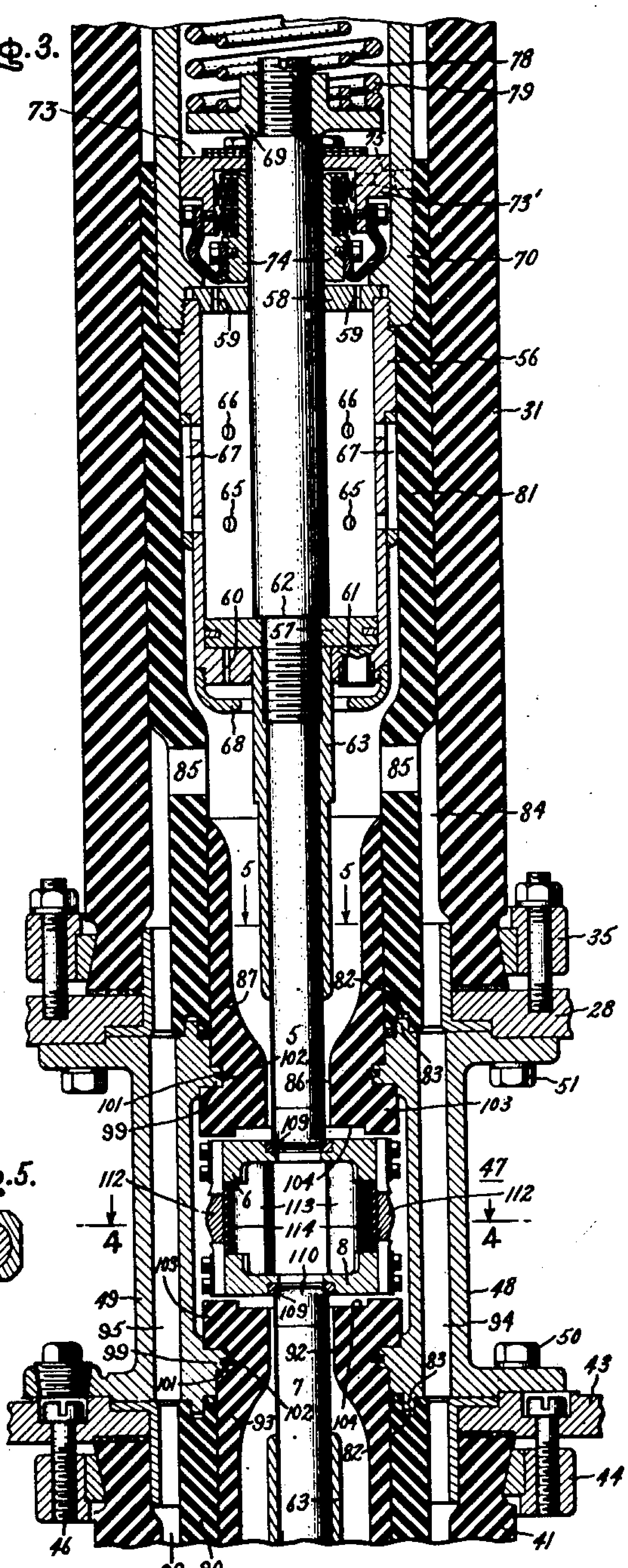

Fig. 5.

