

Nov. 3, 1970

W. M. LEEDS ET AL

3,538,281

COMPRESSED-GAS CIRCUIT INTERRUPTER WITH CYLINDRICAL HIGH
PRESSURE TANK SUPPORTING A SPHERICAL EXHAUST TANK

Filed Dec. 2, 1966

5 Sheets-Sheet 1

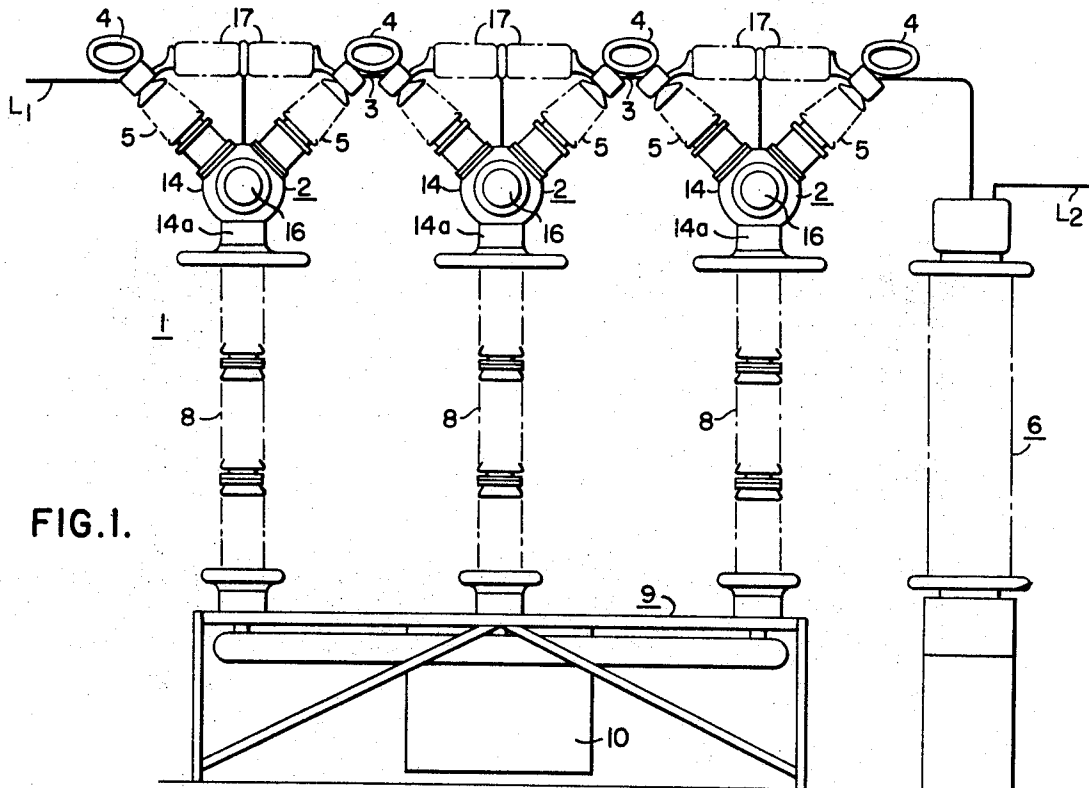


FIG. 1.

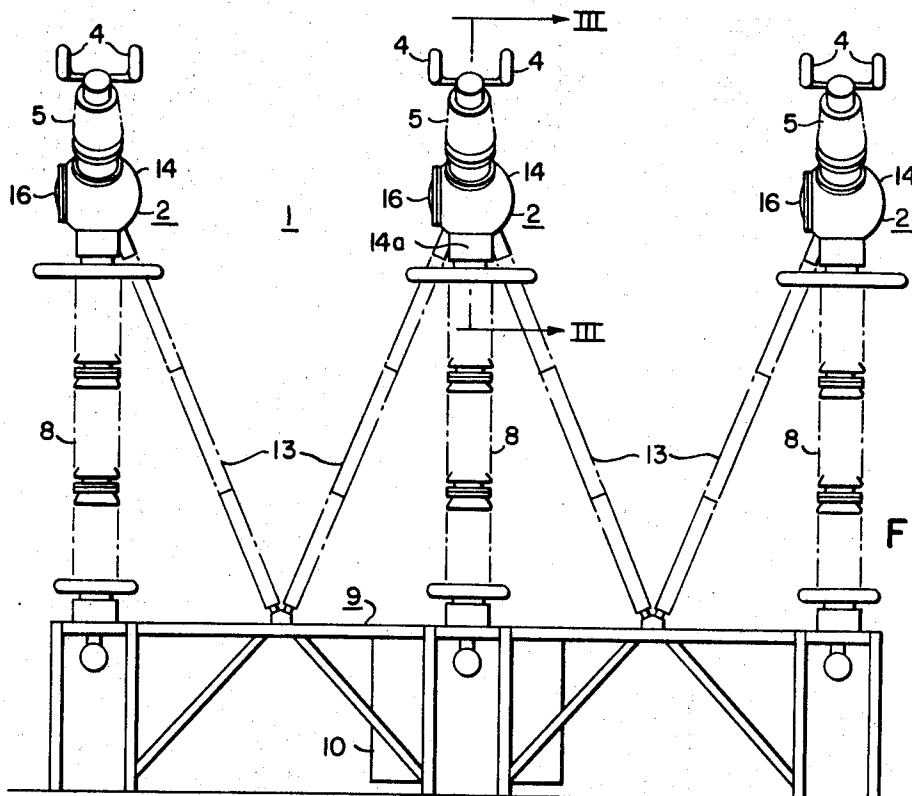


FIG. 2.

