Dec. 4, 1962 J. M. RAMRATH 3,067,307

FLUID BLAST INTERRUPTING DEVICE FOR OIL CIRCUIT BREAKERS

Filed Jan. 15, 1960 3 Sheets-Sheet 1

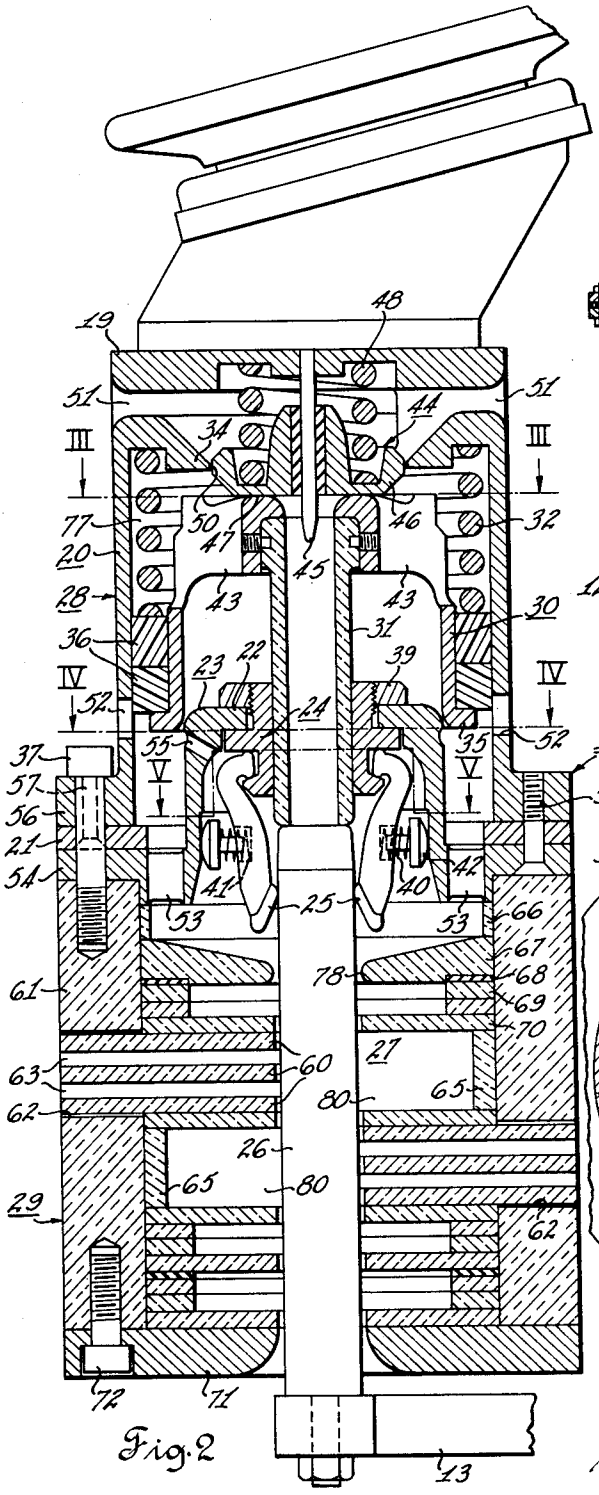


Fig. 2

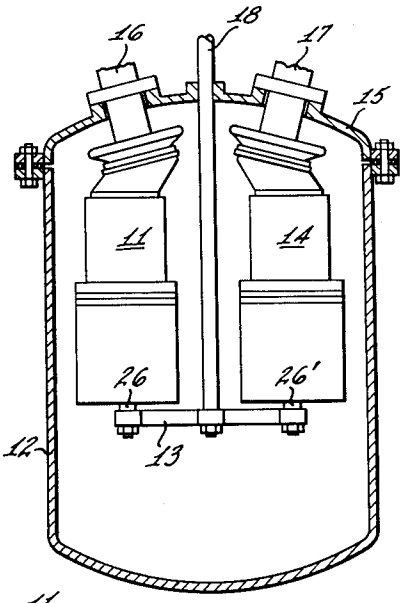


Fig. 1

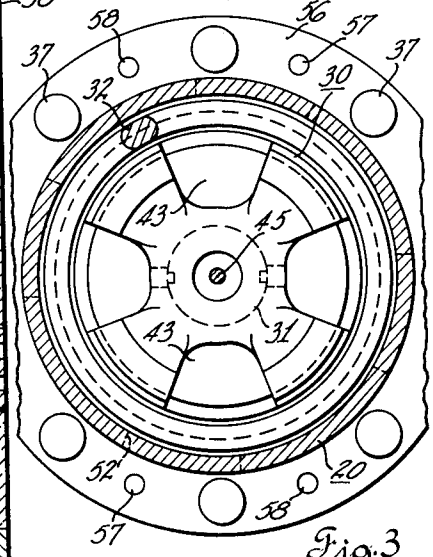


Fig. 3

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FLUID BLAST INTERRUPTING DEVICE FOR OIL CIRCUIT BREAKERS

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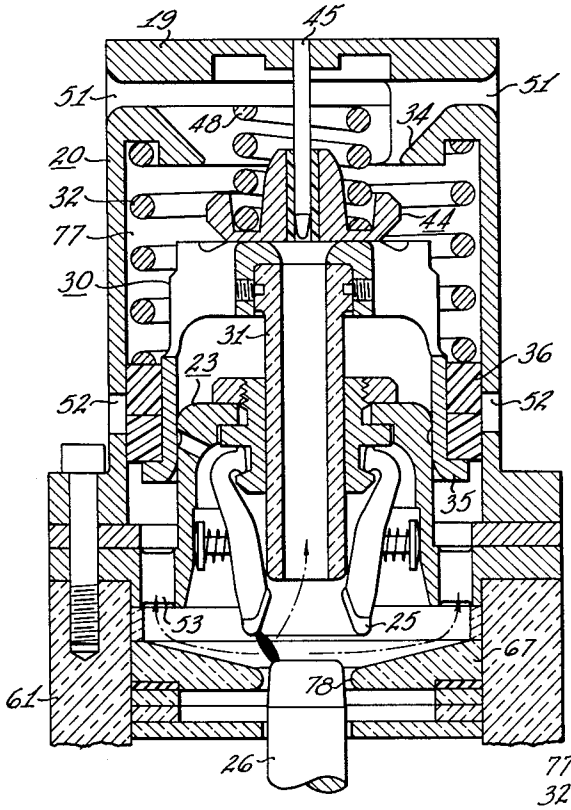


