

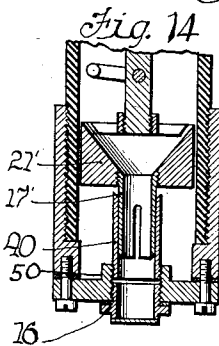
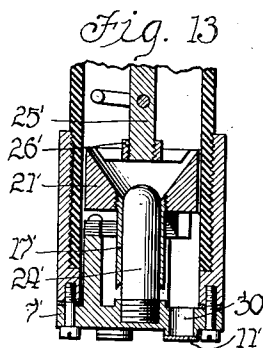
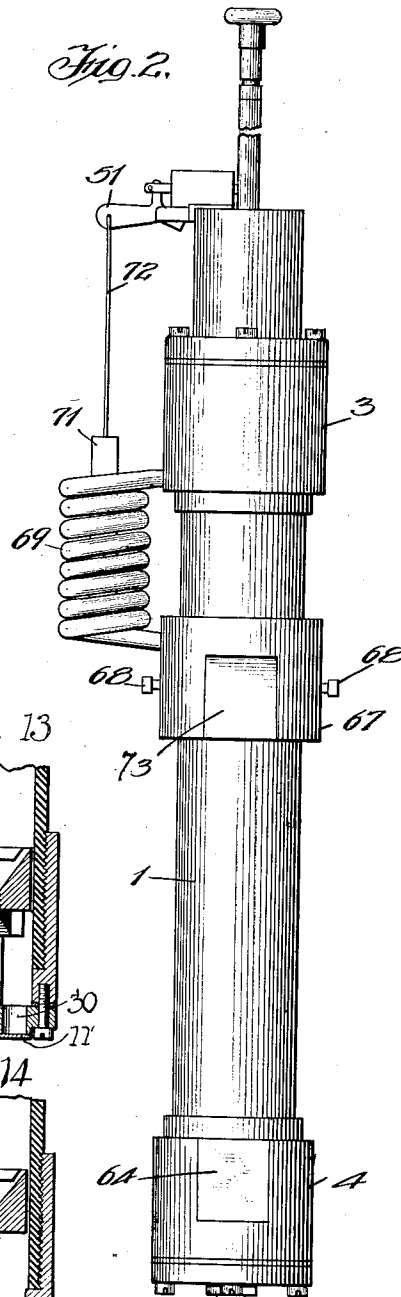
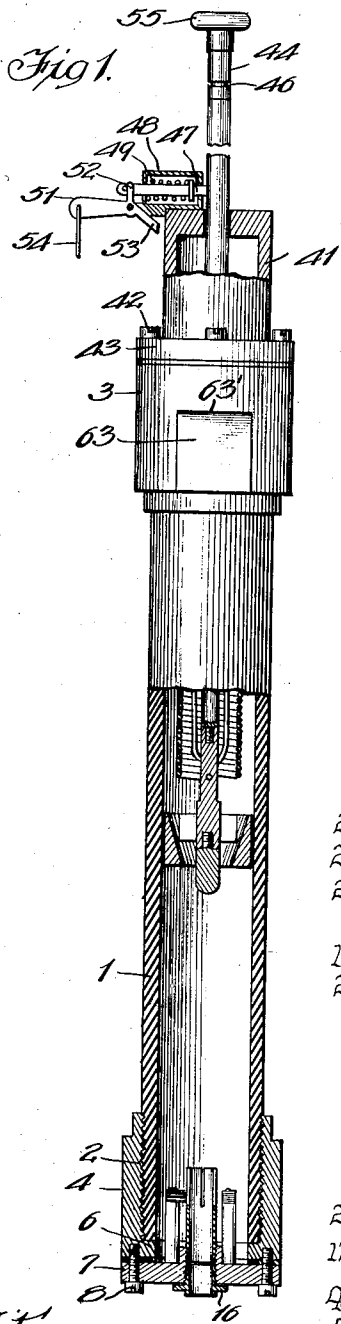
N. J. CONRAD.
CIRCUIT BREAKER.

APPLICATION FILED APR. 27, 1918.

Patented Apr. 6, 1920.

4 SHEETS—SHEET 1.

1,336,069.



Witnesses:

W. P. Kilroy

Harry R. L. White.

Inventor:

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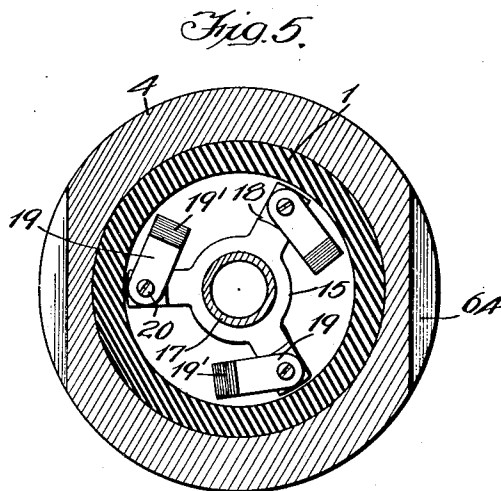
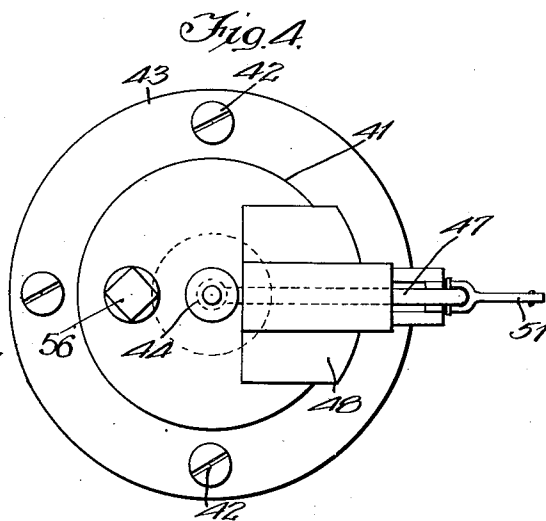
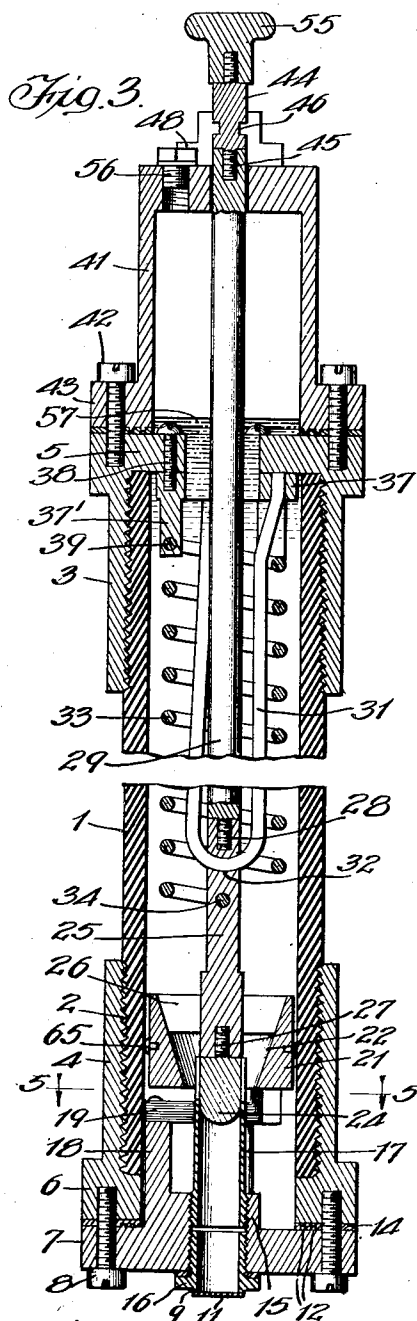
By *Crown, Hanson & Burnham*
ATTYS.