Nov. 3, 1970

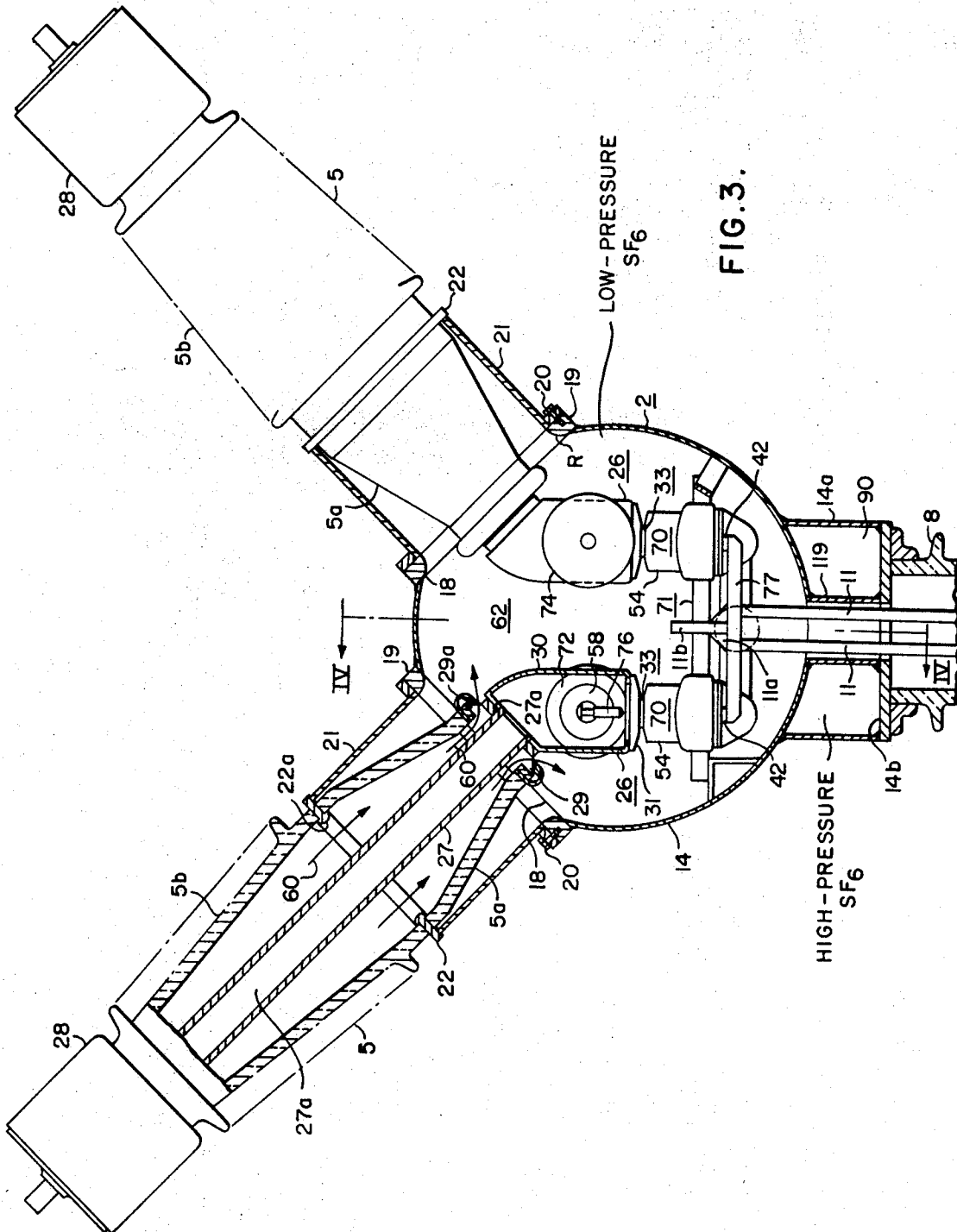
W. M. LEEDS ET AL

3,538,281

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Filed Dec. 2, 1966

5 Sheets-Sheet 2



Nov. 3, 1970

W. M. LEEDS ET AL

3,538,281

COMPRESSED-GAS CIRCUIT INTERRUPTER WITH CYLINDRICAL HIGH
PRESSURE TANK SUPPORTING A SPHERICAL EXHAUST TANK

Filed Dec. 2, 1966

5 Sheets-Sheet 3

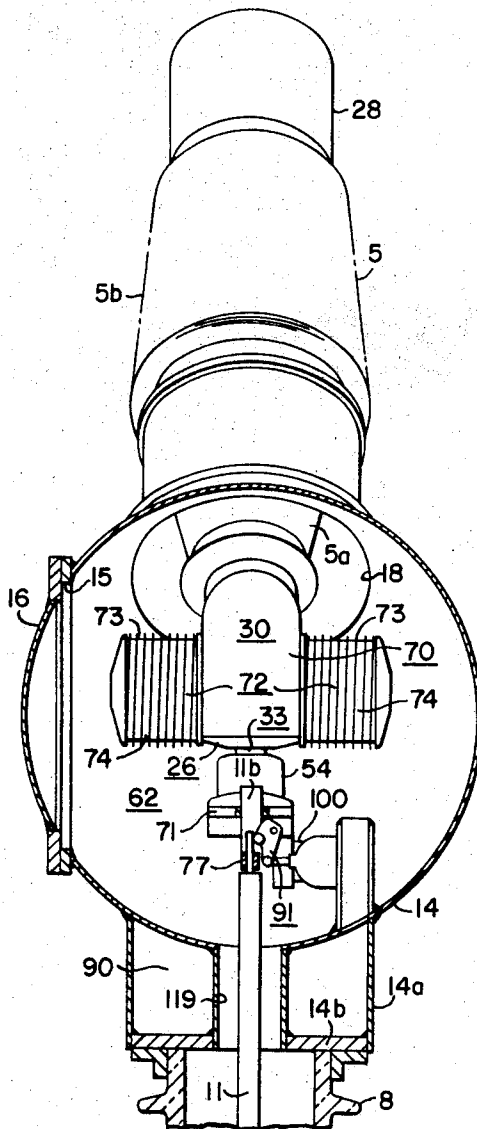


FIG. 4.