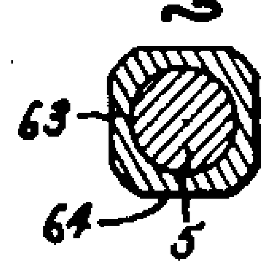

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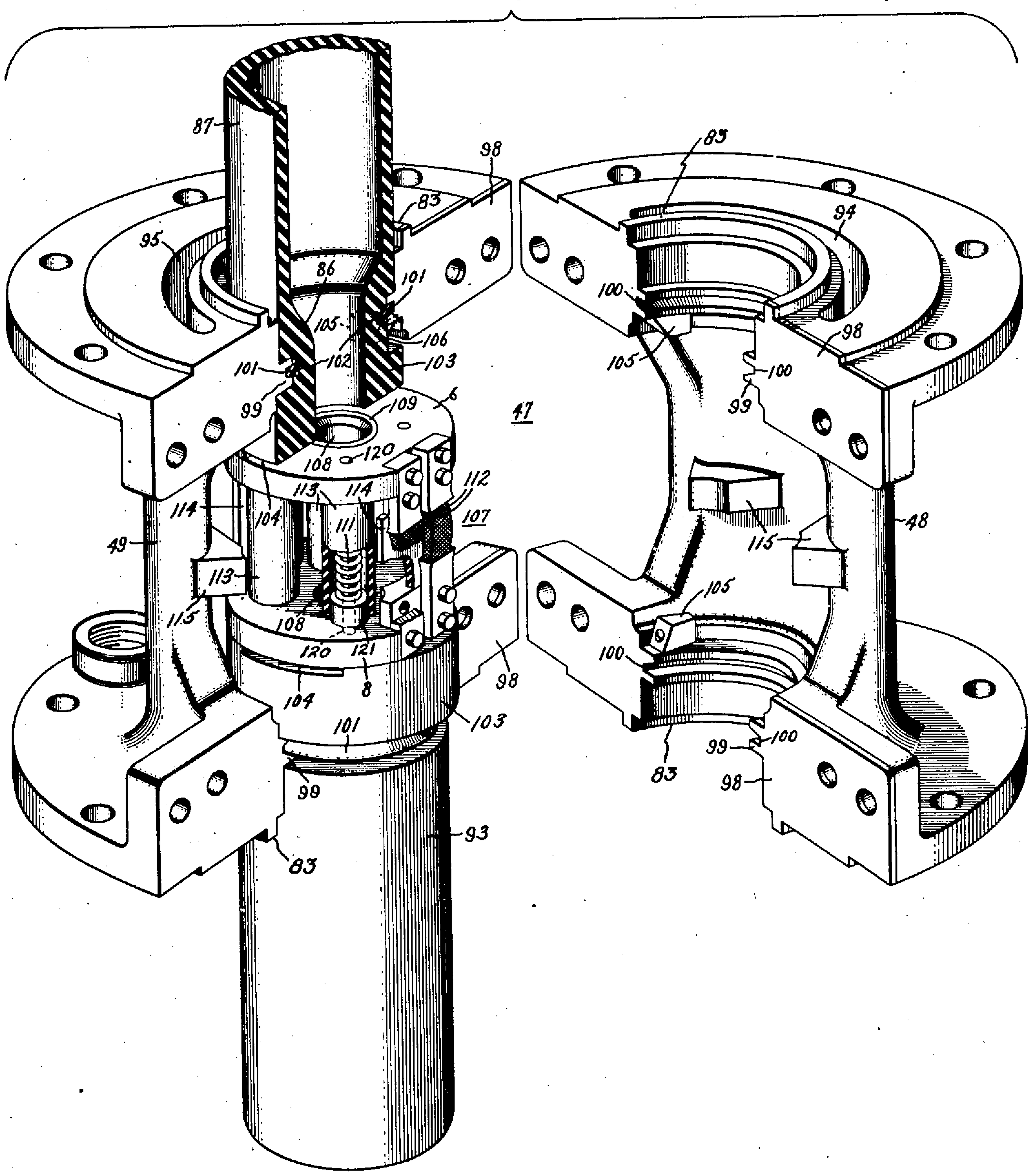
Fig. 6.



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UNITED STATES PATENT OFFICE

2,444,765

ELECTRIC CIRCUIT BREAKER

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Application December 27, 1944, Serial No. 570,006

10 Claims. (Cl. 200—148)

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Our invention relates to high voltage electric circuit breakers, and more particularly to circuit breakers of the gas blast type having separable contacts between which a blast of gas is directed for extinguishing arcing. Sepcifically, our invention is an improvement on Rankin Patent 2,306,186, granted December 22, 1942, and assigned to the same assignee as the present application.

It is an object of our invention to provide a new and improved electric circuit breaker which will interrupt currents at higher voltages and in a shorter interval of time than was heretofore possible.

It is another object of our invention to provide a new and improved electric circuit breaker capable of interrupting large amounts of electrical energy which is sturdy in construction, simple in design and provides satisfactory operation in every respect.

Further objects and advantages of our invention will become apparent as the following description proceeds and the features of novelty which characterize our invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of our invention reference may be had to the accompanying drawings, in which Fig. 1 is a perspective view of a commercial embodiment of an electric circuit breaker embodying our invention; Fig. 2 is an enlarged sectional view of the interrupting unit of our invention; Fig. 3 is an enlarged view of a portion of Fig. 2; Fig. 4 is a sectional view taken on line **4—4** of Fig. 3; Fig. 5 is a sectional view taken on line **5—5** of Fig. 3, and Fig. 6 is an exploded perspective view partly in section, of a portion of the interrupting unit shown in Figs. 2 and 3.

Referring now to Fig. 1 of the drawings, there is illustrated a polyphase circuit breaker generally indicated at **1** comprising a plurality of single pole units **2**, **3** and **4**, respectively. Each of these units **2**, **3** and **4** includes a plurality of relatively separable arcing or interrupting contacts such as **5**, **6**, **7** and **8** illustrated in Figs. 2 and 3. These arcing or interrupting contacts associated with the respective interrupting units **2**, **3** and **4** are serially connected with a set of isolating contacts the movable contact arms of which are designated as **9**, **10** and **11**, respectively. Each of the interrupting units **2**, **3** and **4** is supported from a framework generally indicated at **12** by a tripod arrangement of insulators designated at **13**, the poles **2**, **3** and **4** being spaced the desired

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distance for proper electrical clearance. Isolating contact arms **9**, **10** and **11** are pivotally mounted on horizontal pivots generally indicated at **14** and are gear-driven from rotatable insulators **15**, one associated with each disconnecting contact arm **9**, **10** and **11**. Each disconnecting contact arm is adapted to engage with a cooperating stationary contact designated by the numeral **16** mounted on a suitable insulator **17** supported from framework **12**. Each of the contacts **16** is electrically connected to an associated line terminal **18**. The other line terminals **19** for the various poles of the polyphase circuit breakers are indicated as extending from the top of each interrupting unit **2**, **3** and **4**. A suitable weather protecting shield such as **20** may be associated with each interrupting unit.