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4 SHEETS—SHEET 2.



Witnesses:
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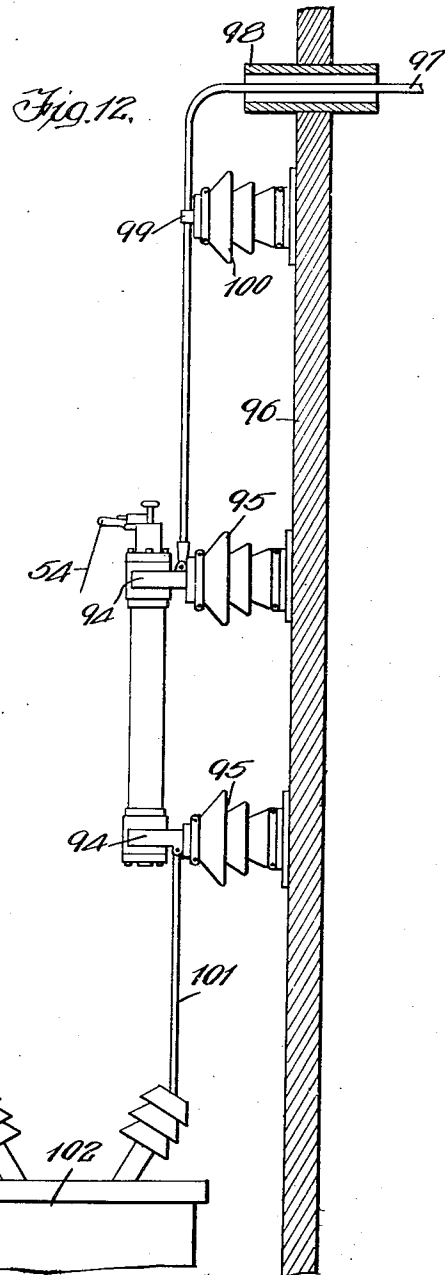
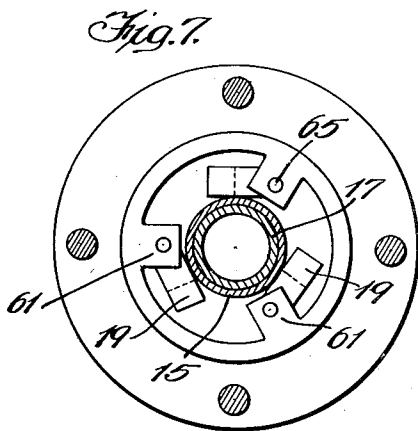
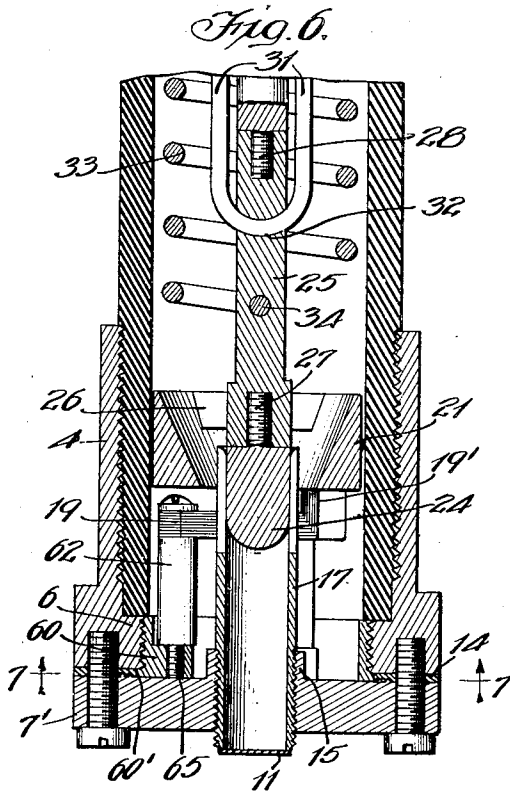
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Patented Apr. 6, 1920.