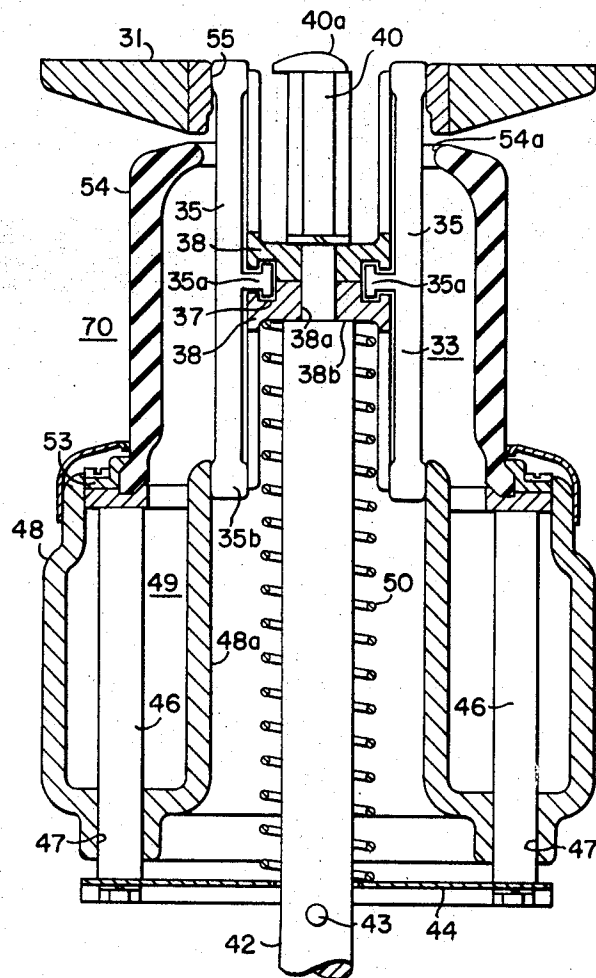


FIG. 5.

Nov. 3, 1970

W. M. LEEDS ET AL.

3,538,281

COMPRESSED-GAS CIRCUIT INTERRUPTER WITH CYLINDRICAL HIGH
PRESSURE TANK SUPPORTING A SPHERICAL EXHAUST TANK

Filed Dec. 2, 1966

5 Sheets-Sheet 4

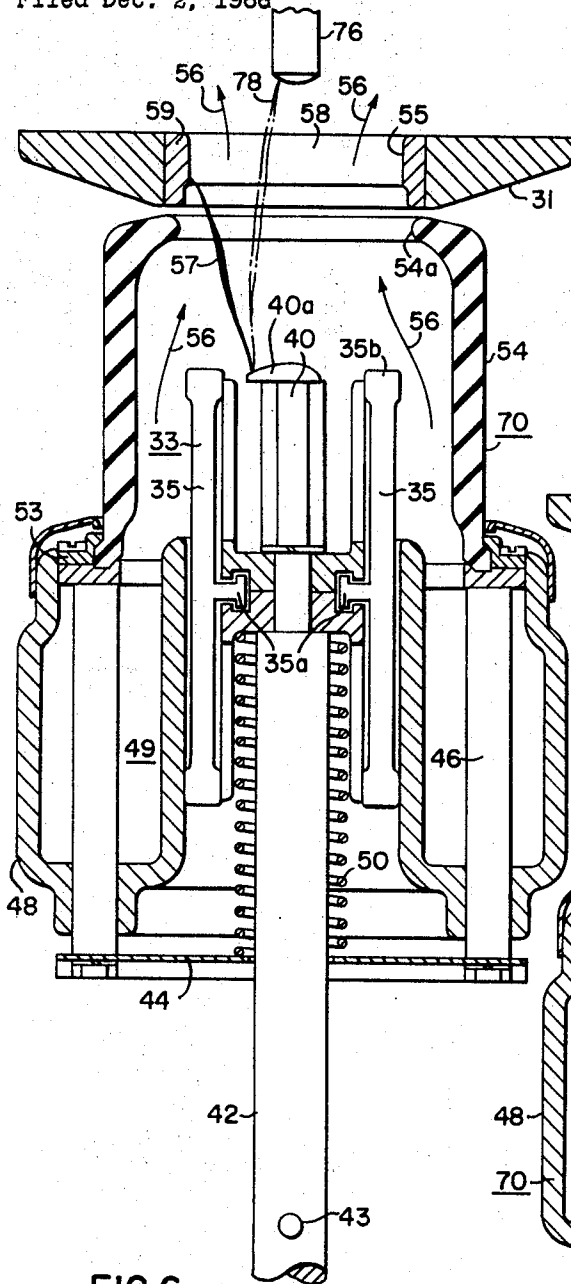


FIG. 6.

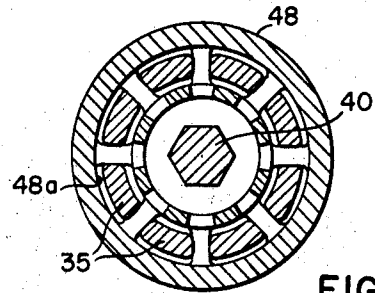


FIG. 8.