Suspended from supporting framework **12** are a plurality of tanks **21**, **22** and **23**, respectively, associated with poles **2**, **3** and **4**. These tanks are each adapted to contain a source of fluid under pressure such as air or other gas and are adapted to be interconnected with the associated interrupting units by conduits **24**.

Our invention is particularly concerned with the construction of the interrupting units such as **2**, **3** and **4**. Since these interrupting units are all identical we have chosen to illustrate in Figs. 2, 3, 4, 5 and 6 the interrupting unit **2**. The operating means and control system for the electric circuit breaker shown in Fig. 1 is of no concern in the instant application but is disclosed in copending application Serial No. 565,834, Boisseau, Beall, Frank and Lowery, filed November 30, 1944, and assigned to the same assignee as the present application.

Referring now to Figs. 2, 3, 4, 5 and 6, it may be observed that contacts **5** and **6** and contacts **7** and **8** comprise two sets of serially arranged interrupting contacts mounted in a single unit as contrasted with the above mentioned Rankin patent where the serially arranged arcing contacts are mounted in separate units. Essentially then, circuit interrupting unit **2** comprises two separate interrupting structures generally designated as **25** and **26**, respectively, the interrupting structure **25** including arcing contacts **5** and **6** while the interrupting structure **26** includes arcing contacts **7** and **8**. The interrupting structures **25** and **26** are essentially identical and the upper structure **25** comprises an outer insulating column **27**, preferably formed of porcelain or other weather-proof material, which is supported on a suitable base plate **28**. Insulating column **27** is united with base plate **28** by a clamping ring 29. Arranged concentrically with insulating column 27 so as to define an annular space 30 therebetween, is insulating tube 31. This tube 31 is preferably formed of a phenolic resin compound such as may be purchased on the market under the trade-mark Herkolite. The annular space 30 is preferably filled to the level indicated with a suitable insulating liquid 32. This liquid may comprise oil or preferably a liquid halogenated hydrocarbon composition such as is described and claimed in United States Letters Patent 1,931,373, granted upon an application of F. M. Clark and assigned to the same assignee as the present application. The liquid filled annular space 30 has the upper end theerof sealed by a plate 33, suitable gaskets being provided between plate 33 and concentrically arranged insulating tubes 27 and 31. Preferably the upper and lower ends of insulating tube 31 are held in sealing engagement with the cooperating parts of the interrupting unit 25 by suitable clamping rings 34 and 35, respectively. The annular space 30 may be filled with liquid through the opening which is normally closed by bolt 36. Thus insulating column 27, insulating liquid 32 and tube 31 form an insulating housing for contact 5.

The interrupting structure 26 comprises the outer insulating column 37 identical with the column 27 described above, and preferably formed of porcelain or other waterproof material. Insulating column 37 is supported on a suitable base plate 38 and united thereto by a clamping ring 39. Arranged concentrically with insulating column 37 so as to define an annular space 40 is an insulating tube 41 identical with the insulating tube 31 described above. The annular space 40 is preferably filled to the level indicated in Fig. 2 with a suitable insulating liquid 42 identical with the liquid 32 described above. The liquid filled annular space 40 has the upper end thereof sealed by a plate 43 suitable gaskets being provided between plate 43 and concentrically arranged insulating tubes 37 and 41. Preferably the upper and lower ends of insulating tubes 41 are held in sealing engagement with the cooperating parts of the interrupting unit by suitable clamping rings 44 and 45, respectively. The annular space 40 may be filled with liquid through the opening which is normally closed by the bolt 46.

As was mentioned above in connection with Fig. 1, the tripod arrangement of insulators 13 supports interrupting unit 2 by supporting the base plate 38 and consequently the interrupting structure 26. The base plate 28 of interrupting structure 25 is supported on a flanged air line and contact support generally indicated at 47 comprising two substantially identical castings 48 and 49, best shown in Fig. 6 which form an arcing chamber housing. This air line and contact support 47 supports interrupting structures 25 and 26 in spaced relationship and unites them into a unit comprising interrupting unit 2. Suitable capscrews 50 passing through the lower flanges of support 47 unite it to plate 43 while capscrews 51 extending through the upper flanges of support 47 unite it with base plate 28.