Fig.6

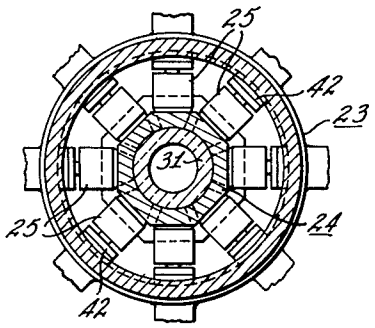


Fig.5

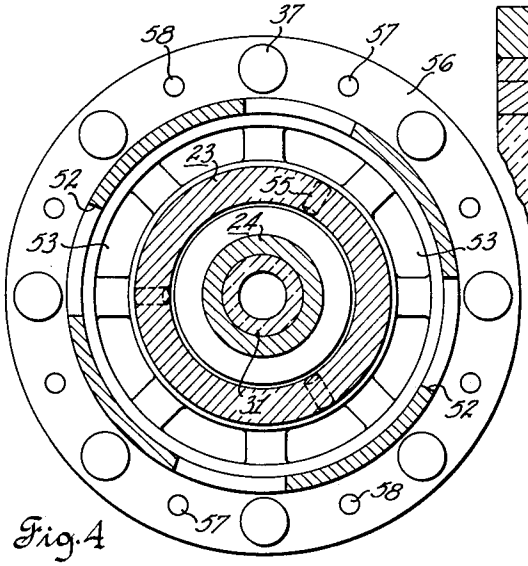


Fig.4

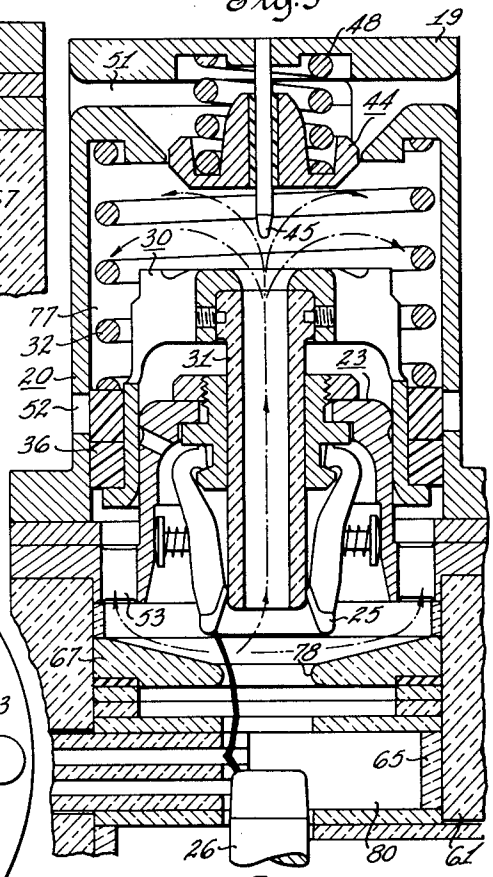


Fig.7

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FLUID BLAST INTERRUPTING DEVICE FOR OIL CIRCUIT BREAKERS

Filed Jan. 15, 1960 3 Sheets-Sheet 3

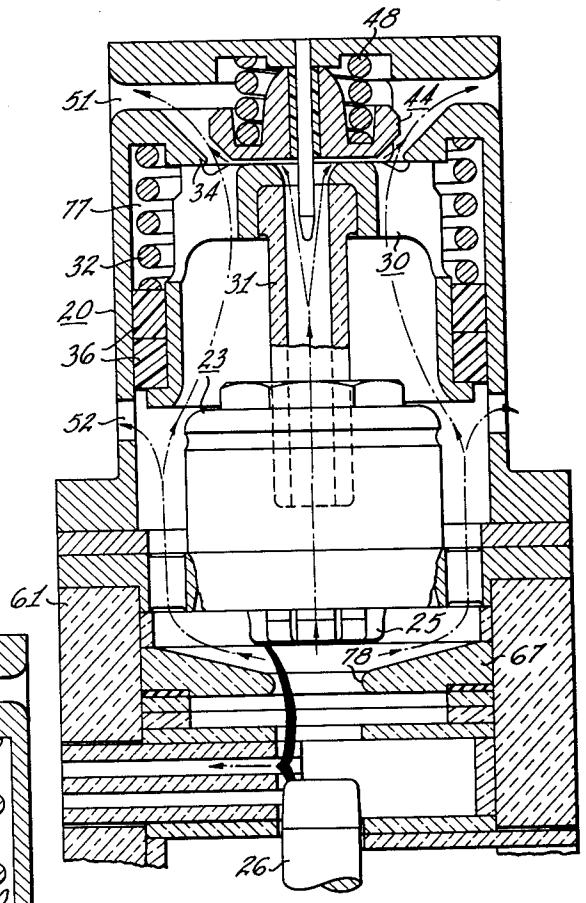


Fig. 8

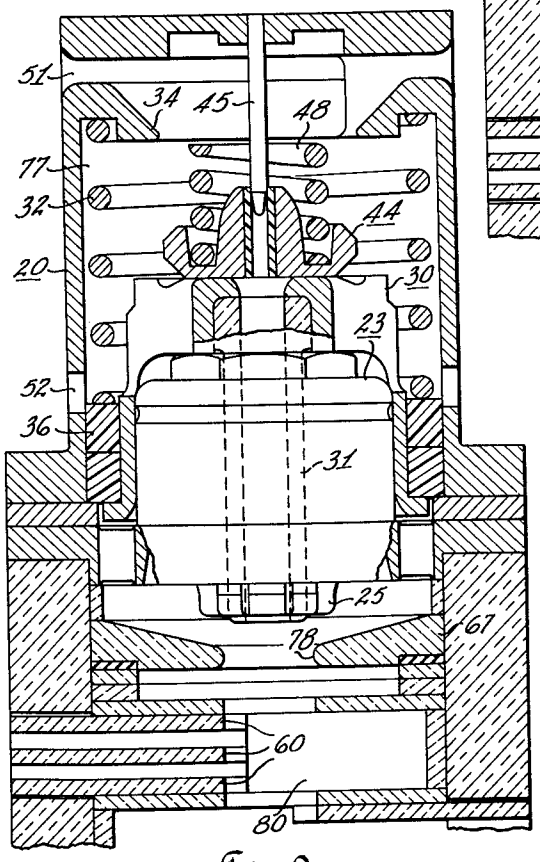


Fig. 9

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3,067,307

FLUID BLAST INTERRUPTING DEVICE FOR OIL CIRCUIT BREAKERS

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Filed Jan. 15, 1960, Ser. No. 2,752
15 Claims. (Cl. 200—150)

This invention relates to electric circuit interrupters and more particularly to high speed oil circuit breakers of the fluid blast type.

More specifically this invention relates to a novel structure for effecting the very rapid initiation, elongation and extinction of electric arcs drawn in circuit interrupters. This invention is applicable to the interruption of high voltage arcs such as those drawn in 287 kv. circuits but is also applicable on low voltage circuits.

It is known that a rapid lowering of the dielectric strength of an arc extinguishing fluid, such as oil, occurs after it impinges upon the arc stream and that it is desirable to eliminate such contaminated fluid as quickly as possible and to subject the arc stream to the action of fresh fluid of high dielectric strength. The isolation or disconnection of a capacitance load by a circuit breaker in an alternating current system is subject to transient overvoltages, the magnitudes of which depend on the capacitance of the load, the voltage of the system and the type of the circuit breaker. In one-half cycle after the first current zero, the voltage of the source has reversed to its crest value and approximately double this voltage appears across the circuit breaker contacts as a circuit recovery voltage. Whether or not restriking of the arc occurs depends on several factors such as the type of the circuit breaker including the speed and the magnitude of the separation of its contacts, the magnitude of the circuit recovery voltage, and the leading kva. of the load.

In the oil blast circuit breakers of the prior art interrupting devices equipped with oil pistons for efficient interruption of magnetizing and capacitive currents generally use separate push rods for their operation. This arrangement positions the centers of the contact rod and push rod in different planes resulting in expensive and space consuming interrupting devices, complicated bridging contacts and large oil tanks.