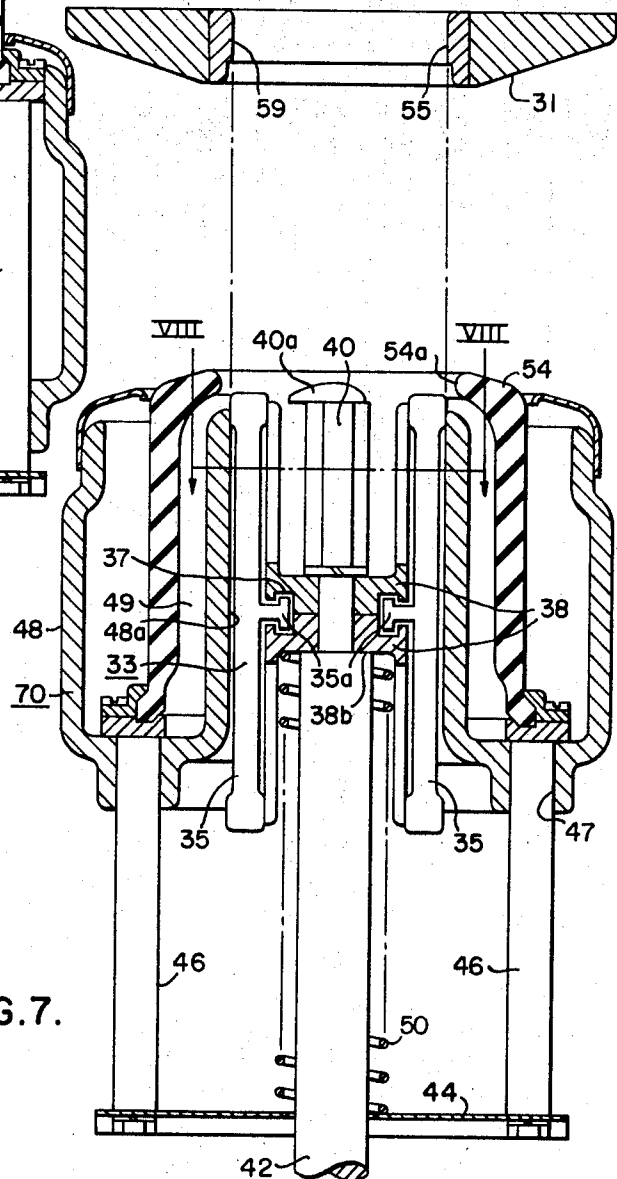


FIG. 7.

Nov. 3, 1970 **W. M. LEEDS ET AL** **3,538,281**
COMPRESSED-GAS CIRCUIT INTERRUPTER WITH CYLINDRICAL HIGH
PRESSURE TANK SUPPORTING A SPHERICAL EXHAUST TANK
Filed Dec. 2, 1966
106 5 Sheets-Sheet 5

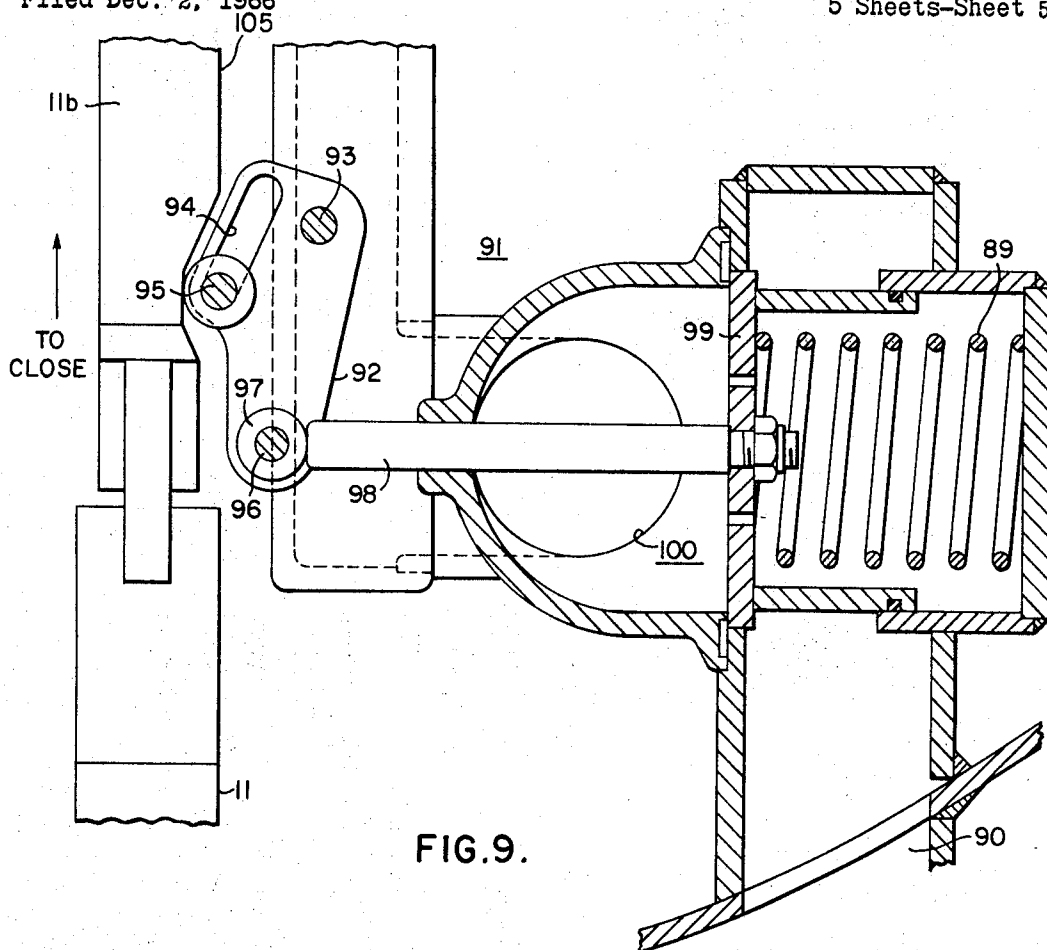
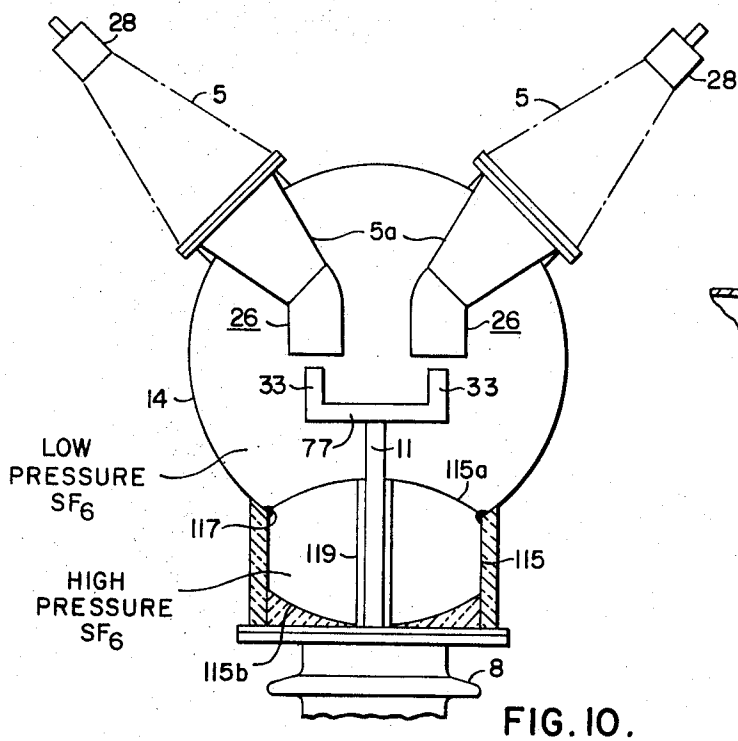
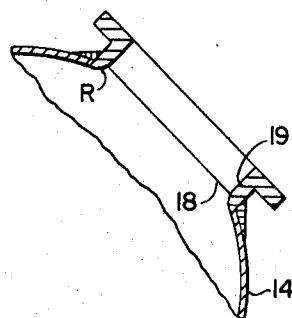
W. M. LEEDS ET AL.