Depending from base plate 38 of interrupting unit 2 is a connection pad 52 which is adapted to be electrically connected with disconnecting contact arm 9 of Fig. 1. Depending from connection pad 52 is an air line casting 53 including an annular air passageway 54 therein. Air conduit 24 of suitable insulating material such

as porcelain is connected to air line casting 53 by means of a suitable adaptor 55 which is provided with guide means for directing the air flow into the annular passageway 54. Supported within the chamber defined by insulating tube 41 and above casting 53 is the fluid motor assembly for movable contact 7. The fluid motor assembly for movable contact 7 is substantially identical with the fluid motor assembly for contact 5 and consequently the latter will be described first since it is shown in greater detail in Fig. 3.

The fluid motor assembly for movable contact 5 comprises a cylinder 56 within which is mounted a piston 57. The upper end of cylinder 56 is closed by a cylinder head 58 including a plurality of restricted or metering orifices 59. The lower end of cylinder 56 is closed by an integrally formed cylinder head having a restricted or metering orifice 60 therein as well as a check valve 61. Movable contact 5 which is a rod-like member, is fixedly connected to piston 57 by having piston 57 slipped over a portion of reduced cross section and held against the flange 62 by means of a piston sleeve 63 threadedly mounted on rod contact 5. Piston sleeve 63 has a portion of almost rectangular cross-section as is best shown in Fig. 5 and acts as a guide for rod contact 5 in that its cylindrical corners cooperate with a circular bore in the cylinder head at the lower end of cylinder 56. Piston sleeve 63, as is clearly shown in Fig. 3 has cut-away flat sides 64 as indicated in Figs. 3 and 5 for a substantial length thereof. These cut-away portions, which may be accomplished by machining or the like, provide pressure relief ports for the lower end of cylinder 56 for about the first two-thirds of the return or closing stroke of contact 5. When the portion of piston sleeve 63 having no cut-away portions enters the closely fitting bore in the lower cylinder head then dash-pot action begins by virtue of the escape port or metering orifice 60 which will be described in greater detail hereinafter.

Dashpot action for controlling the opening movement of contact 5 is obtained by passing air around piston 57 through suitable metering holes 65 and 66 in cylinder 56. Bypass ducts 67 interconnect openings 65 and 66 so that when piston 57 moves between openings 65 and 66 air under pressure is introduced ahead of piston 57 to control and dashpot the continued opening movement thereof by virtue of the provision of metering orifices 59. The lower end of cylinder 56 is provided with an electrostatic shield 68 that moderates the high voltage gradient in the region of the separated contact tips.

Rod contact 5 extends through upper cylinder head 58 and terminates in a spring retainer 69. Cylinder 56 is threadedly connected to a flanged conducting cylinder 70 having an upper annular flange 71 which may be bolted to member 33. A filler plug 72 is provided in flange 71 axially arranged with respect to bolt 36 so that the liquid 32 may be poured into annular space 30 even though flanged cylinder 70 is in the position indicated in Figs. 2 and 3. Flanged cylinder 70 defines an annular space within which is mounted the sliding contact assembly 73 comprising a plurality of contact fingers 74 slidingly engaging the extension of rod contact 5. The sliding contact assembly 73 includes a split contact support casting 73′ which may be expanded by means of tapered screw 75 into close electrical contact with enclosing flanged cylinder 70.

Flanged conducting cylinder 70 is electrically connected with an upper connection 76 which in turn may be electrically connected with terminal 19. Upper connection 76 is in effect a cylindrical conducting housing which supports a spring retainer 77. A spring means comprising springs 78 and 79 is suitably mounted between the spring retainers 69 and 77 so as normally to bias movable contact 5 to the closed position in engagement with contact 6, as is shown in Figs. 2 and 3. A breather pipe 80 connects the space in the chamber formed by flanged conducting cylinder 70 and upper connection 76 with atmosphere.

Surrounding cylinder 56 and a portion of flanged conducting cylinder 70 of interrupting structure 25 is an insulating tubular member 81 preferably constructed of the same insulating material as tube 31. The lower end of insulating tube 81 is provided with an annular recess 82 which cooperates with an annular tongue 83 formed on airline and contact support 47. Between tubes 81 and 31 is defined an annular air conduit 84 which is connected by suitable ports 85 with the interior of tube 81 forming the interrupting chamber. Air flowing through ports 85 enters cylinder 56 through check valve 61 to cause opening movement of retractable contact 5. The major portion, however, of the air entering the interrupting chamber through ports 85 flows through a nozzle 86 defined by a sleeve-like tubular insulating member 87. Tubular insulating member 87 is preferably formed of a gas evolving material which may comprise horn fiber or the like. Preferably, the arc confining structure defined by insulating tube 87 is constructed in the manner disclosed and claimed in Boyer Patent 2,157,815, granted May 9, 1939, and assigned to the same assignee as the present application. Insulating tube 87 is coaxially arranged with respect to contact 5 and forms an annular fluid passageway around contact 5.