In accordance with the invention claimed a new and improved coaxial compensated oil piston interrupting device is provided within a pressure confining structure. Relatively movable contacts are arranged to operate within an arc extinguishing fluid in the structure and are separated to draw an arc to be extinguished by blast action within the structure. A spring biased piston is axially arranged with the contacts and is provided with a piston rod extending therethrough. One of the contacts and the piston rod engage each other in contact closed position. Means are provided which are operative during circuit closing movement of the circuit interrupter for engaging one of the contacts with the piston rod for driving the piston to its biased position within the pressure structure so that during a circuit opening operation the piston moves in contact opening direction for applying an impulse blast to the arc immediately after separation of the contacts.

It is, therefore, one object of this invention to provide a new and improved circuit breaker structure for establishing and lengthening an arc.

Another object of this invention is to provide a new and improved circuit interrupting mechanism in which the relatively movable contacts and the fluid actuating piston are coaxially arranged.

A further object of this invention is to provide a new and improved circuit interrupting mechanism in which a fluid actuating piston employing two relatively movable

parts is provided with means for equalizing the pressure on both sides thereof over at least a part of its working stroke.

A still further object of this invention is to provide a new and improved circuit interrupting mechanism in which an oil impulse piston employs a closable opening forming a pressure equalizing passage therethrough.

A still further object of this invention is to provide a new and improved circuit interrupting mechanism in which an oil impulse piston employs a hollow, tubular piston rod forming a pressure equalizing passage through the piston.

A still further object of this invention is to provide a new and improved circuit interrupting device in which a hollow, tubular piston rod forming a pressure equalizing passage through the piston engages the movable contact at its open end during contact closing operation and disengages from the movable contact during its opening operation thereby exposing the equalizing passage to the arc gas pressure immediately upon contact separation.

A still further object of this invention is to provide a new and improved circuit interrupting mechanism in which a dual purpose inlet, outlet port is controlled by a valve means actuable to more than one port controlling position determinable by the pressure created by the arc.

A still further object of this invention is to provide a new and improved circuit interrupting device employing a new fluid actuating piston utilizing two integrating parts.