4 SHEETS—SHEET 3.



Witnesses:
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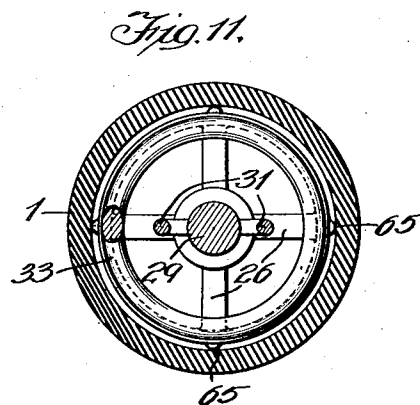
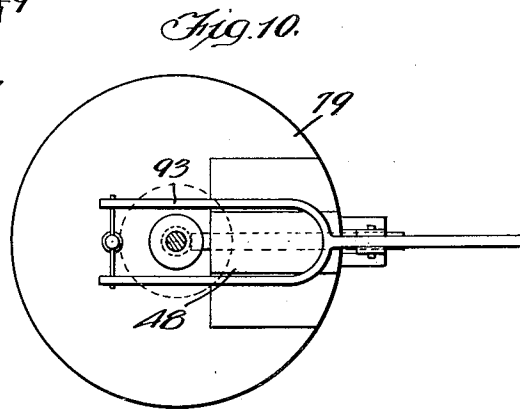
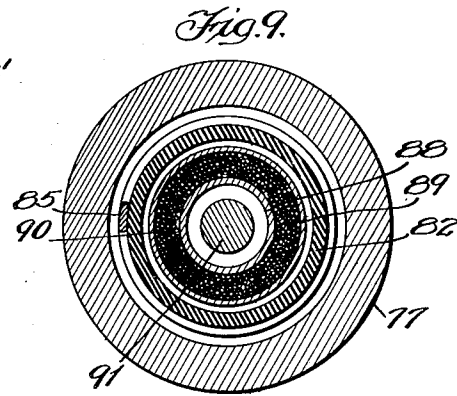
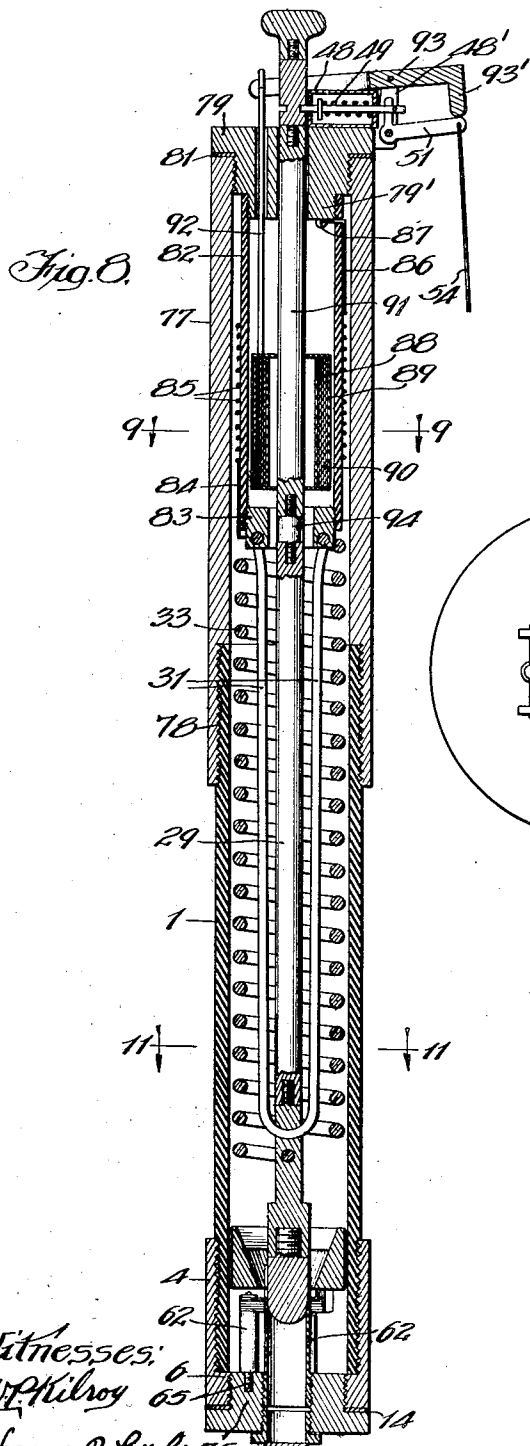
N. J. CONRAD.
CIRCUIT BREAKER.

APPLICATION FILED APR. 27, 1918.

1,336,069.

Patented Apr. 6, 1920.

4 SHEETS—SHEET 4.



Witnesses:

W. H. Kilroy

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UNITED STATES PATENT OFFICE.

NICHOLAS J. CONRAD, OF CHICAGO, ILLINOIS.

CIRCUIT-BREAKER.

1,336,069.

Specification of Letters Patent.

Patented Apr. 6, 1920.

Application filed April 27, 1918. Serial No. 231,142.

To all whom it may concern:

Be it known that I, NICHOLAS J. CONRAD, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Circuit-Breakers, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to circuit breakers.

Circuit breakers are usually inserted in transmission lines at a point where the same connect with transformers, converters and other apparatus. They perform the duty of interrupting the current flow in the line for switching or clearing disturbances.

The problem of interrupting current flow in a modern transmission line becomes of particular difficulty where the volume of current flowing is relatively great and the potential under which the line works is relatively high. The interruption of such current flow liberates energy at a destructive rate at the point of interruption. This tends to the rapid deterioration of the circuit breaker.

The efficiency and reliability of the circuit breaker depend upon the rapidity with which the current flow can be interrupted and the ability of the breaker to minimize and harmlessly dissipate the energy liberated. The safety of valuable electrical apparatus and the demand for continuous service requires a thoroughly efficient and reliable circuit breaker.

Heretofore the trend of practically all development in circuit breakers has been toward the improvement of the well-known oil circuit breaker. This type of breaker has numerous faults and limitations inherent in its construction and principle of operation, which have so far been insurmountable and have proven obstacles to its adoption in as full a measure as the service requires.

One great drawback of a typical oil circuit breaker is its large bulk and complexity. Owing to its size it takes up a relatively large amount of valuable space in the power house or sub-station which could otherwise be devoted to other apparatus. Owing to the complicated construction of the oil circuit

breaker its initial cost is high and this, in addition to the extent of valuable space it occupies, renders the oil circuit breaker a costly piece of apparatus.

The complicated construction involves a relatively great number of moving parts, having a large inertia and slowness of operation, which is highly undesirable. The operation of the breaker should be rapid enough to clear a 60 cycle line within the time required to complete the first cycle or two after the overload occurs. This is beyond the performance of the average oil circuit breaker.

The problem of housing the oil breaker in a suitable tank or casing has also been very difficult to solve. Casings constructed of wood or other insulation have hitherto been altogether unsatisfactory, due to their limited strength for resisting the explosive-like shock in interrupting large amounts of power. Inasmuch as the resisting strength of the casing to expanding forces within the same is inversely proportional to the diameter of the casing, all other things remaining equal, it will be obvious from the size of the casing necessary to house the ordinary oil circuit breaker, that to construct it of insulating material is not feasible. Even metallic casings on oil breakers frequently blow off or rupture and due to the large quantity of heated oil contained in them, they constitute a menace to the safety of the operator. Moreover these metallic casings must be considerably larger than the switch dimensions to provide ample oil space about the switch contacts for insulating the impressed potential and this augments the above objections as to size.

My invention provides an improved circuit breaker for overcoming the above difficulties and for securing other incidental advantages. My improved breaker is characterized by a rapidity of operation generally capable of clearing a 60 cycle circuit within the time required to complete the first cycle or two after the overload occurs. The energy dissipated in the casing during the arcing is accordingly a minimum.

The improved breaker is a small compact unit which may be readily inserted and removed from operative position in the line. Its supporting fittings are of a conventional

pattern and require no particular supporting structure. The breaker is easily handled and may be removed and replaced by another breaker for repairing or recharging with insulating fluid. It may also be used as a portable circuit breaking element to be carried to the point where the line is to be disconnected. In power house and substation installations the breaker permits a straight line run in any case as from the lead in insulator to the transformer or the like. There is no looping or doubling back of the bus as is necessary with the customary oil breakers and thus a saving of copper and a neater installation are obtained.