The fluid motor assembly associated with contact 7 is substantially identical with the assembly described in connection with movable contact 5 and accordingly no further description will be included herein. The corresponding parts are designated by the same reference numerals. Instead of the flanged member 70 described above, a conducting member 88 is provided which defines an annular air passage space 89 between insulating tube 41 and cylinder 88. Cylinder 88 houses the spring means comprising springs 78 and 79, one end of which engages spring retainer 77 supported in air line casting 53. An insulating tube 90 in some respects similar to insulating tube 81 defines with insulating tube 41 and conducting cylinder 88, the annular air passageway 89 which is a continuation of annular air passageway 54. Insulating cylinder 90 is provided with ports 91 which connect the annular air passageway 89 with the interrupting chamber in which contact 7 is adapted to move. An insulating nozzle 92 defined by tubular member 93 identical with member 87 described above, is provided for movable contact 7.

In order to interconnect air passageways 84 and 89 air line and contact support 47 comprises two parallel diametrically opposite arcuate conduits 94 and 95 formed respectively in castings 48 and 49. This construction is best shown in Figs. 4 and 6. It will be observed that with this construction large openings to atmosphere designated in Fig. 4 by the numerals 96 and 97, are defined between castings 48 and 49 so that any

arc gases or any gases, for that matter, flowing through nozzles 86 and 92 may freely escape to atmosphere. The castings 48 and 49 are bolted together as a unitary structure separated by thick, nonmagnetic shims 98 to prevent eddy current losses. It will be obvious that when assembled with the annular tongues 83 at the upper and lower ends of air line contact support 47, fitting into the annular grooves 82 of cylinders 81 and 90, respectively, a complete air passage is provided from conduit 24 to the upper end of interrupting unit 2. This air passage comprises annular passage 54, annular passage 89, arcuate passages 94 and 95 and annular passage 84.

Insulating members 87 and 93 are identical and define nozzles 86 and 92, respectively, as was discussed above.

In order to hold insulating members 87 and 93 in position each casting 48 and 49 is provided with an upper and lower semi-annular ridge 99 provided with a recess 100 for accommodating a suitable sealing means such as the resilient gasket or washer 101. The semi-annular ridges 99 are adapted to fit into annular recesses 102 formed in the exteriors of insulating members 87 and 93. Insulating members 87 and 93 are provided with an enlarged head 103 adjacent the exhaust ends of nozzles 86 and 92 respectively. In order to provide auxiliary nozzle venting means to atmosphere the insulating members 87 and 93 are provided with a slot or shallow cross channel duct 104 extending across the nozzle end of the insulating members so that fluid flowing through nozzles 86 and 92 may escape to atmosphere through shallow cross channel 104. It will be observed from Fig. 6 that these venting slots or channels 104 together with contacts 6 and 8, respectively, define the venting passageways, the purpose of which will be brought out in greater detail hereinafter.

In order to be sure that the channel exhaust ducts or venting passageways 104 are properly directed toward passages 96 and 97 leading to atmosphere and furthermore so that insulating members 87 and 93 cannot rotate out of the position shown in Fig. 6, keying clamps 105 on castings 48 and 49 cooperate with corresponding cut-away portions 106 in insulating members 87 and 93, respectively. With this arrangement when castings 48 and 49 are bolted together not only are insulating members 87 and 93 which define nozzles 86 and 92, respectively, held in sealing relationship by virtue of gasket 101, but channel ducts or venting passages 104 are directed toward the openings 96 and 97 leading to atmosphere.

Heretofore, insulating nozzles for axial type air blast breakers have been streamlined, that is, provided with both a convergent and divergent portion ahead of and beyond the nozzle throat respectively, for obtaining high speed air flow through the nozzle throat. The provision of a divergent portion has required the positioning of the fixed contact in spaced relation to, or beyond, the nozzle throat, so that a delay intervened between the parting of the movable rod from the fixed contact to draw an arc and the rod's subsequent withdrawal from the nozzle throat to permit high speed air flow through the throat for extinguishing the arc.

Our invention decreases this delay, thereby appreciably reducing the arcing or interrupting time, by eliminating the divergent portion of the nozzle so that the fixed contact may be positioned closely adjacent the nozzle throat as clearly shown in Figure 3. We have found that the omission of the divergent portion of a nozzle is not disadvantageous if the fixed contacts provide for axial air flow therethrough and that auxiliary lateral venting means are afforded closely adjacent the contacts such as is provided for example, by the above described cross channels 104.

