July 18, 1933.

F. FARRELL

1,918,901

ELECTRIC SWITCH

Filed Jan. 4, 1932

3 Sheets-Sheet 1

FIG. 1.

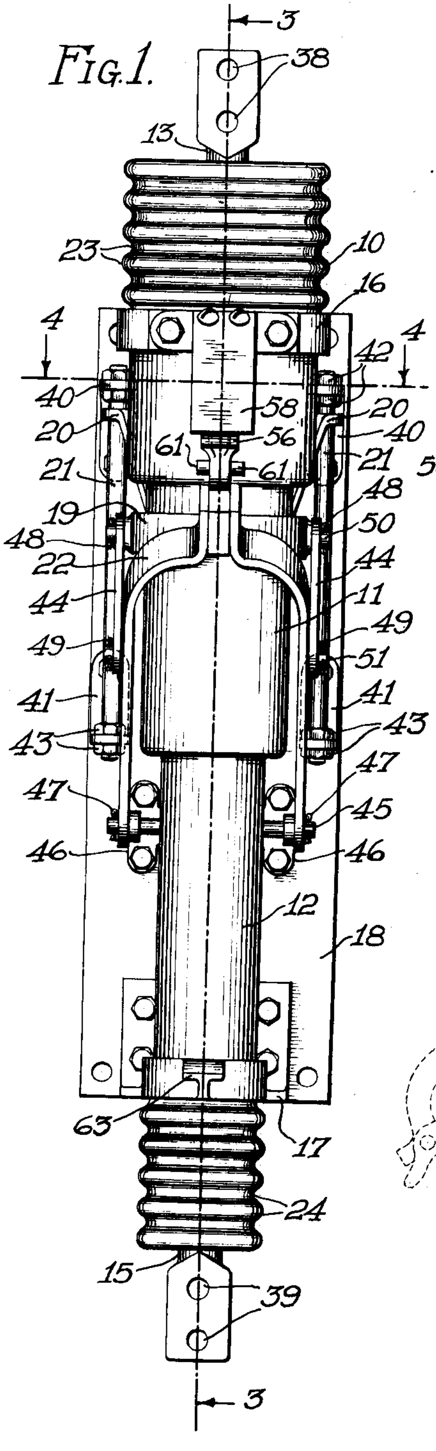

FIG. 2.