Objects and advantages other than those set forth will be apparent from the following description when read in conjunction with the accompanying drawings, in which:

FIG. 1 is an elevational view partly in section of a circuit interrupter embodying the invention and shown in circuit closed position;

FIG. 2 is an enlarged sectional view through one of the interrupting devices shown in FIG. 1 in the breaker closed position;

FIG. 3 is a cross sectional view taken along the line III—III of FIG. 2;

FIG. 4 is a cross sectional view taken along the line IV—IV of FIG. 2;

FIG. 5 is a cross sectional view taken along the line V—V of FIG. 2;

FIG. 6 is an enlarged sectional view through one of the interrupting devices shown in FIG. 1 during a contact disengaging operation;

FIG. 7 is an enlarged sectional view similar to FIG. 6 of the internal parts of the piston and relief valve shown in full pressure compensating position;

FIG. 8 is an enlarged view similar to FIGS. 6 and 7 of the internal parts of the piston and relief valve during excessive pressure development; and

FIG. 9 is an enlarged view of the structure shown in FIGS. 6, 7 and 8 in the breaker open position.

Referring more particularly to the drawing by characters of reference, FIG. 1 illustrates an oil circuit breaker unit of the high voltage type such as that used in power transmission systems. Unit **11** is suspended from one line terminal of the circuit interrupter in a suitable pressure confining structure such as tank **12** and submerged in a suitable insulating arc extinguishing fluid, such as oil. A conducting bridging bar **13** serves to connect electrically the arc extinguishing unit **11** with an identical unit **14** in a manner well known in the art. Supported on a cover **15** of the tank **12** are a pair of terminal bushings **16** and **17** (partially shown), to the lower ends of which are secured arc extinguishing units **11** and **14**. The cross bar **13** is actuated reciprocally in the vertical direction by an insulating lift rod **18** to open and close relatively movable cooperating contacts of the arc extinguishing units **11** and **14**.

FIG. 2 is an enlarged view in cross section of the left hand arc extinguishing structure shown in FIG. 1. The right hand arc extinguishing structure is of similar design. In FIG. 2 the breaker is shown in its contact closed position and current passes from a conductor (not shown) in bushing **16** through a mounting plate **19** which is suitably fastened to bushing **16** and is formed as an integral part of cylinder **20** through plate **21**, flange **22** of contact housing **23**, collar **24**, a plurality of contact elements such as finger contacts **25** into a movable rod shaped contact **26**. Contact **26** is arranged in a pressure chamber **27** which aids in extinguishing the arc drawn between the relatively movable contacts **25** and **26**. Current flows in the contact closed position from contact **26** across the bridging bar **13** to the movable rod shaped contact **26'** arranged in unit **14** and through substantially identical parts in unit **14** in reverse manner. The current loop through the cluster of relatively stationary finger contacts **25** and the contact housing **23** magnetically increases contact pressure of the finger contacts against the relatively movable rod contact **26** at high magnitude currents in the well known manner.

The interrupting unit **11** comprises a metallic top section **28** and an insulating lower section **29**. The top section comprises a pump arranged within cylinder **20** and employing a piston **30**, nonmetallic piston rod **31** extending from and through piston **30** and a driving spring **32**. Piston **30** and piston rod **31** are arranged for movement longitudinally of unit **11** with the driving spring **32** being arranged between an inturned flange forming valve seat **34** on one end of cylinder **20** and an outwardly turned flange **35** on the periphery of the dome shaped piston **30**. Two spacer rings **36** are arranged between spring **32** and flange **35** on the periphery of piston **30**. Cylinder **20** is clamped to the lower section **29** by a plurality of spaced bolts **37** one of which is shown in FIG. 2.

The piston rod **31** shown herein as a hollow push rod, extends through collar **24** and a clamping unit **39** and axially into contact housing **23**. A plurality of finger contacts **25** (note FIGS. 2 and 5) are pivotally mounted in octagonally arranged grooves in collar **24** and rest with their arcing tips on the periphery of the movable rod shaped contact **26** within the cluster formed by these finger contacts. Contact pressure is provided by springs **40** each seated with one end in a spring well **41** of finger contacts **25** and in an insulating button **42** with the other end. The movable contact **26** supports the piston rod **31** against the pressure or bias exerted by spring **32**.

Piston **30** shown and described herein integrates with contact housing **23** to form a piston means having two integrating parts i.e. a relatively movable part such as piston **30** and a relatively stationary part such as contact housing **23**.

As shown more clearly in FIG. 3 the dome shaped piston **30** is provided with a spider-like configuration freely venting fluid from one side to the other side thereof through a plurality of apertures **43** thereby equalizing the pressure on both sides of the piston. A valve assembly **44** loosely rests on the dome of piston **30** and is reciprocally guided by rod **45** fastened to mounting plate **19** and arranged to extend longitudinally of unit **11**. The valve assembly **44** comprises a movable valve element **46** biased against its valve seat **47** on the dome of piston **30** only by the combined weight of compression spring **48** and valve element **46**. Compression spring **48** rests in the valve assembly **44** and extends between it and mounting plate **19** substantially uncompressed when the circuit breaker is in the closed position. As noted from FIG. 2 cylinder **20** has a circular opening **50** in one end thereof formed by valve seat **34** in which valve element **46** is arranged. Between valve seat **34** and plate **19** a plurality of exhaust ports **51** are arranged which are controlled by valve element **46**. Cylinder **20** is provided with further openings or ports **52** below spacer rings **36**. Openings or ports **55** are provided in housing **23** adjacent collar **24**.

The clamping unit or nut **39** clamps the collar **24** and finger contacts **25** to the contact housing **23**. Housing **23** has a number of openings **53** (shown in FIGS. 2 and 4) through its bottom flange **54** arranged immediately underneath spacer rings **36**. Plate **21** is mounted to the bottom of flange **56** of cylinder **20** by means of flathead screws **57**. Flathead screws **58** tap into flange **56** of cylinder **20** to hold contact housing **23** to the underside of plate **21**. All three structural parts, namely cylinder **20**, contact housing **23** and plate **21** are attached to the lower section **29** of unit **11** by means of cap screws or bolts **37**.