3,538,281

COMPRESSED-GAS CIRCUIT INTERRUPTER WITH CYLINDRICAL HIGH
PRESSURE TANK SUPPORTING A SPHERICAL EXHAUST TANK

Filed Dec. 2, 1966

5 Sheets-Sheet 5



1

2

3,538,281

COMPRESSED-GAS CIRCUIT INTERRUPTER WITH CYLINDRICAL HIGH PRESSURE TANK SUPPORTING A SPHERICAL EXHAUST TANK

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Int. Cl. H01h 33/80

U.S. Cl. 200—148

7 Claims

ABSTRACT OF THE DISCLOSURE

A high-voltage compressed-gas type of circuit interrupter is provided having a spherical exhaust tank at line potential solely supported by a cylindrical high-pressure gas reservoir. An upstanding insulating column supports the two tanks up in the air. The spherical exhaust tank may have circular openings therein to accommodate pre-machined mounting flanges, the latter supporting a pair of series terminal bushings, which project into the interior of the spherical exhaust tank carrying stationary contact assemblies at their interior ends. Cylindrical terminal bushing supports with smoothed inner ends may be welded into the circular openings for accommodating the terminal bushings, whereby the electrical gradient is improved adjacent the weld seams.

The high-pressure gas reservoir may have a heavy flat closure plate at its lower end resting upon the upstanding insulating column, or the high-pressure gas reservoir may have domed upper and lower closure plates. One of the domed closure plates may be the same piece as burned out of the lower end of the spherical exhaust tank.

This invention relates, generally, to circuit interrupters of the compressed-gas type and, more particularly, to such circuit interrupters with spherically-shaped tanks.

A general object of the present invention is to provide an improved and highly-efficient tank configuration for a compressed-gas circuit interrupter of simplified construction and adaptable, where required, for the higher voltages, for utilization with modular units in series.

A more specific object of the present invention is the provision of an improved compressed-gas circuit interrupter having a simplified and readily fabricated spherical tank assembly.

A further object of the present invention is the provision of a dual-pressure type of compressed-gas circuit interrupter involving a simplified spherical tank assembly and utilizing a minimum quantity of tank material.

An ancillary object of the instant invention is the provision of an improved dual-pressure type of compressed-gas circuit interrupter resulting in a modular-type breaker construction of attractive appearance and having a highly functional design.

Yet a further object of the present invention is the provision of an improved tank configuration for a compressed-gas circuit interrupter in which the shape and configuration of the tank walls renders the structure resistant to pressure deformation when high-pressure gases are utilized.

Still a further object of the present invention is the provision of an improved metallic tank construction for a circuit interrupter in which high-electrical gradient stresses are reduced by a novel aperture formation in the assembly of the several parts.

In U.S. Pat. No. 3,214,546, issued Oct. 26, 1965 to Winthrop M. Leeds, and assigned to the assignee of the instant invention, there are illustrated and described various types of dual-pressure circuit interrupters adaptable for support at the upper ends of insulating columns, and

suitable for various voltage ratings by the use of several such modular units in series relation. It is a further object of the present invention to improve upon the tank configuration and circuit-interrupter constructions of the aforesaid patent rendering the same of simplified construction, more readily capable of fabrication, and highly efficient in operation.

In accordance with a preferred embodiment of the invention, a spherical metallic tank rests upon, and is welded to, a short cylindrical tank, which serves as a single high-pressure gas reservoir. Preferably, cylindrical flanges are utilized for mounting the terminal bushings which extend into the tank structure. The vertical cylindrical portion of the tank structure may either be closed at its lower end by a flat plate, or both the upper and lower ends of the short cylindrical section may be provided with domed ends. In addition, a steel pipe may be welded through the top and bottom ends of the high-pressure chamber to provide a conduit, or duct for transmitting low-pressure gas to ground potential. Such steel pipe may, in addition, accommodate the vertically-extending operating rod for actuating the movable contact structure.

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

FIG. 1 is a side elevational view of a three-phase dual-pressure type of compressed-gas circuit interrupter embodying principles of the present invention;

FIG. 2 is an end elevational view of the three-phase compressed-gas circuit interrupter of FIG. 1;

FIG. 3 is a vertical sectional view taken along the line III—III of one of the modular compressed-gas units of FIGS. 1 and 2, the left-hand unit being shown partially in section, and the contact structure of both units being indicated in the closed-circuit position;

FIG. 4 is a vertical sectional view taken substantially along the line IV—IV of FIG. 3, again the contact structure being illustrated in the closed-circuit position;

FIG. 5 is an enlarged fragmentary vertical sectional view taken through the separable contact structure of one of the arc-extinguishing units of the arc-extinguishing assembly of FIGS. 3 and 4, the contact structure being illustrated in the closed-circuit position;

FIG. 6 is a view similar to that of FIG. 5, but illustrating the conditions during the arcing period while the guide-flow insulating member is retained in its upward extended position due to differential gas pressure;

FIG. 7 is a view similar to that of FIGS. 5 and 6, but illustrating the disposition of the several parts in the fully open-circuit position;

FIG. 8 is a detailed sectional view taken substantially along the line VIII—VIII of FIG. 7;

FIG. 9 is a considerably enlarged fragmentary view indicating the blast-valve operating linkage, the blast-valve linkage and the contact operating rod being illustrated in the closed-circuit position with the blast valve closed;

FIG. 10 is a somewhat diagrammatic view illustrating a compressed-gas circuit-interrupter tank configuration of modified construction; and,

FIG. 11 is a fragmentary sectional view illustrating the manner in which the cylindrical flanges for mounting the terminal bushings may be pre-machined before welding to provide a large-radius contour for a low electrical stress at the point of entrance of the terminal bushings.