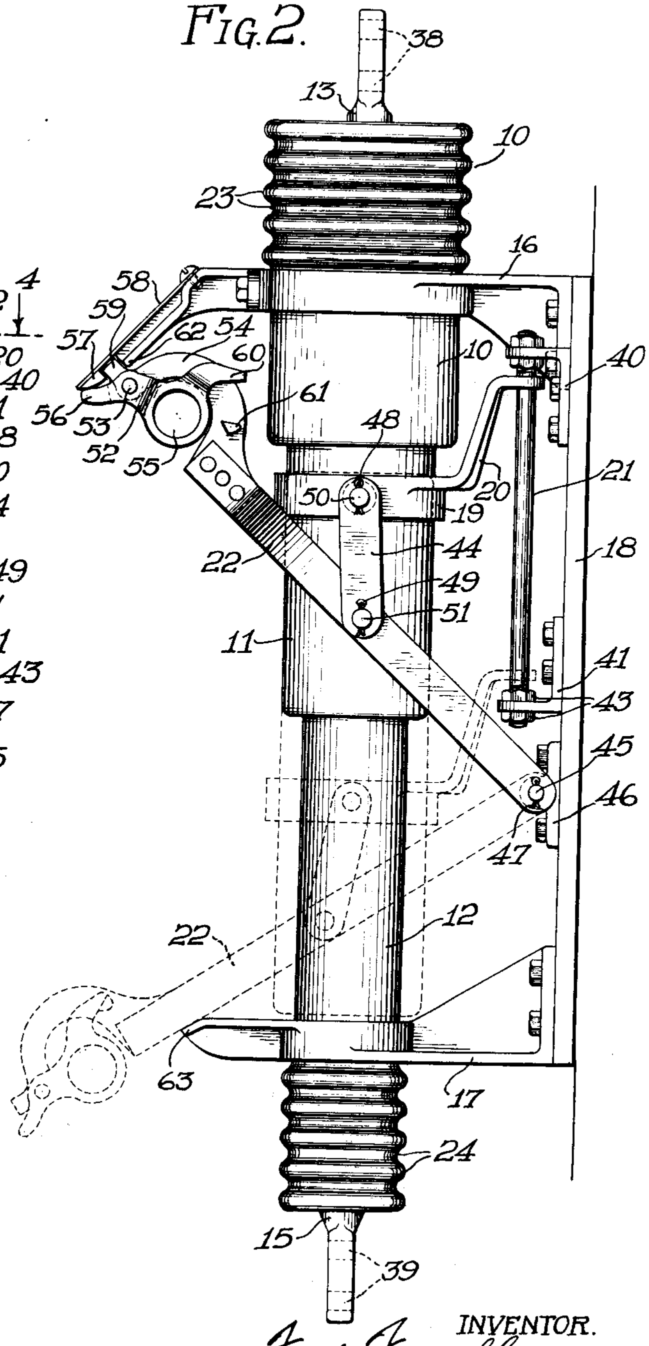

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FIG. 3.

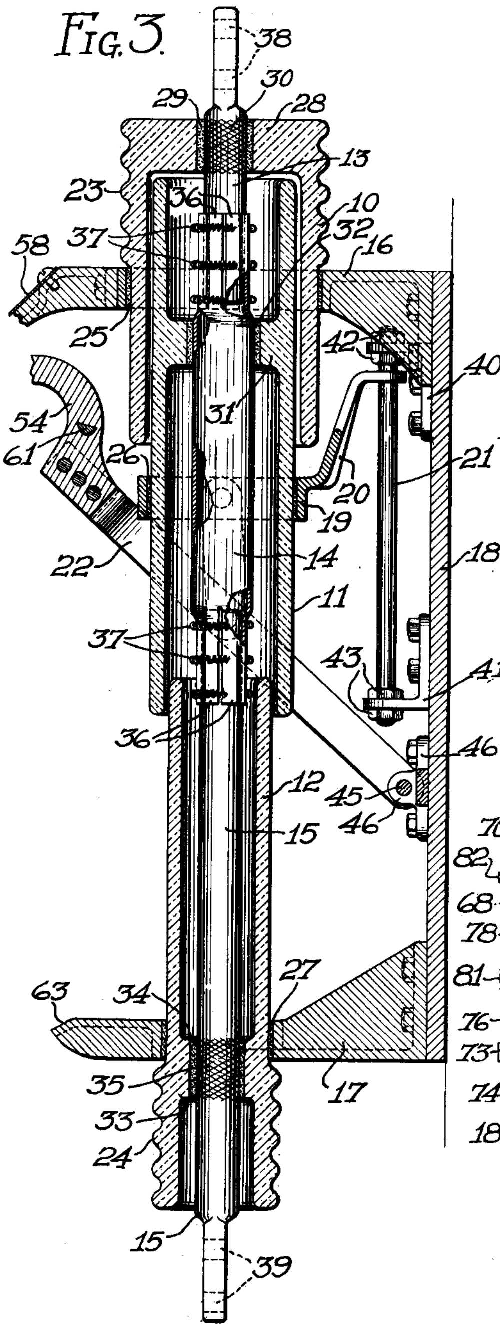

FIG. 4.

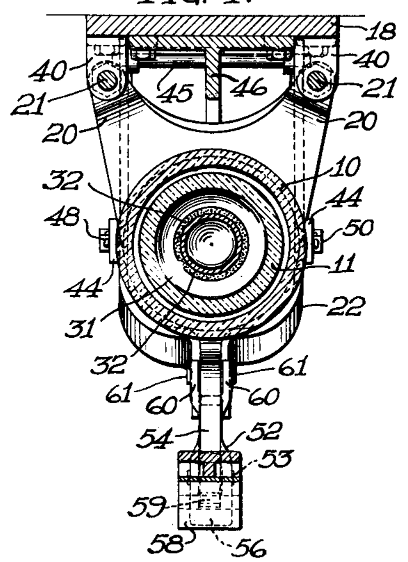

FIG. 5.