Due to the compactness and simplicity of my circuit breaker, I am able to house it in a casing of relatively small compass and this permits me to make the casing of insulation and maintain a high safety factor. As previously explained, with a given sectional thickness, the smaller the diameter of the casing the greater its resisting strength to pressures developed therein. To take care of abnormal short circuit conditions I provide a safety vent which will yield and harmlessly discharge the insulating fluid before a pressure sufficient to rupture the casing can develop.

This discharge of the small quantity of insulating fluid which the device contains can have no dangerous consequence. This insulating fluid is non-inflammable and has peculiar arc extinguishing properties.

By constructing the casing of insulation, I am able to dispose the contacts directly thereon, minimizing space, and increasing the insulation of the breaker. Furthermore there is thus no possibility of the arc jumping to the casing through the formation of a large gas bubble.

The cost of my improved circuit breaker is but a fraction of the cost of the ordinary oil circuit breaker.

I contemplate operating my improved circuit breaker either manually or automatically by a tripping coil. The breaker is so constructed that by the addition of a few simple parts the manually operated breaker may be readily converted into an automatically operated breaker. In one of the automatic forms of my invention I have arranged the circuit breaker and tripping coil so that they are both self-contained in the breaker casing.

To acquaint those skilled in the art with the manner of constructing and practising my invention, I have illustrated in the accompanying drawings one particular embodiment thereof.

Figure 1 is a view partly in elevation and partly in section of my improved circuit breaker, showing the contacts separated;

Fig. 2 is an elevational view of the same

with the external automatic tripping coil attached thereto;

Fig. 3 is an enlarged sectional view of the circuit breaker showing the contacts in engagement;

Fig. 4 is a plan view of the circuit breaker;

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 3;

Fig. 6 is a fragmentary sectional view of the lower end of the circuit breaker showing a modified arrangement;

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 6;

Fig. 8 is a sectional view of one automatic form of circuit breaker in which the breaker and tripping coil are self-contained in the breaker unit;

Fig. 9 is an enlarged sectional view taken on the line 9—9 of Fig. 8;

Fig. 10 is a plan view of the circuit breaker shown in Fig. 8;

Fig. 11 is a sectional view taken on the line 11—11 of Fig. 8;

Fig. 12 is a diagrammatic illustration of a typical installation of my improved circuit breaker;

Fig. 13 is a sectional view of a modified arrangement of the arcing contacts; and

Fig. 14 is a similar view of a different arrangement.

The inclosing casing of the circuit breaker consists of a tube or sleeve 1 of insulating material. This tube may be made of glass, although from a structural standpoint I find bakelized fiber preferable, as it is not so brittle and may be readily machined.

Accordingly I thread the ends of the tube 1 as shown at 2, in Figs. 1 and 3, for screwing into the end ferrules 3 and 4. The ends of the tube 1 screw up against internal flanges 5 and 6 in the ferrules 3 and 4 respectively.

The lower ferrule 4 has attached thereto a base cover 7 by cap screws 8. A tight joint between the ferrule 4 and cover 7 is assured by providing the cover with annular ridges or corrugations 12 which bite into a soft metal gasket 14 disposed between the cover and ferrule.

A boss 15, integral with the cover 7, projects centrally from the face of the cover. This boss has a threaded opening which continues down through the cover 7 and is closed at the bottom by a hollow flanged plug 16. A small annular rib 9 projects downward around the edge of the opening in the plug 16 and has soldered thereto a thin metallic disk 11. This disk will blow if an abnormal pressure develops in the circuit breaker and will thereby prevent rupturing of the tube 1.

A split sleeve or socket 17 which comprises one of the arcing contacts threads into the upper end of the boss 15. A plu-

5 rality of upright posts 18, preferably three in number, are formed integral with the cover 7 and projects up concentrically with and around the sleeve 17. Upon the tops of these posts are secured laminated brushes 19, as by the screws 20. The three brushes are disposed symmetrically with respect to each other above the split sleeve 17 and have their ends bent upwardly as shown at 19' to form the main contact for engagement with the movable contact member 21. The laminated brushes 19 by extending out free from the top of the posts 18 have a slight resiliency which insures even contact by the member 21 with all three brushes.

10 The contact member 21, which also forms a plunger, has a conical passageway 22 which functions as a liquid director or nozzle for directing the flow of an arc extinguishing liquid, with which the casing 1 is filled, around the tip of the arcing contact 24. The member 21 is formed integral with a stem 25 through the spider arms 26. About the periphery of the member 21 are four rounded guide pins 65, clearly shown in Fig. 11, which space the member 21 from the inner walls of the tube 1 and guide the member 21 in its travel through the tube.

15 The arcing contact 24 consists of a renewable plug having a threaded stud 27 which threads into the end of the stem 25. This contact projects below the liquid director 21 and with the parts as illustrated in Fig. 3 is adapted to contact with the split sleeve 17. The upper end of the stem 25 has a threaded socket for the reception of the reduced extension 28 of the rod 29.

20 A plurality of flexible cables 31 are secured in holes in the stem 25 as shown at 32, and extend up and have contact with the upper ferrule 3. A helical spring 33 surrounds the rod 29 and cables 31 and has its lower end secured to the stem 25 as shown at 34.

25 A sleeve member 37 is suspended from the flange 5 of the upper ferrule 3, by cap screws 38. The lower reduced portion 37' of the sleeve member is formed with a plurality of longitudinal slots through which extend the cables 31, which are soldered in sockets in the solid ring portion 37. The slotted formation of the portion 37' provides a plurality of posts extending down from the ring portion 37, which have holes 39 provided therein. The upper end of the tension spring 33 is threaded through these holes and is securely soldered therein.

30 The top of the circuit breaker is closed over by a cap member 41, bolted to the ferrule 3 by screws 42 passing through the flange 43 and tapping into the ferrule. The upper end of the cap 41 is of relatively thick section to form an effective guide for the end of the rod 29.

35 A hard metal shank 44 threads into the

end of the rod 29 through the reduced pin 45. The rod is preferably made of stock metal rod but it might be made of insulation. The shank 44 is annularly grooved at 46 for cooperation with the spring pressed trigger 47 for holding the circuit breaker in set position.

The trigger 47 is inclosed in a casing 48 mounted on top of the cap member 41. A spring 49, confined within the casing 48 and bearing against a flange on the trigger 47 tends to keep the latter in the groove 46. An operating handle 51 is pivoted to an extension of the casing 48 and has a finger 52 engaging behind a pin on the trigger 47 for retracting the latter. Another finger 53, abutting an inclined face on the casing 48 limits the releasing movement of the lever 51. A cord or similar connecting means 54 is attached to the lever 51 for tripping the trigger 47 conveniently from a distance. The upper end of the rod 29 is provided with a knob or handle 55 to make it easier for the operator to reset the switch or breaker after tripping. A cord may be arranged to depress the plunger so that the switch may be set from a distance. For three-phase service I have provided a ring with cords running to the three levers 51 so that the phases may all be tripped out simultaneously.