Referring to the drawings, and more particularly to FIGS. 1 and 2 thereof, the reference numeral 1 generally designates a three-phase dual-pressure type of compressed-gas circuit interrupter. As shown, the circuit interrupter 1 comprises three modular units 2 for each phase, such units being electrically connected in series by connectors 3. Electrostatic rigs 4 may be used for the prevention

3

of high electrical stresses adjacent the confronting ends of the terminal bushings 5 of the units 2.

If desired, a suitable current-transformer structure 6 may be employed for measurement of the current passing through the interrupter 1 and for relaying purposes.

Supporting the modular units 2 in an upstanding relation at the upper ends of insulating supporting columns 8 is a frame support 9, to which is secured a mechanism housing 10. Disposed interiorly of the mechanism housing 10 is a suitable operating mechanism, which may be of conventional type, and functioning to synchronize the operation of operating rods 11 extending upwardly within each of the supporting insulating columns 8. Reference may be had to the linkage set forth in U.S. patent application filed June 12, 1964, Ser. No. 374,708, now U.S. Pat. 3,291,947, issued Dec. 13, 1966 to Roswell C. VanSickle and assigned to the assignee of the instant invention, for a possible type of linkage construction. Such linkage, however, constitutes no part of the present invention.

With reference to FIG. 2 of the drawings, it will be noted that assisting in the upward rigid support of the several modular units 2 are diagonally-extending insulating support rods 13, which provide a desirable bracing construction.

It will be noted that each modular unit 2 comprises a generally spherical metallic tank 14 having preferably only a single access manhole 15 associated with a hinged door 16, by means of which access may be obtained interiorly of each tank structure 14.

To assist in dividing the voltage equally between the several modular units 2, and also providing a certain amount of support, is serially related impedance sections 17, which may comprise resistance or capacitance elements, such as are of the type set forth in U.S. Pat. 2,748,226, issued May 29, 1956, to MacNeill et al., and assigned to the assignee of the instant application.

With particular attention being directed to FIG. 3 of the drawings, it will be noted that the spherical tank 14 has circular apertures 18 burned, or otherwise cut thereout, and having welded thereto flange collars 19. Each flange collar 19 has fixedly secured thereto, by means of mounting bolts 20, a flanged cylindrical support member 21, to the outer end of which is fixedly mounted the terminal bushing 5 by means of the support ring 22.

In more detail, the terminal bushing 5 comprises a pair of insulating shells 5a, 5b having interposed therebetween the supporting ring 22 having a smoothly curved inner periphery, as shown at 22a (FIG. 3). Extending axially through the terminal bushing 5, and serving the function of carrying the current interiorly of the tank structure 14, and also supporting a stationary contact assembly 26, is a tubular conductor stud 27. The conductor stud 27 may have associated therewith a suitable biasing-spring construction, not shown, and an outer cap structure 28.

Fixedly secured, as by a threading and clamping arrangement, to the interior end 27a of the terminal stud 27 is an apertured support casting 29 having fixedly secured thereto an exhaust chamber 30. As shown, the exhaust chamber 30 includes a lower metallic orifice plate 31 making contacting engagement with a bridging contact assembly, generally designated by the reference numeral 33. FIGS. 5-8 may be referred to for a more detailed description of the bridging contact assemblage 33. With particular reference being directed to FIG. 5 of the drawings, the bridging contact assemblage 33 comprises a plurality of circumferentially-disposed double-ended contact fingers 35 having an inwardly-extending, generally T-shaped retaining member 35a. The T-shaped retaining portion 35a is somewhat resiliently secured within an enlarged aperture 37 formed by the mating of a pair of complementary-slotted spring cups 38 having central apertures 38a provided therethrough. A rod-shaped arcing horn 40 having an arc-resisting tip portion 40a is provided extending through the pair of apertures 38a and fixedly secured to the upper end of an operating rod 42. Extending laterally

4

through the metallic operating rod 42 is an abutment pin 43, which serves, during the closing operation, to pick up a cross-bar 44, generally of channel-shaped configuration. Fixedly secured to the ends of the cross-bar is a pair of metallic push rods 46, which extend through apertures 47 provided through a generally annular cup-shaped casting member 48 defining a gas-entrance chamber 49. Interposed between the base portion 38b of the lower slotted spring assembly 38 and the cross-bar 44 is a compression retrieving spring 50, the function for which will be more clearly apparent hereinafter.

As shown more clearly in FIG. 5, the lower ends 35b of the several spring fingers 35 make sliding contacting engagement with the inner surface 48a of the annular cup-shaped member 48 and serve to transmit current therethrough in the closed-circuit position, as shown in FIG. 5. Disposed at the upper ends of the two diametrically-located push-rod 46 is a retaining ring 53 fixedly secured to a fluid-directing nozzle member 54 defining an outlet orifice 54a.