To further reduce the interrupting time, so that it will be less than three cycles, it is advantageous to use fixed contacts having a wipe as short as possible consistent with the normal current carrying capacity of the circuit breaker. Accordingly, we provide abutting type arcing contacts 5 and 6 and 7 and 8 that have a wipe of but 1/16 inch. The contacts 6 and 8 which form the relatively stationary contacts, are constructed as a unitary contact assembly best shown in Fig. 6 and generally designated by the reference numeral 107. This unitary arcing contact assembly 107 comprises upper and lower disk-like contacts 6 and 8 having a central opening or bore 108 therethrough. Surrounding each of the openings 108 on the sides of disk-like contacts 6 and 8 facing movable contacts 5 and 7, respectively, are beveled inserts 109 of an arc resisting material. These beveled arc resistant inserts cooperate with movable contacts 5 and 7 which are preferably provided with arc resistant tips 110 having a spherical end. By beveling the arc resistant inserts 109 in the bores 108 of arcing contacts 6 and 8, self-centering means for the spherical arcing tips 110 of the retracting contacts 5 and 7 are provided. This arrangement of the contacts also provides an effective high pressure circular line contact for the continuous carrying of its rated current, the high pressure being provided by springs 78 and 79 acting on contacts 5 and 7 as well as a plurality of springs 111 interposed between contacts 6 and 8 in contact assembly 107 to bias contacts 6 and 8 apart so as to engage the enlarged heads 103 of insulating members 87 and 93, respectively. Disk contacts 6 and 8 are electrically interconnected by a plurality of flexible connections 112 bolted into recesses in the disk sides. In order to prevent the exhausting arc gases from direct contact with the springs 111 and flexible conductors 112 we provide suitable arc resistant insulating guards 113 and 114. The insulating guards 113 are insulating cylinders enclosing springs 111. A rod-like member 120 is positioned inside each of the cylindrical guards 113 and is journally supported by contacts 6 and 8. Interposed between one end of spring 111 and the adjacent disk-like contact 8 is a cylindrical member 121 which surrounds the rod 120 and which extends into the tube 113 in a telescoping manner so as to permit limited relative movement of the disk-like contacts 6 and 8 along their axes without exposing the spring 111 to the deteriorating effect of the arc. A similar cylindrical member 121 may be interposed between the other end of each spring 111 and the adjacent disk-like contact 6. Insulating guards 114 are rectangular plates retained between the flexible conductors 112, the adjacent insulating cylinders 113, and the lugs 115 of air line castings 48 and 49 as best shown in Fig. 4.

Contact assembly 107 is adapted to be inserted between insulating members 87 and 93 by suitably compressing springs 111. Any suitable means for compressing these springs may be provided to enable the ready insertion and removal of contact assembly 107. Preferably such means will be removable and will be used only to remove or insert the contact assembly 107 in its position between insulating members 87 and 93. It should be understood that when the circuit breaker is in the closed position indicated in Figs. 2 and 3, compression springs 111 are compressed and small spaces as is obvious from Fig. 3, exist between the contact assembly 107 and insulating members 87 and 93. When the contacts 5 and 7 are open or removed as in Fig. 6, compression springs 111 force disk contacts 6 and 8 into engagement with insulating members 87 and 93 so that channel ducts 104 are the only means through which fluid under pressure may escape to atmosphere unless the gases flow through the openings or bores 108 in disk contacts 6 and 8. In order that contact assembly 107 is held in a particular position in air line and contact support 47, suitable lugs 115 integrally formed with castings 48 and 49 are adapted to engage the insulating cylinders 113 and hold contact assembly 107 in a predetermined position.

It is desirable to provide for the examination and maintenance of the interrupting structure of a circuit breaker after periods of service, and for this purpose the split construction of the air line and contact support 47 which supports interrupting structure 25 provides convenient access to the arcing members. In order that air line and contact support 47 may be readily removed without first removing interrupting structure 25, we have provided a plurality of jack screws 116 interposed between base plate 28 and plate 43 so that upon removal of cap screws 51 interrupting structure 25 may be raised several inches by operating jack screws 116. After this, air line and contact support 47 may be opened up as shown in Fig. 6 so that full access to the arcing contacts and nozzles is achieved. Then the stationary arcing contact assembly 107 may be removed for repairs or replacement, also the insulating members 87 and 93 may be pushed further into air or insulating tubes 81 and 90, respectively, thereby exposing the arc resisting tips 110 of movable contacts 5 and 7 which may also be removed for replacement. If desired, the insulating members 87 and 93 comprising nozzles 86 and 92, respectively, may be entirely withdrawn from insulating tubes 81 and 90 respectively.

In order that the arc gases may be sufficiently cooled before being exhausted to atmosphere and furthermore to prevent air line and contact support 47 and the arcing contacts from being exposed to the weather, the space between plates 28 and 43 is preferably enclosed by an exhaust housing 117 having a suitable opening 118 to atmosphere. A screen 119 may be provided to keep insects and birds from adversely affecting the operation of the circuit breaker. If desired suitable cooling and deflecting baffles 120 may also be provided in the exhaust housing 117. It will be understood that exhaust housing 117 may readily be removed when inspection of the arcing contacts or the like is desired.