40 The cap member 41 is provided with a filling hole closed by the plug 56, Fig. 3, for filling the casing with the arc extinguishing liquid 57. This liquid is preferably carbon tetrachlorid or a polychlor derivative of a suitable hydrocarbon as disclosed in copending application, Serial Number 120,625 filed September 18, 1916, although, if desired, other liquids, or even fluids such as gases or air may be used to quench the arc. The casing is filled to a level slightly above the upper ferrule 3 and accordingly I have also provided annular corrugations on the under face of the flange 43 which cooperate with a soft metal gasket between the cap member 41 and ferrule 3 to prevent leakage of liquid a structure similar to that between the lower ferrule 4 and base cover 7.

45 The breaker unit is supported in spring clips which engage over the splayed or flattened portions 63 and 64 in the upper and lower ferrules 3 and 4.

50 The splays 63 and the ferrule 3 form shoulders 63' which engage over the top of the upper clip and suspend the circuit breaker therein.

55 The spring clips are usually mounted on suitable insulators and are connected in series in line, or they may be arranged in parallel with an ordinary switch of low power interrupting capacity for the special purpose of receiving a portable circuit breaker unit when it is desired to interrupt the current flow. This latter practice has been set

forth in detail in my co-pending application, Serial Number 192,875, filed June 24th, 1917.

The operation of the circuit breaker will be obvious from the following description.

The cord 54 is pulled, rocking the tripping lever 51 and retracting the trigger 47 from the groove 46. Instantly the contact members 21 and 24 are moved up from the stationary base contact under the tension of the spring 33. In the initial part of this movement the metallic liquid director 21 first breaks contact with the brushes 19 and thereafter the total current and the ensuing arc are carried between the split sleeve 17 and arcing tip 24. The motion of the liquid director 21 catches the arc extinguishing liquid above the same and sprays it in a cylindrical stream down into the arc drawn between the tip 24 and sleeve 17. The quenching action of this arc extinguishing liquid streaming out of the liquid director at a high velocity is so effective that under actual working conditions the contacts 24 and 17 are separated but a very short distance before the arc is broken.

A normal accumulation of gas generated by the arc will escape through the rod opening in the cap 41, this opening being sufficiently restricted to prevent any considerable discharge of arc extinguishing liquid.

In the event that a destructive pressure is developed by the arc, the disk 11 will be blown off the vent plug 16 and the arc extinguishing liquid and gas will be blown out therethrough. The arc will be extinguished, however, by the liquid passing down through the liquid director 21.

To reset the circuit breaker the knob 55 is thrust downward by the operator until the trigger snaps into the annular groove 46. This may be accomplished at a distance with the circuit breaker in the spring clips as previously described, or with it removed therefrom.

It will be noted that the split sleeve 17 projects considerably above the base cover 7 and that the opening through the sleeve affords the only outlet for the arc extinguishing liquid 57 to be blown out through the vent plug 16. Several advantages are obtained by this arrangement. First, the relatively large amount of arc extinguishing liquid confined around the sleeve 17, which remains undisturbed in the operation of the circuit breaker, prevents the heat of the arc from reaching the ferrule 4 and base cover 7. The raised position of the arcing sleeve 17 prevents the heat of the arc from affecting the vent plug, particularly on operation under normal current flow. Second, when the vent disk 11 is blown off, the gases from the arc are directly in line with the open vent through the hollow sleeve 17 and

may escape directly. And third, in the above action, the arc extinguishing liquid is cutting across the rim of the split sleeve 17 and its escape through the open vent and is virtually "cutting" the arc off at the rim of the sleeve.

I have disposed all parts likely to be burned by the arc in accessible positions. The tip 24 and sleeve 17 will draw practically all of the arcs and these parts are easily and cheaply renewable. The brush tips 19' lie below the end of the split sleeve 17 and accordingly there is small probability of these brushes being burned. The brushes and arcing sleeve may be removed as a unit for renewal by simply disengaging the base cover 7.

I also contemplate reversing the positions of the sleeve and arcing tip as shown in Fig. 13. In this case the sleeve 17' threads into the constricted throat of the liquid director 21' and thus sprays the arc extinguishing liquid through the sleeve and onto the tip 24'. The stem 25' is made separable from the liquid director 21' by threading into a hub 26' formed in the spider 26. The arcing tip 24' screws down into the base cover 7'. Excess pressure venting occurs through the ports 30 which are disposed about the tip 24' between the posts 18. These ports may be closed by plugs similar to the plug 16 or by disks 11' soldered to annular beads or ribs encircling the ports.

In Fig. 14 I have shown a still different arrangement wherein the sleeve 17', depending from the liquid director 21', telescopes into another split sleeve 40 which screws into the boss 50 on the base cover. This boss is concentric with the usual vent plug 16. This figure also illustrates an arrangement applicable to any of the previous forms wherein the main contact brushes 19 are dispensed with by having the arcing contacts carry the entire current flow. This is possible because of the fact that both sleeves 17' and 40 are slotted so as to be quite springy. Even if irregularities or rough spots are caused by arcing the springiness of the sleeves permits of a good contact being secured.

The forms shown in Figs. 13 and 14 have the common advantage of causing the arc extinguishing fluid to pass from the center of the upper sleeve 17' radially outwardly to fill the space vacated by the piston 21'. This causes a flow across the edges of the sleeve 17' tending to cool and wash away the arc.

In Figs. 6 and 7 I have illustrated a modified arrangement for mounting the laminated brushes 19. The internal flange 6 of the ferrule 4 is internally threaded for the reception of a threaded ring 60, which has a small flange 60' adapted to bear up against the under face of the ferrule 4. As shown

in Fig. 7, this ring has three integral lugs 61 projecting radially inward adjacent the boss 15 on the base cover 7'. The three posts 62, which support the laminated brushes 19 at their upper ends, have screw studs 65 at their lower ends, which thread into these lugs 61. In this construction the greater portion of the current flowing between the ferrule 4 and brushes 19 will pass through the threaded joint between the ring 60 and internal flange 6. This possesses the advantage over the previous construction in that the heavy flow of current need not pass through the soft metal gasket 14.

In Fig. 6 I have dispensed with the vent plug 16 by having the split sleeve 17 thread down through the base cover 7' and having the disk 11 soldered to the end thereof.