It is desirable to position the gas-flow fluid-directing member 54 in an upper extended position in the closed-circuit position of the interrupter, as illustrated in FIG. 5 of the drawings. By suitable means, more clearly described hereinafter, gas is caused to enter within the gas entrance region 49, and this high-pressure gas is driven upwardly through the orifice 54a of the fluid-directing member 54 in the direction of the arrows 56 (FIG. 6) and through the orifice member 31 into the interior 58 of the exhaust member 30. This will serve to extinguish the established arc 57 (FIG. 6), which is drawn between the arcing horn 40 and the stationary orifice contact 59 composed of arc-resisting material, which constitutes the inner periphery of the orifice 55 through the stationary orifice contact 31. The exhausted gas is forced through the interior 27a (FIG. 3) of the terminal stud 27, and by suitable openings, not shown, is forced to return downwardly, as indicated by the arrows 60 of FIG. 3, and through the apertures 29a of the supporting casting 29 to the region 62 interiorly of the tank structures 14.

To assist in the extinction of the arcs 57 established within the interrupting units 70 connected in series by a conducting bus-bar structure 71 is a resistance means, generally designated by the reference numeral 72, and comprising a pair of electrically-parallel wire-wound resistance elements 73, wound around laterally off-jutting insulating sleeves 74, and electrically connected between the central exhaust chamber 30 and the centrally-located stationary arcing horn 76.

The blast of gas passing radially inwardly through the fluid-directing member 54 carries the initially established arc, drawn between the contacts 59, 35, to the arcing horns 40, 76 with the two resistor elements 73 electrically in parallel. The reduced current amperage and the improved power factor facilitates the interruption of the arc 78 (indicated by dotted line of FIG. 6) drawn within each of the arc-interrupting units 70.

To synchronize the opening and closing movements of the two operating rods 42, there is provided a relatively light-weight horizontally-disposed cross-bar 77, fixedly secured to the upper ends of the insulating operating rods 11. Preferably, the upper ends of the operating rods 11 are joined, as at 11a, and provide a guide extension 11b, which may be guided within a suitable guide aperture provided by the conducting bus-bar construction 71.

To control the admission of a high-pressure blast of SF₆ gas from the high-pressure region 90 (FIG. 3), there is provided a blast-valve assembly, generally designated by the reference numeral 91 (FIG. 9), and including a pair of pivotally-mounted blast-valve levers 92, pivotally mounted about a stationary pivot pin 93. Each blast-valve lever 92 has an elongated slot 94 provided therethrough, within which slides a roller assembly 95. The roller assembly 95 is biased by springs, not shown, to a roller pin 96, about which is encircled a roller 97, which makes abut-

ment with the valve stem 98 of a blast valve 99. It will, therefore, be apparent that rightward opening movement of the blast-valve stem 98 will cause opening of the blast valve 99 and permit the exhausting of a blast of high-pressure gas through a conduit structure 100 and into the two gas-entrance regions 49 of the two arc-extinguishing units 70.

During the closing operation, the cam portion 105 (FIG. 9), which previously caused opening counterclockwise rotation of the blast-valve lever assembly 92, will cause the roller assembly 95 to move to an inoperative position, that is being moved laterally upwardly along the slots 94 against the spring tension of the biasing spring (not shown). The result will be that there will be no blast occurring during the closing stroke.

Certain features of the bus-bar construction 71 rendering the use of a lightweight cross-bar 77 possible are set forth and claimed in U.S. patent application filed Dec. 2, 1966, Ser. No. 598,807 by Charles F. Cromer and Charles B. Wolf, and assigned to the assignee of the instant application. In addition, certain features of the fluid-director nozzle construction 54 are set forth and claimed in U.S. patent application filed Dec. 2, 1966, Ser. No. 598,761 by Albert P. Strom and Charles F. Cromer and assigned to the assignee of the instant application.

The present invention is particularly concerned with the particular high-pressure and low-pressure tank construction and configuration of the circuit interrupter 1. U.S. Pat. 3,214,546, issued Oct. 26, 1965 to Winthrop M. Leeds, referred to above, described a high-voltage live-tank two-pressure gas breaker design in which the main steel tank at low gas pressure is in the form of a cylinder with the axis horizontal and having domed ends. Inside were located two cylindrical high-pressure gas tanks, which were arranged to send an arc-quenching blast of gas at arcs formed between separating contacts.

When a highly-efficient gas, which is relatively expensive, such as sulfur hexafluoride (SF_6) gas, is used as the gaseous interrupting medium, it is desirable to keep the required volume as small as possible to save cost. One of the purposes of the present invention is to provide a novel tank shape that requires a minimum quantity of gas, is strong to withstand internal gas pressure, has an attractive appearance, and furthermore makes possible reduced electrical stress at the openings 18 of the tank 14 for the terminal bushings 5.

The main tank 14, as shown in FIG. 3, is in the form of a sphere with only one access manhole 15, instead of two required at the domed ends of the cylindrical shaped tank of the aforesaid Pat. No. 3,214,546. It is to be noted that the spherical tank 14 rests upon, and is welded to a short upstanding cylindrical tank 14a, which serves as a single high-pressure gas reservoir, constituting the space 90. It is to be noted, furthermore, that the cylindrical flanges 19 for mounting the terminal bushings 5 meet the spherical tank 14 in a circular intersection 18. Thus, simple pre-machining of the flanges 19 before welding into the tank 14 provides a large radius contour R for a low electrical stress at this point. Reference is particularly directed to FIGS. 3 and 11 of the drawings in this connection. The circular intersection 18 requires a minimum of machining and gives maximum strength.

Previous tanks employed in the prior art, have had intersecting cylinders for the terminal flanges requiring expensive cast shields of odd shape to reduce the voltage stress concentration.

As shown in FIGS. 3 and 4, the high-pressure cylindrical tank 14a is closed at the bottom end by a heavy flat plate 14b. An alternate embodiment of the present invention is illustrated in FIG. 10, in which the high-pressure tank 115 is shown domed at both the top and bottom ends, as at 115a, 115b, for high mechanical strength. A hole 117 is burned into the bottom of the main spherical tank 14, and the two tanks welded together, as shown in FIG. 10. With care in design, the

domed piece 115a burned out of the spherical tank 14 can be utilized as one end of the high-pressure tank 115.