When the circuit breaker is in the closed position indicated in Figs. 2 and 3, retractable contacts 5 and 7 are in the position indicated in the drawings. The diameter of the retracting nozzles is such as to be only 1/8 inch smaller than the diameter of the insulating nozzles 86 and 92. When a circuit interrupting operation is desired a suitable blast valve (not shown) is opened and compressed air is released in conduits 24 so that it may be supplied to interrupting units 2, 3 and 4. In interrupting unit 2 this moving air flows through the annular passageways 54, 89 and 84 as well as in arcuate ducts 94 and 95. This air flows through openings 85 and 91 into the interrupting chambers where part of it is effective to move pistons 57 and consequently to retract contacts 5 and 7. The major portion of the fluid blast flows from the twin interrupting chambers through nozzles 86 and 92 and through cross channels 104 to atmosphere. As soon as the fluid under pressure flows through check valves 61 to operate pistons 57 relative separation of the arcing contacts 5 and 7 results so that fluid under pressure may flow through the bores 108 in stationary contact assembly 107 and thence to atmosphere through the lateral exhaust openings 96 and 97. As the contacts simultaneously retract the full bore of the nozzles 86 and 92 are opened immediately so that two high velocity blast streams flow toward each other to cause interruption of the arc which is enclosed within two opposing hose-like blasts in a manner similar to that described in United States Letters Patent 2,084,886, Biermanns, granted June 22, 1937, and assigned to the same assignee as the present application. By virtue of the short wipe of the arcing contacts positioned adjacent the nozzle throat, as described above interruption of the arc drawn occurs in less than three cycles from the time of initiation of the interrupting operation.

As the pistons move to a position corresponding to a mid-stroke position of contacts 5 and 7 thereby uncovering metering holes 65, air is admitted through duct 67 and openings 66 ahead of pistons 57 which air cushions the remainder of the opening stroke, this by-passed air being permitted to escape through metering orifices 59. Cessation of the blast stream by closing the blast valve (not shown) permits the contacts 5 and 7 to reclose rapidly under the influence of return springs 78 and 79, due to the venting from cylinders 56 afforded by the flat sides 64 of piston sleeves 63 as already described. During the latter part of the closing stroke, the check valve 61 in cylinders 56 prevents air from freely escaping from cylinders 56 and consequently a dashpot action is provided for diminishing the closing impact of the contacts, the metering hole 60 being provided to control the dashpot action.

We have discovered that the disk type arcing contacts 6 and 8 described above are considerably superior to telescoping or abutting type contacts used heretofore in that as soon as the arc is drawn a single arc interconnects movable contacts 5 and 7 enclosed in the two blast streams so that contacts 6 and 8 are relatively free from arc burning. This long single arc is completely enclosed by the two opposing cylindrical blast streams of highly insulating cooling air moving at high velocity which impinge together and exhaust radially outwards through lateral openings 96 and 97 from the central region of the stationary contact structure. Under these conditions the arc is extinguished at current zero and cannot reestablish itself while the insulating high pressure blast continues. The efficiency of the axial blast interrupter depends upon the passage of an adequate arc enveloping blast stream of cool, high pressure gas through the throats of the nozzles 86 and 92. The impingement of the opposing blasts and the restricted bores of stationary contact 107 impede the otherwise free flow through nozzles 86 and 92. By providing the auxiliary venting means comprising cross channel ducts 104 adjacent the disk contacts we compensate for the restriction imposed by

the bores 108 and the impingement of the fluid blasts so that no decrease in velocity of the air results. Furthermore, the venting passages comprising channel ducts 104 permits an initial blast to flow even though bores 108 are still sealed off by contacts 5 and 7 after they have separated sufficiently to permit contact disks 6 and 8 to engage insulating members 87 and 93. We have found greatly increased interrupting capacity by the provision of channel ducts 104.

While we have shown and described a particular embodiment of our invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from our invention in its broader aspects and we, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of our invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In a fluid blast electric circuit breaker comprising a pair of relatively movable contacts separable to form an arc therebetween, a sleeve-like member coaxially arranged with respect to one of said contacts to form an annular fluid passageway around said one contact, the other contact being disk-like in form and having an opening therein which cooperates with said one contact to prevent the passage of fluid through said opening when said contacts are in engagement, said sleeve-like member abutting against said disk-like contact to define radial passages therebetween, and means for supplying a blast of arc extinguishing fluid to said annular fluid passageway and through said opening when separation of said contacts occurs.

2. In a fluid blast electric circuit breaker comprising a pair of relatively movable contacts separable to form an arc therebetween, an insulating sleeve-like member coaxially arranged with respect to one of said contacts to form an annular fluid passageway around said one contact, the other contact being disk-like in form and having an opening therein which cooperates with said one contact to prevent the passage of fluid through said opening when said contacts are in engagement, said sleeve-like member abutting against said disk-like contact to define radial passages therebetween, and means for producing a blast of fluid in said annular fluid passageway and through said opening when separation of said contacts occurs.