The breaker unit hereinbefore described is readily adaptable to automatic operation through the provision of a tripping relay having mechanical connection with the tripping lever 51. I have illustrated such an arrangement in Fig. 2. A ferrule 67 is clamped upon the tube 1, immediately below the upper ferrule 3, by set screws 68. A solenoid winding 69, of relatively heavy wire, is attached to the ferrules 3 and 67 in any suitable manner. A core 71 is suspended in the center of the solenoid 69 by a cord 72 attached to the end of the tripping lever 51.

The spring clips in the breaker mounting engage respectively with the splayed surface 64 on the ferrule 4 and the splayed surfaces 73 on the ferrule 67. This puts the solenoid or tripping coil 69 in series with the current flowing through the circuit breaker and it will be apparent that overload values of current will be operative to attract the core 71 and automatically trip the circuit breaker. The breaker may be adjusted to trip at different overloads by disposing the core 71 higher or lower in the solenoid 69.

In Fig. 8 I have illustrated a modified form of automatic circuit breaker with the tripping relay disposed in the breaker casing. The general construction and arrangement of the contacts and other parts in the lower end of the breaker is substantially the same as previously described. As illustrative of the simplified arrangement, I have shown the lower ferrule 4 closed off by a single plug 75 which threads up in the flange 6 of the ferrule. The brush posts 62 are supported on this plug by having their studs 65 threaded into the latter. The solenoid mechanism is incased in a metallic sleeve 77 which threads onto the end of the bakelized fiber tube at 78. The upper end of the sleeve 77 is closed off by a plug 79 which threads down into the sleeve and compresses the gasket 81 upon the end of the sleeve. A tube 82, of insulation, threads onto the reduced extension 79' of the plug 79. A con-

ductor ring 83 threads into the lower end of this insulating tube, and functions to support the end of the tension spring 33 and to interconnect the ends of the cables 31 with the lead 84 from the solenoid winding 85. The turns of this winding are wound about the insulating tube 82 and the upper turn is connected through the lead 86 extending through a hole back into the tube 82 with the metallic plug 79 as indicated at 87.

A magnetic core having the two concentric brass shells 88 and 89 is disposed within the insulating tube 82. The annular space between the shells 88 and 89 is filled with a plurality of soft iron wires 90, disposed in vertical lengths between the shells. The ends of the shells may be crimped over or end plates may be provided which embrace the rod section 91 and guide the core for reciprocation within the solenoid winding 85. A small rod 92 is attached to the upper end of the core and extends out through a hole in the plug 79 and has pivotal connection in a forked lever 93, as shown in Fig. 10. This forked lever is pivoted between forked bracket arms 48' integral with the latch casing 48. A depending arm 93' of the forked lever extends down adjacent the end of the tripping lever 51.

The resetting rod may consist entirely of insulation or may be sectionalized with an insulating section interposed as shown. This insulation section is designated 94 and has reduced pins which thread into the upper and lower rod sections 91 and 29. This construction or some similar arrangement is necessary to prevent shunting of the solenoid winding 85 which would otherwise result by the current flowing directly from the plug 79 through the rod down to the movable contacts.

The metallic sleeve 77 engages in a round spring clip of well known type at the top of the circuit breaker mounting. The current flow will thus be through the sleeve 77, plug 79, through the solenoid winding 85 and down through the cable 31 to the breaker contacts and lower ferrule 4.

It will be noted that the solenoid core 88 is normally suspended in the lower part of the solenoid winding 85. Energization of this solenoid tends to attract the core up into the center of the winding, which action is operative to trip the circuit breaker. By making proper adjustment, this tripping action can be made to occur at any desired overload value of the current flowing through the solenoid. These adjustments can be made by changing the number of turns in the solenoid winding, by raising or lowering the solenoid core, or by adjusting the tension of the latch spring 49.

In the diagram of Fig. 12 I have illustrated a typical installation of my improved circuit breaker. The breaker is mounted in

clips 94 carried on insulators 95 supported from the wall or panel 96 in the substation or power house. The line wire 97 enters through the lead-in tube 98 and passes directly down through the clamp 99 on the insulator 100 to the upper spring clip 94. From the lower spring clip 94 the line connects through the bus 101 to the transformer 102.

It will be noted that there is a straight run of the line from the point of entrance at 98 to the transformer 102 and that the space usually occupied by the oil circuit breaker is here occupied by the transformer.

The straight line run is obtained through the location of the circuit breaker terminals on the opposite ends of the casing. With oil circuit breakers both leads from the breaker come out of the top of the casing and therefore one lead must be looped down around the casing or laterally across to the transformer. Accordingly by the present installation, a saving of copper is gained and furthermore through the ability to mount the circuit breaker on a wall, switching panel or upon any available support, all floor space may be utilized for transformers and other apparatus.

I do not intend to be limited to the particular details shown and described.

I claim:

1. In a circuit breaker, a casing of insulation, a body of liquid in said casing, a stationary contact at one end of said casing, a movable contact normally engaging with said stationary contact, a resetting member having connection with said movable contact and extending out through the top of said casing, a spring normally tending to separate said contacts supported by said casing, means for mechanically tripping said movable contact to release the same, and liquid directing means operable by the motion of said movable contact to project said liquid between said contacts.

2. In a circuit breaker, a body of liquid, a stationary contact, a movable contact, a liquid directing member for one of said contacts and a cylinder in which said liquid directing member forms a piston, said liquid directing member having means cooperating with said piston function for positively projecting the liquid upon the space between said contacts, said liquid directing means having electrical connection with said movable contact and forming a contact auxiliary thereto.

3. In a circuit breaker, a casing, an arc extinguishing liquid in said casing, a stationary contact member supported at the lower end of said casing, a movable contact member normally contacting with said stationary contact member, spring means for separating said contact members, and means for mechanically tripping said movable con-

tact to release the same, said movable contact member having sliding engagement along the walls of said insulating casing.

4. In a circuit breaker, a containing casing of insulation having terminal members thereon, a stationary element in the lower end of said casing, a movable switching element cooperating therewith, each having electrical connection with said terminals, means tending to separate said switching elements, manual means for releasing said movable switching element, said movable switching element having guiding engagement along the sides of said insulating casing.

5. In a circuit breaker, a containing casing of insulation, a stationary contact member mounted in one end of said casing, a rod guided for movement in said casing, a movable contact member carried by said rod, said movable contact member having guiding engagement along the sides of said insulating casing, spring means for separating said contacts, and means for mechanically tripping said rod to release said movable contact.

6. In a circuit breaker, a cylindrical shell of insulation, ferrules on the ends of said shell, a main contact mounted on the ferrule at the lower end of said shell, an arcing contact cooperating with said main contact, a rod extending through the top ferrule, a main contact carried by said rod, an arcing contact connected to said latter main contact, spring means tending to separate said contacts, and releasable means engaging with the upper end of said rod.