The pair of tanks, welded as a unit, can be mounted on the supporting insulator by providing short legs. This makes for a convenient point of separation for purposes of shipment to a customer.

It may be convenient to weld a steel pipe 119 through the top and bottom ends of the high-pressure chamber 115, preferably on the central axis for two purposes. One is to provide a duct for leading low-pressure gas from the main tank 14 to the porcelain supporting column 8 and then to ground. A connection to a gas compressor allows this gas to be raised to a high pressure and stored, first in a reservoir at ground potential, and then carried up through an insulated pipe, as needed, to the reservoir 90, 115 at high potential.

By way of recapitulation, during the opening operation, the operating rods 11, extending upwardly with the insulating columns 8 are forcibly moved downwardly by suitable mechanism disposed interiorly within the operating housing 10. The downward opening movement of the operating rods 11 causes simultaneous downward opening movement of the cross-bars 77 and the bridging contact structures 33. The camming action of the cam 105 (FIG. 9) secured to the operating rods 11 effects opening of the blast-valve structure 91 and causes the entrance of high-pressure gas into the gas-entrance chamber 49. This will maintain the fluid-directing orifice members 54 in their upper position, as illustrated in FIG. 6, despite the fact that the bridging members 33 will be forcibly moved downwardly causing separation between the pickup pin 43 and the cross-bar 44. The gas pressure within the region 49 will be greater than the spring pressure exerted by the compression spring 50. The net result is that the fluid-directing nozzle member 54 will be maintained in its upper extended position during arc interruption, as shown more clearly in FIG. 6 of the drawings.

The downward movement of the bridging contact assembly 33 will initially draw an arc between the contact portions 35b and 59. The upwardly flowing high-pressure gas flowing through the orifice opening 55 and into the exhaust chamber 30 will effect arc transfer from the separating contacts 35b, 59 to the arc horns 40, 76, thereby inserting the two resistor elements 73 into series circuit, thus reducing the amperage of the current being interrupted. The residual-current arc is established between the arcing contacts 40, 76 and the longitudinal passage of the high-pressure gas into the exhaust region 58, as indicated by the arrows in FIG. 6, will quickly effect extinction of this residual-current arc. Further downward opening movement of the operating rods 11 will cause the cam 105 to ride off of the blast-valve roller 95, thereby permitting the compression spring 89 to effect reclosure of the blast valve 99.

The reduction of the pressure within the entrance region 49, resulting from reclosure of the blast valve 99, will permit the retrieving compression spring 50 to effect downward retracting motion of the fluid guide 54 to a position illustrated in FIG. 7 of the drawings. The interrupter 1 is now in the open-circuit position with the fluid director 54 in its lowered position improving the dielectric conditions at the contact gap.

During the closing operation, suitable mechanism disposed interiorly of the mechanism housing 10, will be effective to cause upward closing motion of the several operating rods 11. The upward closing motion of the operating rods 11 will effect, through the cross-bars 77, upward movement of the operating rods 42. This motion will continue until the pickup pin, or abutment 43, strikes the cross-bar 44, thereby causing the fluid director 54 to move upwardly with the bridging contact structure 33 as a unit. Such closing motion continues until the bridging contacts 33 assume the position illustrated in FIG. 5 of the drawings.

For replenishment of the high-pressure gas within the high-pressure reservoir 90 there is preferably provided a

compressor, as previously mentioned, and a suitable insulating feed conduit, which extends upwardly within the insulating column 8 of each unit 2.

From the foregoing description it will be apparent that there is provided an improved compressed-gas circuit interrupter having an improved tank configuration, which is readily adaptable for fabrication and providing regions 18 free of high-voltage stress. In addition, the construction is suitable for multiple units in series for the higher voltage applications. For example for 500 kv. application, three units, such as illustrated in FIG. 1, would be required. For a lower-voltage rating, of course, the number of units could be reduced.

Although there has been illustrated and described specific 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. In combination, a fluid-blast circuit interrupter including upstanding insulating column means surrounding a vertical insulating operating rod, a spherical relatively low-pressure exhaust tank surmounted on said insulating column means and having a pair of terminal bushings extending therewithin, relatively stationary contact structure supported adjacent the inner extremity of each terminal bushing, movable contact means actuated by vertical reciprocal motion of said insulating operating rod for electrically interconnecting the two relatively stationary contact structures, a high-pressure tank interposed between said insulating column means and the spherical relatively low-pressure exhaust tank and constituting the sole intervening supporting member, said high-pressure tank including a cylindrical upstanding wall portion below and supporting the spherical relatively low-pressure exhaust tank, and means blasting high-pressure gas from said high-pressure tank toward said contact means to exhaust into the general interior of the spherical tank.

2. The fluid-blast circuit interrupter of claim 1, wherein the exhaust tank is metallic and at high voltage in the closed-circuit position of the interrupter.

3. The fluid-blast circuit interrupter of claim 1, wherein a circular opening is provided in the exhaust-tank wall for accommodating each terminal bushing.

4. The fluid-blast circuit interrupter of claim 1, wherein the high-pressure tank has a lower end metallic support plate resting directly on said upstanding insulating column means.

5. The fluid-blast circuit interrupter of claim 1, wherein said high-pressure tank includes domed upper and lower end plates.

6. The combination of claim 5, wherein one of the domed end plates of the high-pressure tank is obtained by the cut-out lower portion of the spherical tank.

7. The combination of claim 3, wherein cylindrical terminal bushing supports with smoothed inner ends are welded into the circular openings for accommodating the terminal bushings, whereby the electrical gradient is improved adjacent the weld seams.

References Cited

UNITED STATES PATENTS

1,957,982	5/1934	Smith	174—142 X
1,957,983	5/1934	Smith	174—18 X
2,079,231	5/1937	Smith	174—142 X
2,581,571	1/1952	Baker et al.	200—150 X
3,052,783	9/1962	Buron	200—148
3,189,718	6/1965	Tominaga	200—148
3,350,528	10/1967	McKeough	200—148 X
3,358,104	12/1967	Cromer et al.	200—148

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U.S. Cl. X.R.

174—18, 142