The lower section **29** of unit **11** comprises a plurality of spaced stacked barrier plates **60** which are arranged within a shell **61**. Shell **61** is provided with two openings **62** which may be arranged (as shown) to extend through shell **61** in opposite directions. Built into the grid structure formed by the barrier plates **60** are the exhaust nozzles **63** which protrude through the openings **62**. These nozzles are keyed in place by check tubes **65**. A spacer **66** is interposed between the contact housing **23** and a deflector **67** arranged at the inner end of the barrier plate stack. A gasket **68** made out of a resilient material such as a cork composition is arranged between the barrier plate **69** and deflector **67** to provide a tight stacking of the interrupting pot components of the lower section **29**. The barrier plates **69** and **70** form stuffing box-like oil compartments. A metallic bottom plate **71** is fastened to the underside of shell **61** by means of a plurality of cap screws **72** (one of which is shown in FIG. 2).

For contact inspection cap screws **37** are removed and the whole shell **61** with contents comes off. The tips of the finger contacts **25** then come into full view and can be readily examined. If the arcing tips of contacts **25** need dressing or if replacement is deemed necessary, flathead machine screws **58** are removed. With the removal of screws **58** the contact housing **23** may be removed including the piston **30** and piston or push rod **31**. Piston **30** is able to pass through plate **21**. Valve element **46** and valve spring **48** also are removable with the contact housing **23** so that the valve can be inspected. Spacers **36**, however, cannot come out of cylinder **20** because plate **21** serves as a stop for them. This is important because pump spring **32** biased against spacers **36** is still highly compressed in the breaker open position.

Readjustment or realignment of the arcing contacts after contact inspection or replacement are not usually necessary because the contacts cannot get out of alignment as they can only be mounted in the same central position. In applications where a plurality of interrupting units similar to units **11** and **14** are used it might be desirable to have nozzles **63** face in a particular direction. This can be readily accomplished as the fastening screws **37** are displaced from each other 45 degrees around the periphery of unit **11**; thus one-eighth of a turn or more of the lower section **29** can be readily obtained. The lower sections, however, are usually keyed in the desired position so that a selected position is always assured. In applications of this invention utilizing a plurality of interrupting units **11** the metallic bottom plate **71** becomes the lower terminus of voltage grading resistors (not shown) connecting the finger contact cluster and this bottom plate. Bottom plate **71** approaches the moving rod contact **26** close enough to establish a spark over circuit, thus placing the grading resistors in parallel with the arc on the inside of units **11** and **14**.

The circuit breaker interrupting structure functions selectively depending upon the range of the magnitude of the current it has to interrupt.

When interrupting low magnitude currents encountered at line dropping the tripping impulse from a current transformer (not shown) causes an operator of the circuit breaker (not shown) to move lift rod **18** downwardly as shown in FIG. 1. Since the piston or push rod **31** rests on the end of the movable contact **26**, the whole piston assembly follows the movement of the movable

contact 26 due to the pressure exerted by the spring 32. Piston 30 having a spider-like central portion passes oil readily from the underside through apertures 43 to the space above the piston thereby equalizing the pressure on both sides of the spider-like portion of piston 30. The oil under the piston can readily escape out of the vent holes 52 in the side of cylinder 20 until these holes are covered by the spacer rings 36 and the inner periphery of piston 30 engages with the outer periphery of the contact housing 23. At this point in its operation piston 30 becomes a pump and renders the equalizing effect of aperture 43 ineffective. At this moment the simultaneous axial movement of the movable contact 26 and piston 30 and piston rod 31 ceases. The movement of the piston slows down because it has now become a pump and must displace the oil trapped under it in the annular space between cylinder 20 and contact housing 23. Up to this moment the stored energy of the spring has been fed back into the contact rod and added to its acceleration. Contact 26 now moves away from the piston rod 31 and an arc is formed between the finger contacts 25 and the tip of movable contact 26 at their separation. Gravity and suction upon the downward movement of contact 26 have drawn valve assembly 44 out of its hole blocking position in flange or valve seat 34. FIG. 2 illustrates valve assembly 44 in position wherein it is blocking the aperture or hole 50 formed by the inturned flange 34 of cylinder 20. FIG. 6 illustrates the valve assembly drawn out of the aperture formed by flange 34. Fresh oil can freely flow through this hole from outside of unit 11 through passageways 51 to the space 77 above piston 30. The top of piston 30 remains covered by the valve assembly 44 as the piston rod 31 moves downward with piston 30. The oil under pressure of the pump formed by piston 30 and housing 23 now causes an impulse blast to flow into the void created by the retreating contact 26 through the opening 53 in the bottom flange of the contact housing 23 and attacks the arc concentrically. Some of the oil under pressure of the pump will bypass the contact 26 through the annular opening 78 in deflector 67. Thus, oil is in movement when the arc is drawn through opening 78 in deflector 67. At an early current zero the insulating oil forced into the void by the pump will extinguish the arc and reestablish dielectric strength thus preventing reignition. The circuit is now interrupted.

When interrupting medium magnitude currents encountered at load switching and low power faults the initial phases of the interrupting operation are the same as that described above for interrupting low magnitude currents up to the point of drawing an arc. As a power arc develops, oil is decomposed and a gas pressure develops under the cluster formed by the finger contacts 25. This pressure is communicated through the hollow piston rod 31 to the space above piston 30. The oil in the column formed in piston rod 31 is driven upward and the valve element 46 is driven off of its valve seat as illustrated in FIG. 7 into the circular opening 50 thus blocking the exit passageways 51. The pressure developed under the piston is thereby communicated through piston rod 31 to the now substantially sealed chamber above piston 30 without loss of pressure and pressure compensation is achieved. Depending upon the magnitude of current and the developed pressures, spring 48 becomes compressed to a greater or lesser degree as the case may be. However, the periphery of the valve element 46 keeps circular opening 50 substantially blocked throughout a predetermined range of pressures. The pump is now able to squeeze oil into the arc zone because the pressures are equalized. The oil flow parallel to the arc intensifies as the arc lengthens through the hole 78 in deflector 67 and into chambers 80 immediately behind nozzles 63. The developing pressure drives the arc into the openings of nozzles 63 where it is extinguished at an early current zero.