7. In a circuit breaker, a casing of insulation, a stationary contact member mounted in one end of said casing, an operating element extending out through the other end of said casing, a movable contact member carried by said operating element, arc extinguishing liquid in said casing, liquid directing means carried by said movable contact member and operated by movement of said movable contact member to project the liquid between said contacts, and means for mechanically tripping said operating element.

8. In a circuit breaker, a sleeve of bakelized fiber or like insulation, ferrules screw threaded on to the ends of said sleeve, contact brushes secured to the lower ferrule, a base cover closing said lower ferrule, a removable arcing contact carried by said base cover and projecting above said brushes, a normally closed excess pressure vent in said base cover, a rod extending out through said top ferrule and normally held in descended position, a metallic liquid director secured to the end of said rod and normally contacting with said brushes, a renewable arcing tip projecting below said liquid director and engaging with said arc-

ing contact, flexible cables connecting said liquid director with said top ferrule, a tension spring tending to retract said liquid director, arc extinguishing liquid in said sleeve, and trigger means mounted on said top ferrule and operable to release said rod.

9. In combination, an inclosing casing, a terminal member on said casing, a plurality of resilient contacts mounted within said casing and having connection with said terminal member, a movable contact member engaging with said contacts, arcing contacts carried by said movable contact member and said terminal member, said arcing contacts remaining in contact until after said movable contact member has separated from said resilient contacts.

10. In combination, an inclosing casing, a terminal member on said casing, a plurality of resilient brushes mounted on said terminal member, a sleeve contact mounted on said terminal member, said sleeve contact projecting beyond said brushes, a movable contact member engaging with said brushes, and a supplementary contact projecting from said movable contact member and engaging in said sleeve contact.

11. In combination, an inclosing casing, a ferrule on one end of said casing, lugs projecting into said casing, a plurality of resilient brush units attached to said lugs and having their ends extending longitudinally in said casing, a cap member closing off said ferrule, a split sleeve removably mounted in said cap member and projecting between said brushes, a movable contact member normally seating on the ends of said brushes, and a supplementary arcing contact carried by said movable contact and extending into said split sleeve.

12. In a circuit breaker, a casing, contacts in said casing, spring means tending to separate said contacts, latch means for releasing said spring means, a fluid in said casing, and means operated by said spring means for projecting said fluid into the path of the arc drawn in the separation of said contacts, said contacts being normally confined within said casing, both when in engaged and disengaged positions.

13. In a circuit breaker, a casing, a pair of main contacts in said casing, a pair of arcing contacts, spring means tending to separate said contacts, latch means for releasing said spring means, a fluid in said casing, and means controlled by the separating movement of the contact for projecting said fluid into the arc drawn in the separation of said contacts.

14. In a circuit breaker, a casing, a stationary contact in said casing, a movable contact engaging with said stationary contact, spring means tending to separate said contacts, latch means for releasing said spring means, a fluid in said casing, and

fluid directing means carried by and operated by movement of said movable contact member for projecting said fluid between said contacts.

15. In a circuit breaker, a casing, a stationary contact in said casing, a movable contact engaging with said stationary contact, a guiding member attached to said movable contact, spring means tending to separate said contacts, a mechanical detent engaging with said guiding member, a fluid in said casing, and fluid directing means carried by and operated by movement of said movable contact for projecting said fluid between said contacts.

16. In a circuit breaker, a sleeve of insulation, metallic means closing the ends of said sleeve to form a casing, a pair of contacts in said casing, spring means within the sleeve tending to separate said contacts, electromagnetically operated means for releasing said spring means, a fluid in said casing, and means for projecting said fluid into the path of the arc drawn in the separation of said contacts.

17. In a circuit breaker, a sleeve of insulation, metallic means closing the ends of said sleeve and forming a casing, contacts in said casing, spring means tending to separate said contacts, a fluid in said casing, fluid directing means on said movable contact, operated by movement of the said movable contact electrically operated latch means on the outside of said casing for releasing said spring means and electrically operated means for said last means mounted on said sleeve.

18. In a circuit breaker, a sleeve of insulation, metallic means closing the ends of said sleeve and forming a casing, contacts in said casing, spring means tending to separate said contacts, a fluid in said casing, means for forcibly projecting said fluid between said contacts, said latter means serving as an auxiliary contact, latch means for releasing said spring means, and a tripping coil supported on the outside of said casing for tripping said latch means.

19. In a circuit breaker, a sleeve of insulation, metallic means closing the ends of said sleeve and forming a casing of insulation, a plurality of terminals on said casing, contacts in said casing and having connection with said terminals, means tending to separate said contacts, a plunger moving with the movable contact and serving to direct an arc extinguishing fluid upon the contact, said plunger serving as an auxiliary contact, latch means for holding said contacts in engagement, and a tripping coil mounted on said terminals and having mechanical connection with said latch means.

20. In a circuit breaker, a sleeve of insulation, metallic means closing the ends of said sleeve and forming a casing, contacts

in said casing, spring means tending to separate said contacts, a fluid in said casing, means for forcibly projecting said fluid between said contacts, said latter means serving as an auxiliary contact, a mechanical detent for holding said contacts in engagement, means for manually releasing said detent and means for automatically releasing said detent.

21. In a circuit breaker, a sleeve of insulation, metallic ferrules closing the ends of the sleeve, stationary and movable contacts in said sleeve, connected to said ferrules, and electromagnetic means contained in said sleeve for separating said contacts.

22. In a circuit breaker, a casing of insulation, stationary and movable contacts in said casing, said movable contact having guiding engagement along the walls of said casing, and electromagnetic means contained in said casing for controlling the separation of said contacts.

23. In a circuit breaker, a sleeve of insulation, metallic ferrules closing the ends of the sleeve, contacts in said sleeve, electrical means contained in said sleeve for separating said contacts, and manual means operable from the outside of said sleeve for resetting said contacts, said metallic ferrules forming the external terminals for said contacts.

24. In a circuit breaker, a sleeve of insulation, metallic ferrules closing the ends of the sleeve, contacts in said sleeve, electrical means contained in said sleeve for automatically separating said contacts, and latch means operable from the outside of said sleeve for manually separating said contacts, said metallic ferrules serving as the external terminals for said contacts.

25. In a circuit breaker, a tube of insulation, terminals adjacent the ends of said tube, a stationary contact in said sleeve having connection with one of said terminals, a relatively movable contact having connection with another terminal, a resetting member attached to said movable contact and extending out of said tube, means tending to separate said contacts, latching means engaging with said resetting member and normally retaining said contacts in engagement, and electromagnetic means in said tube for tripping said latching means.