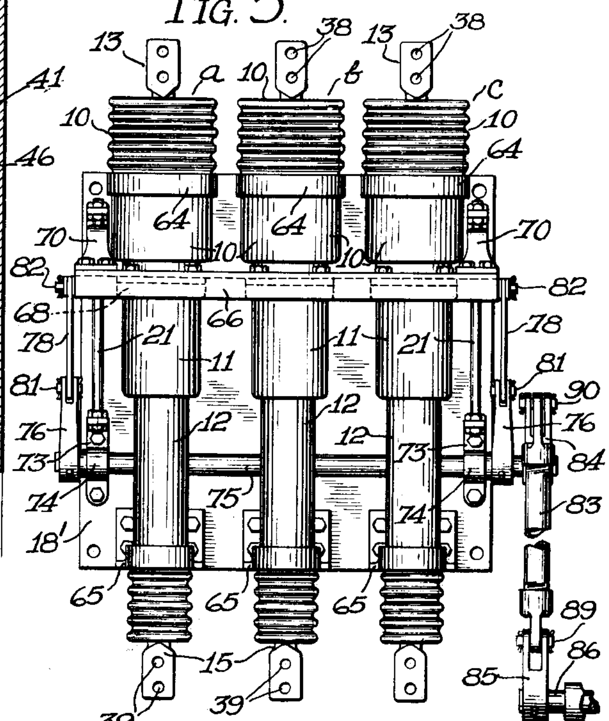

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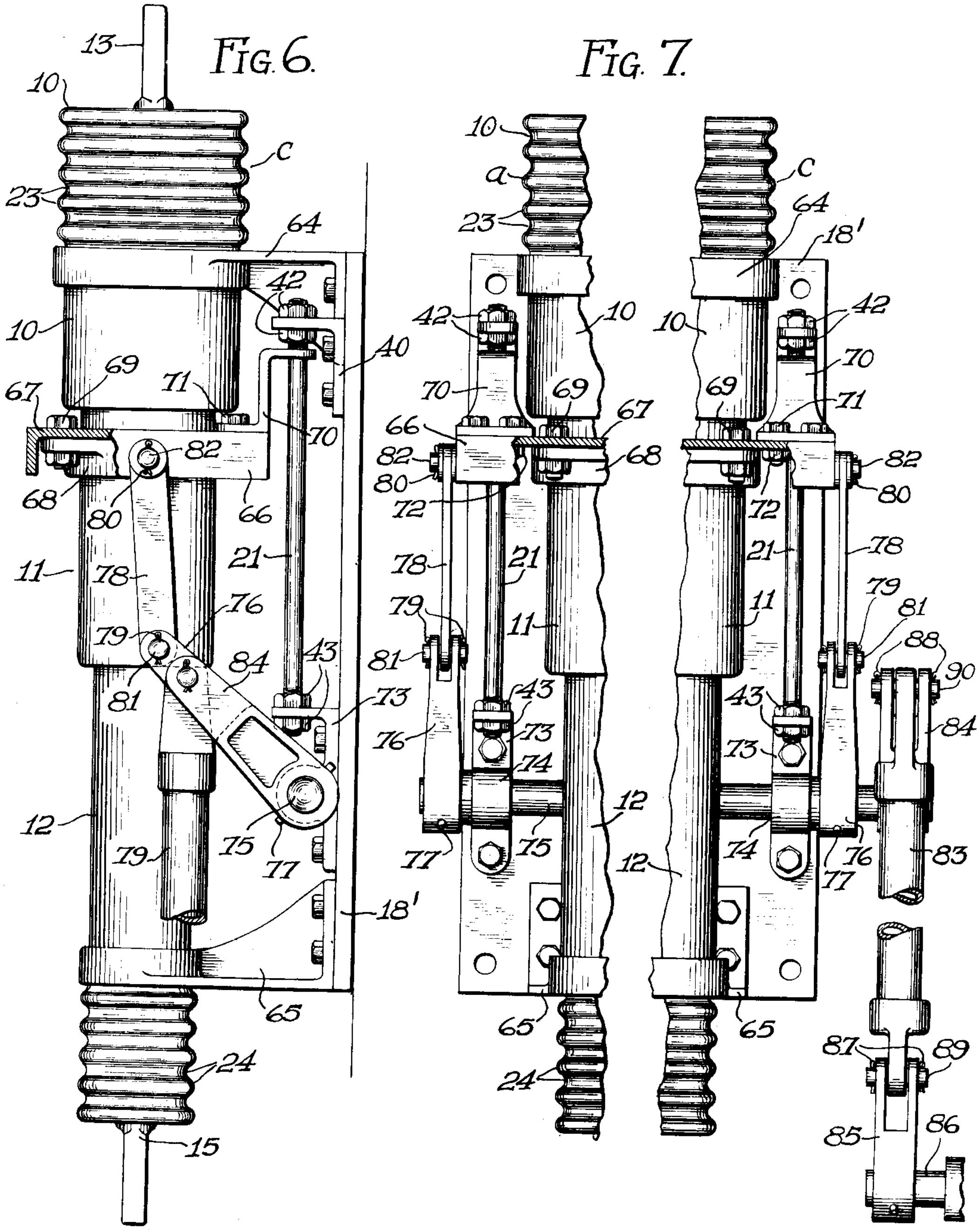
FIG. 6.

FIG. 7.