When interrupting high magnitude currents which stem from heavy short circuits the interrupting operation follows the same pattern as described above for interrupting medium magnitude currents encountered at load switching and low power faults including the pressure compensation of valve assembly 44. However, as the arc energy increases due to the greater amount of electric power, the gas development becomes accelerated and dangerous pressures are created. The increased pressure above piston 30 compresses valve spring 48 driving valve element 46 upward through the opening formed by flange 34 thereby opening passageways 51 to the zone above piston 30 and relieving the pressure therein as shown in FIG. 8. The balance of pressure below and above piston 30 is upset and compensation ceases. At the same time piston 30 is driven upward by the extreme pressure developed underneath it. The spacer rings 36 overrun the port holes 52 in cylinder 20 thereby relieving the pressure in cylinder 20. The interrupting device now functions as a pure suicidal device and interruption is achieved in the upper or lower nozzle chambers 80.

After the arc is interrupted and the circuit breaker is in its open position the valve and piston assemblies assume the positions shown in FIG. 9. In each of FIGS. 6, 7 and 8 the paths of the pressure waves created by the arcs are illustrated by arrows.

To close the circuit breaker the movable contact 26 is moved upward by an operator (not shown) and the contact rod strikes the lower end of the piston rod 31 some distance underneath the finger contacts 25 driving the piston assembly upward. As the valve assembly 44 is resting on top of the piston assembly, the hole formed by flange or valve seat 34 is open. The oil above the piston assembly escapes free to the outside of unit 11 through passageways 51 and dashpot action is prevented. As the spacer rings 36 clear ports 52 in cylinder 20 oil from outside of unit 11 rushes in refilling the annular space around the contact housing 23. In contact closed position valve element 46 is now seated against valve seat 47 with its body closing the circular opening 50 in flange 34. Spring 32 is now compressed. In overtravel piston 30 abuts the underside of flange 34 after elevating the valve assembly 44 to a venting position similar to that shown in FIG. 8 to prevent dashpot reaction upon piston 30.

Although but a few embodiments of the present invention have been illustrated and described it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

Having now particularly described and ascertained the nature of my said invention and the manner in which it is to be performed, I declare that what I claim is:

1. A circuit interrupter comprising a pressure confining structure, relatively movable contacts adapted to operate in said structure, an arc extinguishing fluid in said structure, means for separating said contacts to draw an arc to be extinguished by blast action within said structure, a cylinder arranged within said structure, a spring biased piston arranged within said cylinder and axially arranged with said contacts, a piston rod mounted to extend through said piston, one of said contacts and said piston rod engaging each other in abutting arrangement in contact closed position, means for equalizinng the pressure on both sides of said piston during a part of its stroke in contact opening direction, and means operative during circuit closing movement of said interrupter for abutting said one of said contacts against said piston rod and driving said piston to its biased position within said cylinder so that during a circuit opening operation said piston moves in contact opening direction for applying after a predetermined movement an impulse blast to the arc immediately after separation of said contacts.

2. A circuit interrupter comprising a pressure confining

structure, relatively stationary and movable cooperating contacts adapted to operate in said structure, said stationary contact comprising a cluster of finger contact elements, an arc extinguishing fluid in said structure, means for separating said contacts to draw an arc to be extinguished by blast action within said structure, a cylinder arranged within said structure, a spring biased piston arranged within said cylinder and coaxially arranged with said contacts, a piston rod mounted to extend through said piston and into said cluster of finger contact elements, said movable contact and said piston rod engaging each other in said cluster of finger contact elements in abutting arrangement in contact closed position, means for equalizing the pressure on both sides of said piston during a part of its stroke in contact opening direction, and means operative during circuit closing movement of said interrupter for abutting said one of said contacts against said piston rod and driving said piston to its biased position within said cylinder so that during a circuit opening operation said piston moves in contact opening direction for applying after a predetermined movement an impulse blast to the arc immediately after separation of said contacts.

3. A circuit interrupter comprising a pressure confining structure, relatively movable contacts adapted to operate in said structure, an arc extinguishing fluid in said structure, means for separating said contacts to draw an arc to be extinguished by blast action within said structure, a cylinder arranged within said structure, a spring biased piston arranged within said cylinder and axially arranged with said contacts, a hollow piston rod mounted to extend through said piston for equalizing the pressure on both sides of said piston during a part of its stroke, one of said contacts and said piston rod engaging each other in abutting arrangement in contact closed position to close one end of said piston rod, and means operative during circuit closing movement of said interrupter for abutting said one of said movable contacts against said piston rod and driving said piston to its biased position within said cylinder, said piston rod and said one of said contacts moving together in abutting relationship during a part of said piston stroke and during the rest of said piston stroke separating from said one of said contacts for applying an impulse blast to the arc immediately after separation of said contacts.

4. A circuit interrupter comprising a pressure confining structure, relatively movable cooperating contacts adapted to operate in said structure, an arc extinguishing fluid in said structure, means for separating said contacts to draw an arc to be extinguished by blast action within said structure, a spring biased piston means arranged within said structure, said piston means comprising two integrating parts, one of said parts being movable relative to the other part during a part of the movement of said piston means, said movable part being provided with means for equalizing the pressure on both sides thereof during at least a part of its movement relative to said other part, one of said contacts and at least one of said parts of said piston means engaging each other in abutting arrangement in contact closed position, and means operative during circuit closing movement of said interrupter for abutting said one of said movable contacts against said one of said parts of said piston means and driving said piston means to its biased position within said structure, said piston means and said one of said contacts moving together in abutting relationship during a part of the piston stroke in contact opening direction and during the rest of the piston stroke separating from said one of said contacts for applying an impulse blast to the arc immediately after separation of said contacts.