26. In a circuit breaker, a tube of insulation, terminals adjacent the ends of said tube, a stationary contact in the end of said tube and having connection with one of said terminals, a movable contact having connection with another terminal, a resetting rod attached to said movable contact, and extending out of the end of said tube, a spring tending to separate said contacts, latch means engaging with said rod, and normally retaining said contacts in engagement, elec-

tromagnetic means in said tube for tripping said latching means, fluid in said tube, and means for projecting and directing said fluid into the path of the arc drawn between said contacts, said latter means serving as an electrical contact.

27. In a circuit breaker, a casing, a stationary contact in said casing having spring means, a movable contact in said casing, said movable contact comprising a sleeve member engaging with said stationary contact, spring means for separating said contacts, an arcing contact supported centrally with respect to the sleeve, a fluid in said casing, and means for directing said fluid through said sleeve member and about the arcing contacts upon separation of said contacts.

28. In a circuit breaker a casing, a terminal closing one end of said casing, a stationary main contact having a central arcing contact within the casing and connected to said terminal, a movable main contact in said casing, adapted to engage said first main contact and having a central arcing contact adapted to engage said first central contact, spring means tending to separate said contact, a fluid in the casing, said second main contact having means adapted to trap and direct said fluid upon said arcing contact upon separation of the contacts.

29. In a circuit breaker, a casing, a stationary sleeve contact in said casing, a movable contact engaging with said stationary sleeve contact, a fluid in said casing, and fluid directing means carried by said movable contact operable to forcibly project said fluid upon said movable contact upon separation of said contacts.

30. In a circuit breaker, a casing, a terminal on the end of said casing, a stationary sleeve contact in said casing on said terminal, a movable contact engaging with said stationary contact, spring means for separating said contacts, latch means for releasing said spring means, a fluid in said casing, and an excess pressure vent in said terminal at the base of said stationary sleeve contact to permit discharge of excessive pressure.

31. In combination, a sleeve of insulation having a ferrule at the lower end thereof, a plug member closing said ferrule, said plug member having a central aperture, a tubular contact mounted in the bore of said plug, a yieldable vent member closing the bore of said plug and a movable contact adapted to cooperate with said tubular contact.

32. In combination, a sleeve of insulation, a ferrule on the lower end of the sleeve, a plug closing said ferrule said plug having a central aperture, a tubular contact in said central aperture, a yieldable vent member closing the outer end of said aperture, a body of insulating liquid in the sleeve, a movable

contact adapted to cooperate with the tubular contact, a spring for moving the movable contact upward, and a liquid directing member connected to the movable contact and adapted to project the liquid between the movable contact and the tubular contact when said spring moves the movable contact upward.

33. In combination, a tubular sleeve of insulation having a metallic ferrule on the lower end thereof, a plug closing said ferrule, said plug having a central aperture therethrough, a tubular contact mounted in the aperture, a yielding vent member closing the outer end of said aperture, a movable plug contact adapted to fit into the tubular contact, spring contact means mounted on the plug, a metallic ring connected to the plug contact and adapted to cooperate with said spring contact, said metallic ring forming a piston within the sleeve and having means for directing an arc extinguishing fluid upon the plug contact when the contacts are separated.

34. In combination, a tubular sleeve of insulation, a ferrule about the lower end of the sleeve forming an exterior terminal, a plug for closing the ferrule, a central arcing contact mounted on said plug, spring contacts mounted on the plug, a movable main contact adapted to cooperate with said spring contact, an arcing contact connected to the main contact, spring means for moving the main contact and an arc extinguishing liquid within the sleeve, said main contact having means for directing the liquid upon the arcing contact when the main contact is moved upward.

35. In combination, a sleeve of insulation, a ferrule about the lower end of said sleeve, a plug for closing said ferrule, a main spring contact mounted on said plug and a central arcing contact mounted on said plug, a main movable contact forming a piston within the sleeve, said main contact having a central aperture therethrough, an arcing contact projecting through said central aperture and adapted to cooperate with the stationary arcing contact, a stem connected to the main contact, and spring means connected to the main contact for moving the same away from the stationary contact and for projecting an arc extinguishing liquid between the arcing contacts.

36. In combination, a sleeve of insulation, a metallic plug closing the lower end of the sleeve, a plurality of posts projecting upward from the plug into the sleeve, said posts having spring contacts thereupon and forming the main stationary contact, said plug having a central arcing contact, a main movable contact member forming a piston within the sleeve, said main movable contact having an arcing contact projecting be-

yond the main contact, spring means connected to the main movable contact for separating the movable main and arcing contacts from the stationary main and arcing contacts and means for moving the contacts into engagement.

37. In combination, a sleeve of insulation, a metallic plug member closing the lower end of the sleeve and forming a terminal, a corresponding plug closing the upper end of the sleeve and forming a terminal, contact means on the lower plug comprising a main contact and an arcing contact projecting beyond the main contact, movable contact means comprising a main contact and an arcing contact projecting beyond the main contact, said arcing contacts being adapted to telescope with each other, said main contacts being adapted to be brought into abutting engagement, manual means for moving the movable and stationary contact members into engagement with each and automatic means for separating the contact members.

38. In combination, a casing, a pair of contact members mounted in said casing, said contact members comprising a main stationary contact and a stationary arcing contact projecting beyond the main contact, the movable contact member comprising a main contact and an arcing contact projecting beyond the main movable contact, said arcing contacts being adapted to telescope with respect to each other to form initial and final contacts between the contact members, manual means for bringing the contact members into engagement and automatic means for moving them out of engagement.

39. In combination, a sleeve of insulation, a metallic closure for each end of the casing, switching means within the casing comprising stationary and movable switching members, the stationary switch member comprising a main contact mounted on the lower closure and an arcing contact extending beyond the main contact mounted on said lower closure, said movable switching member comprising a main contact member forming a piston within the sleeve of insulation and an arcing contact extending beyond the main contact, said arcing contacts being adapted to telescope with each other, said main movable contacts forming a liquid director for directing an arc extinguishing liquid upon said arcing contact, an arc extinguishing liquid within the sleeve, manual means for causing engagement of said switching members, and automatic means for moving the movable switch member away from the stationary switch member.

40. In combination, a sleeve of insulation, a closure for one end of the sleeve, a stationary switch member mounted on said closure, said switch member comprising a

main stationary contact and an arcing stationary contact, said arcing contact extending beyond the main contact, a movable switching member comprising a main contact member adapted to engage the main
5 stationary contact member and an arcing contact adapted to engage the stationary arcing contact, said arcing contacts being

adapted to telescope with respect to each other, an arc extinguishing liquid within the sleeve, means for moving the switch members into engagement with each other and automatic means for separating them. 10

In witness whereof I hereunto subscribe my name this 24th day of April, A. D. 1918. 15
NICHOLAS J. CONRAD.