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UNITED STATES PATENT OFFICE

FRED FARRELL, OF ELMWOOD PARK, ILLINOIS, ASSIGNOR TO ELECTRICAL ENGINEERS EQUIPMENT COMPANY, A CORPORATION OF ILLINOIS

ELECTRIC SWITCH

Application filed January 4, 1932. Serial No. 584,618.

The present invention relates to electric switches and has for its general object the production of an electric switch which shall be efficient and satisfactory in operation while being simple in construction and economical to manufacture.

To this end I provide a switch structure including a plurality of insulating tubes arranged in telescopic relation to each other and locate in these tubes the various switch contacts. Relative movements of the tubes make and break the circuit between the inclosed contacts. Preferably three such tubes are employed, the end tubes being fixed and the intermediate tube movable. Reciprocations of the latter cause its contact to make and break circuit between the fixed contacts in the end tubes. Novel mechanism is provided for guiding the movable tube and there is novelty in the construction and arrangement of the switch contacts themselves. Each such association of tubes and contacts constitutes a single switch unit and there will be as many units in a complete switch structure as the circuits may require.

The several features and advantages of the invention will be more fully understood upon reference to the following detailed description taken in connection with the accompanying drawings wherein preferred embodiments of the invention, suited to single-phase and three-phase circuits, are shown.

In said drawings, Fig. 1 is a front elevation of a single-phase disconnect switch constructed and arranged in accordance with the present invention; Fig. 2 is a side elevation of the same; Fig. 3 is a vertical longitudinal section of the same, the plane of section being indicated by the line 3—3 of Fig. 1; Fig. 4 is a transverse section of the same, the plane of section being indicated by the line 4—4 of Fig. 1; Fig. 5 is a front elevation of the three-phase embodiment; Fig. 6 is a side elevation of the three-phase structure; and Fig. 7 is a broken and compacted view in elevation of the same three-phase structure showing the parts more in detail. Throughout these views like characters refer to like parts.

Referring to said drawings in detail and more particularly at first to the single-phase structure of Figs. 1 to 4 inclusive, 10 designates the upper insulating tube, 11 the intermediate or movable insulating tube and 12 the lower insulating tube. Within these tubes, respectively, are the upper electric contact 13, the intermediate contact 14, and the lower contact 15. The fixed tubes 10 and 11 are mounted in end frames 16, 17 carried upon a suitable support 18. An intermediate movable frame 19 carries the movable tube 11 and its contained contact 14. Arms 20 extending from the frame 19 cooperate with guide rods 21 to maintain the reciprocating parts in alignment during their reciprocations. A lever 22 is operative through suitable connections to actuate the intermediate frame 19 and its associated parts.

In the preferred construction, the upper tube 10 is the tube of largest diameter, the intermediate tube 11 is of smaller diameter and the lowermost tube 12 is of the least diameter. These tubes, as clearly shown, are aligned and in telescopic relation to each other, the intermediate tube 11 passing into the upper tube 10 and the lower tube 12 passing into the intermediate tube 11. The reciprocating parts are made smooth and provided with sufficient clearance to prevent their engaging each other when moved as described. The non-overlapping portions of the tubes have their outer surfaces preferably corrugated or otherwise shaped so as to provide a superficial surface of considerable length to increase the resistance to creepage losses of current over the surface of the tubes as is well known in the electric insulator art. As clearly shown the tube 10 has the outer corrugated surface 23 and the tube 12 has the similar surface 24. In the former case the corrugations are all above the end frame 16 and in the latter case they are all below the end frame 17. The tubes are composed of porcelain, bakelite, or the like.

The tube 10 may be secured to the end frame 16 in any suitable way. In the present embodiment the end frame has an opening through it which loosely fits over the exterior of the tube 10 below the corrugations 23. When the tube 10 is properly positioned in the end frame 16 of filling of cement 25 serves to bind the parts together and hold the tube in proper alignment. The tube 11 is similarly secured to the intermediate frame 19 by a similar filling 26. In like manner a cement filling 27 connects the lower tube 12 to the frame 17. As clearly shown these tubes are all carefully aligned so that they may be telescoped by a simple to and fro movement of the central or intermediate tube.

Each tube is provided on its interior with an apertured transverse wall and in each aperture the associated electric contact is secured. Thus, in the case of tube 10, the wall 28 is apertured for the passage of the contact 13. A suitable cement filling 29 secures the contact in place. In order to increase the holding power of the cement, the contact 13 has its outer surface knurled or roughened as indicated at 30. In like manner the transverse wall 31 in the intermediate tube 11 serves to support the intermediate contact 14, a cement filling 32 firmly holding the parts together. Similarly a transverse wall 33 in the lower tube 12 cooperates with a cement filling 34 and a knurled or roughened surface 35 to firmly hold the lower contact in place in the lower tube. As clearly shown, the transverse wall 28 is at the end of the tube 10 while the transverse walls 32 and 33 are located at intermediate points in the lengths of their respective tubes. Obviously these transverse holding walls might be variously positioned in the different tubes in accordance with the judgment of the designer.