5. A circuit interrupter comprising a pressure confining structure, relatively movable cooperating contacts adapted to operate in said structure, an arc extinguishing fluid in said structure, means for separating said contacts to draw an arc to be extinguished by blast action within said structure, a spring biased piston means arranged within said structure, said piston means comprising two integrating parts, one of said parts being movable relative to the other part during a part of the movement of said piston means, said movable part being provided with means for equalizing the pressure on both sides thereof during at least a part of its movement relative to said other part, a piston rod mounted on said one of said parts to extend through said piston means, one of said contacts and said piston rod engaging each other in abutting arrangement in contact closed position, and means operative during circuit closing movement of said interrupter for abutting said one of said movable contacts against said piston rod and driving said piston means to its biased position within said structure, said piston rod and said one of said contacts moving together in abutting relationship during a part of the piston stroke in contact opening direction and during the rest of the piston stroke separating from said one of said contacts for applying an impulse blast to the arc immediately after separation of said contacts.

6. A circuit interrupter comprising a pressure confining structure, relatively movable contacts adapted to operate in said structure, an arc extinguishing fluid in said structure, means for separating said contacts to draw an arc to be extinguished by blast action within said structure, a spring biased piston means arranged within said structure and axially arranged with said contacts, said piston means comprising two integrating parts, one of said parts being movable relative to the other part, said movable part being provided with means for equalizing the pressure on both sides thereof during a part of its movement relative to said other part, a piston rod mounted on said one of said parts to extend through said piston means, one of said contacts and said piston rod engaging each other in abutting arrangement in contact closed position, and means operative during circuit closing movement of said interrupter for abutting said one of said movable contacts against said piston rod and driving said piston means to its biased position within said structure, said piston rod and said one of said contacts moving together in abutting relationship during a part of the piston stroke in contact opening direction and during the rest of the piston stroke separating from said one of said contacts and engaging said other part for applying an impulse blast to the arc immediately after separation of said contacts.

7. A circuit interrupter comprising a pressure confining structure, relatively movable contacts adapted to operate in said structure, an arc extinguishing fluid in said structure, means for separating said contacts to draw an arc to be extinguished by blast action within said structure, a cylinder arranged within said structure, a spring biased piston means arranged within said cylinder and axially arranged with said contacts, said piston means comprising two integrating parts, one of said parts being movable relative to the other part, said movable part being provided with means for equalizing the pressure on both sides thereof during a first part of its movement relative to said other part, a hollow piston rod mounted on said one of said parts to extend through said piston means, said hollow piston rod forming a passage therethrough for equalizing the pressure on both sides of said piston means under predetermined conditions during a second part of the movement of said one of said parts, one of said contacts and said piston rod engaging each other in abutting arrangement in contact closed position to close one end of said piston rod, and means operative during circuit closing movement of said interrupter for abutting said one of said movable contacts against said piston rod and driving said piston means to its biased position within said cylinder, said piston rod and said one of said contacts moving together in abutting relationship during a part of the piston stroke in contact

opening direction and during the rest of the piston stroke separating from said one of said contacts and engaging said other part for applying an impulse blast to the arc immeditaely after separation of said contacts.

8. A circuit interrupter comprising a pressure confining structure, relatively movable contacts adapted to operate in said structure, an arc extinguishing fluid in said structure, means for separating said contacts to draw an arc to be extinguished by blast action within said structure, a cylinder arranged within said structure, a spring biased piston means arranged within said cylinder and substantially axially arranged with said contacts, said piston means comprising two integrating parts, one of said parts being movable relative to the other part, said movable part being provided with means for equalizing the pressure on both sides thereof during a first portion of its movement relative to said other part, said equalizing means being rendered ineffective by said other part during a second portion of the movement of said movable part, a hollow piston rod mounted on said one of said parts to extend through said piston means, one of said contacts and said piston rod engaging each other in abutting arrangement in contact closed position to close one end of said piston rod, and means operative during circuit closing movement of said interrupter for abutting said one of said movable contacts against said piston rod and driving said piston means to its biased position within said cylinder, said piston rod and said one of said contacts moving together in abutting relationship during a part of the piston stroke and during the rest of the piston stroke separating from said one of said contacts for applying an impulse blast to the arc immediately after separation of said contacts.

9. A circuit interrupter comprising a pressure confining structure, a pair of cooperating contacts, one of said contacts being relatively movable and the other of said contacts being relatively stationary, said contacts being adapted to operate in said structure, said stationary contact comprising a cluster of finger contact elements, an arc extinguishing fluid in said structure, means for separating said contacts to draw an arc to be extinguished by blast action within said structure, a cylinder arranged within said structure, a spring biased piston means arranged within said cylinder and coaxially arranged with said contacts, said piston means comprising two integrating parts, one of said parts being movable relative to the other part, said movable part being provided with means for equalizing the pressure on both sides thereof during a first portion of its movement relative to said other part, said equalizing means being rendered ineffective by said other part during a second portion of the movement of said movable part, a hollow piston rod mounted on said one of said parts to extend through said piston into said cluster of finger contact elements, one of said contacts and said piston rod engaging each other in abutting arrangement in said cluster of finger contact elements in contact closed position to close one end of said piston rod, and means operative during circuit closing movement of said interrupter for abutting said one of said movable contacts against said piston rod and driving said piston means to its biased position within said cylinder, said piston rod and said one of said contacts moving together in abutting relationship during a part of said piston stroke and during the rest of said piston stroke separating from said one of said contatcs for applying an impulse blast to the arc immediately after separation of said contacts.