3. In a fluid blast electric circuit breaker comprising a pair of relatively movable contacts separable to form an arc therebetween, an insulating sleeve-like member coaxially arranged with respect to one of said contacts to form an annular fluid passageway around said one contact, the other contact being a disk-like butt contact and abutting against one end of said sleeve-like member, means defining an opening in said disk-like contact, means for producing a rapid flow of fluid through said opening from said annular fluid passageway during the time relative separation of said contacts occurs for extinguishing the arc drawn, and a channel in said one end of said sleeve-like member through which a portion of said fluid blast may escape to atmosphere.

4. In a fluid blast electric circuit breaker comprising a pair of relatively separable retractable type contacts separable to form an arc therebetween, an insulating sleeve-like member coaxially arranged with respect to each of said contacts

to form an annular fluid passageway around each of said contacts, a contact assembly comprising a pair of disk-like contacts interposed between said sleeve-like members and respectively engageable by said arcing contacts, each of said disk-like contacts having an opening therein which cooperates with its respective retractable contact to prevent passage of fluid through said openings when its respective retractable contact is in engagement with its cooperating disk-like contact, each of said insulating sleeve-like members abutting against said disk-like contacts to define a plurality of radial passages therebetween, and means for supplying a blast of arc extinguishing fluid to said annular fluid passageways and through said openings upon relative separation of said retractable contacts and said disk-like contacts.

5. In a fluid blast electric circuit breaker comprising a pair of relatively movable contacts separable to form an arc therebetween, a sleeve-like member coaxially arranged with respect to one of said contacts to form an annular fluid passageway around said one contact, said other contact being disk-like in form and abutting against one end of said sleeve-like member, spring means for biasing said other contact against said sleeve-like member, said disk-like contact having an opening therein which cooperates with said one contact to prevent the passage of fluid through said opening from said annular fluid passageway when said pair of contacts are in engagement, said sleeve-like members abutting against said disk-like contact to define radial passages therebetween, and means for supplying a blast of arc extinguishing fluid to said annular fluid passageway when separation of said contacts occurs.

6. An arcing contact assembly for an electric circuit breaker having a pair of relatively separable contacts each adapted to engage said contact assembly when interposed between said separable contacts, comprising a pair of disk-like members each having a central opening therethrough, spring means interposed between said members to bias said members away from each other, telescoping means for shielding said spring means from the deteriorating effect of the arc drawn upon separation of said contacts, and means for electrically interconnecting said members.

7. An arcing contact assembly for an electric circuit breaker having a pair of relatively separable contacts each adapted to engage said contact assembly when interposed between said separable contacts, comprising a pair of disk-like members each having a central opening therethrough, spring means interposed between said members to bias said members away from each other comprising a plurality of springs surrounding said central openings, telescoping means for shielding each of said springs from the deteriorating effect of the arc drawn upon separation of said contacts, and means for electrically interconnecting said members.

8. In a circuit interrupter, means defining a pair of substantially enclosed arcing chambers arranged in spaced relation with respect to each other, a retractable arcing contact in each chamber, the two adjacent walls of said arcing chambers having discharge openings therethrough disposed in alignment with said arcing contacts, an arcing contact assembly held in position between the adjacent walls of said arcing chambers and adapted to be engaged by said arcing contacts, means for establishing an arc between said arcing contacts so as to extend through said discharge openings upon separation of said arcing contacts, means for establishing a blast of arc extinguishing fluid in each of said arcing chambers, and means directing each blast towards said arc to cause a flow of arc extinguishing gas through said discharge openings to subject the arc playing therein to a strong quenching influence.

9. In a circuit interrupter, means defining a pair of substantially enclosed arcing chambers arranged in spaced relation with respect to each other each defined by a sleeve-like member of insulating material, a retractable arcing contact in each chamber, a pair of substantially stationary contacts held in position between said sleeve-like members, one cooperating with each retractable contact, the two adjacent walls of said arcing chambers having discharge openings therethrough surrounding said arcing contacts, means for establishing an arc between said arcing contacts, means for establishing a blast of arc extinguishing fluid in each of said arcing chambers, and means directing each blast toward said arc playing between its respective arcing contact and discharge opening to cause a flow of arc extinguishing gas through said discharge openings to subject the arc playing therein to a strong quenching influence.

10. In a gas blast circuit breaker having a pair of retractable contact members, a pair of plate members spaced apart, each plate member having an opening therein through which said retractable contact members are respectively movable, means for varying the spacing between said plate members, insulating housing means respectively secured to non-adjacent surfaces of said plate members, and an arcing chamber housing interposed between adjacent surfaces of said plate members and constructed of at least two axially complementary parts to enable ready access to be had to said contacts, the adjacent edges of said complementary parts being recessed to form expulsion ports for discharging the products of a circuit interrupting operation from said chamber and said complementary parts of said housing having ducts formed therein for supplying a blast of gas to said arcing chamber through at least one of said insulating housing means, and means for securing said complementary parts of said housing in position between said plates.

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