10. A circuit interrupter comprising a pressure confining structure, relatively movable contacts adapted to operate in said structure, an arc extinguishing fluid in said structure, means for separating said contacts to draw an arc to be extinguished by blast action within said structure, a cylinder arranged within said structure, port holes arranged within said cylinder, a spring biased piston means arranged within said cylinder and axially arranged with said contacts, said piston means comprising two integrating parts, one of said parts being movable relative to the other part, said movable part being provided with means for equalizing the pressure on both sides thereof during at least a part of its movement relative to said other part, said movable part blocking said port holes during a part of its movement relative to said other part to provide a pumping action, one of said contacts and said piston engaging each other in abutting arrangement in contact closed position, and means operative during circuit closing movement of said interrupter for abutting said one of said movable contact against said piston means and driving said piston means to its biased position within said cylinder, said piston means and said one of said contacts moving together in abutting relationship during a part of the piston stroke in contact opening direction and during the rest of the piston stroke separating from said one of said contacts for applying an impulse blast to the arc immediately after separation of said contacts.

11. A circuit interrupter comprising a pressure confining structure, relatively movable contacts adapted to operate in said structure, an arc extinguishing fluid in said structure, means for separating said contacts to draw an arc to be extinguished by blast action within said structure, a port arranged in and at one end of said structure, a cylinder arranged in said structure, one end of said cylinder at said one end of said structure defining a valve seat, a valve element arranged within said structure for cooperating with said seat to control said port, a spring biased piston movably arranged within said cylinder, said piston defining an opening extending therethrough, one of said contacts being arranged to engage with said piston to close said opening, and means operative during circuit closing movement of said interrupter for abutting said one of said contacts against said piston at the other end of said cylinder to close said opening and to drive said piston to its biased position within said cylinder so that during a circuit opening operation said piston moves in contact opening direction for applying after a predetermined movement an impulse blast to the arc immediately after separation of said contacts and uncovering of said opening, said valve element cooperating with said valve seat to close said port upon drawing of an arc until the pressure created by the arc exceeds a predetermined value.

12. A circuit interrupter comprising a pressure confining structure, relatively movable contacts adapted to operate in said structure, an arc extinguishing fluid in said structure, means for separating said contacts to draw an arc to be extinguished by blast action within said structure, a port arranged in and at one end of said structure, a cylinder arranged in said structure, one end of said cylinder at said one end of said structure defining a valve seat, a spring biased valve element arranged within said structure for cooperating with said seat to control said port, a spring biased piston movably arranged within said cylinder, said piston defining an opening extending therethrough, one of said contacts being arranged to engage with said piston to close said opening, and means operative during circuit closing movement of said interrupter for abutting said one of said contacts against said piston at the other end of said cylinder to close said opening and to drive said piston to its biased position within said cylinder so that during a circuit opening operation said piston moves in contact opening direction for applying after a predetermined movement an impulse blast to the arc immediately after separation of said contacts and uncovering of said opening, said valve element under pressure created by the arc being actuated to cooperate with said valve seat to close said port until the pressure created by the arc exceeds a predetermined value.

13. A circuit interrupter comprising a pressure confining structure, relatively movable contacts adapted to operate in said structure, an arc extinguishing fluid in

said structure, means for separating said contacts to draw an arc to be extinguished by blast action within said structure, a port arranged in and at one end of said structure, a cylinder arranged in said structure, one end of said cylinder at said one end of said structure defining a valve seat, a spring biased valve element arranged within said structure for cooperating with said seat to control said port, a spring biased piston movably arranged within said cylinder, a piston rod defining an opening extending through said piston, one of said contacts being arranged to engage with said piston rod to close said opening, and means operative during circuit closing movement of said interrupter for abutting said one of said contacts against said piston rod at the other end of said cylinder to close said opening and to drive said piston to its biased position within said cylinder so that during a circuit opening operation said piston moves in contact opening direction for applying after a predetermined movement an impulse blast to the arc immediately after separation of said contacts and uncovering of said opening, said valve element under pressure created by the arc being actuated to cooperate with said valve seat to close said port until the pressure created by the arc exceeds a predetermined value.

14. A circuit interrupter comprising a pressure confining structure, relatively movable contacts adapted to operate in said structure, an arc extinguishing fluid in said structure, means for sepaarting said contacts to draw an arc to be extinguished by blast action within said structure, a port arranged in and at one end of said structure, a cylinder arranged in said structure, one end of said cylinder defining a valve seat, a valve element arranged within said structure for cooperating with said seat to control said port, a spring biased piston movable arranged within said cylinder, a piston rod defining an opening extending through said piston, one of said contacts being arranged to engage with said piston rod to close said opening, and means operative during circuit closing movement of said interrupter for abutting said one of said contacts against said piston rod at the other end of said cylinder to close said opening and to drive said piston to its biased position within said cylinder so that during a circuit opening operation said piston moves in contact opening direction for applying after a predetermined movement an impulse blast to the arc immediately after separation of said contacts and uncovering of said opening, said valve element under a first predetermined range of pressures created by the arc being driven against its spring bias to cooperate with said valve seat to close said port, said valve element when the pressures created by the arc exceeds said predetermined range being driven against its spring bias to a position where said valve element opens said port.

15. A circuit interrupter comprising a pressure confining structure containing an arc extinguishing fluid wherein a pair of relatively movable cooperating contacts are adapted to operate in said structure, a resiliently biased piston arranged axially with at least one of said contacts and equalizing the pressure on both sides thereof during a part of its stroke and acting as a pump during another part of its stroke, said one of said contacts engaging said piston in contact closed position to drive said piston to its biased position so that during a circuit opening operation said piston moves in contact opening direction and after a predetermined movement thereof applying an impulse blast to the arc immediately after separation of said contacts.

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