In the present embodiment the end contacts 13 and 15 are preferably solid rods of copper or other suitable conducting material which the intermediate contact 14 is a sleeve of like material which travels up and down over the lower rod 15, always maintaining contact with it, and into and out of contact with the upper rod 13, again engaging the outer surface of the rod as it passes into engagement with it. The ends of the sleeve contact 14 are slitted to provide a series of tongues 36, a set being provided at each end of the sleeve. These slitted tongues have sufficient resiliency so that they may be moved radially toward and from the axis of the sleeve. In order to increase their resiliency and insure their firm contact with the cooperating rods 13, 15 each set of tongues 36 is provided with a set of coiled springs 37 which extend in each instance around all of the associated tongues and exercise a constant pressure tending to force the tongues inward. The end of the rod 13 is sufficiently reduced in diameter to readily pass into the upper end of the sleeve constituting the intermediate contact 14 of the structure. The same is true of the rod 15 and the slitted construction at the lower end of the intermediate contact 14.

By reason of the fact that the end terminals 13 and 15 are fixed and all movement of the switch is confined to the intermediate contact 14 and its associated parts, it is not necessary to use flexible conductors in making connections to the outer ends of the contact rods 13, 15 but in every installation a rigid and permanently located conductor may be employed. For the purpose of connecting these conductors the outer ends of the rods 13, 15 may be variously shaped. In the present instance these ends are flattened and provided with a plurality of apertures 38 in the case of the upper terminal, and 39 in the case of the lower. This permanency in connecting the conductors to the end terminals is of considerable importance in switch boards of the present day construction wherein oil switches are mounted on trucks and moved into and out of chambers in the switch boards, the present structure being well adapted to serve as a disconnect switch in installations of this type.

In order to guide the intermediate tube 11, and its contained contact 14, in a truly rectilinear path, I preferably provide cooperating arms 20 on the intermediate frame 19 and guiding rods 21 on the support 18. Ordinarily two arms and two rods will suffice. The arms extend rearward from the intermediate frame 19, while the rods 21 are carried upon brackets 40, 41 suitably secured to the support. Nuts 42, 43 upon the upper and lower ends of the rods, respectively, serve to rigidly connect the rods to the outstanding lugs of the brackets. The outer ends of the arms 20 are apertured so as to be threaded over the rods 21 with a rather accurate fit between the rod and the opening. As clearly shown, the rods 21 are parallel to the axis of the tubes 10, 11, 12. With this construction it will be at once apparent that all reciprocations of the intermediate portion of the switch will be in a right line. Thus, the contacts 13, 14 will readily telescope when making and breaking circuit and at the same time the sleeve contact 14 will easily travel along the lower contact rod 15.

For the purpose of actuating the intermediate frame 19 and its associated parts, I connect the lever 22 at an intermediate point in its length with the frame 19. As clearly shown the lever 22 is bifurcated and one branch passes on each side of the central tube 11. Preferably connection is made between these parts by two links 44, one link connecting with each branch and the two links being located on opposite sides of the tube 11. The two branches of the lever 22 are journaled for rotation through the agency of a pivotal connection provided by a pivot rod 45 which passes through apertures in the arms of the bifurcated lever and also through upstanding lugs upon bracket 46 suitably secured to the support 18. In the present instance cotter pins 47 through the ends of the pivot 45 hold the pivot in place. Similar pins 48, 49 serve in like manner to hold the links 44 in place upon the associated pivotal trunnions 50, 51.

For the purpose of holding the lever 22 in its upper or switch-closing position, I provide a latch at the forward edge of the upper frame 16 which cooperates with a latch member 52 at the outer end of the lever 22. The latch member 52 is connected by a pivot 53 to an arm 54 which is secured to the outer end of the lever 22. The member 52 has an opening 55 into which a hook may be thrust when it is desired to pull down the lever 22 to open the switch. A downward pull upon the hook, which is passed through the opening 55, will rock the member 52 about its pivot 53 and force its outer end 56, upward against a catch 57 on the outer end of a spring 58 which is secured to the forward edge of the frame 16. The upward movement of the end 56, forces the spring against its normal tendency and causes the catch 57 to move upward out of engagement with a cooperating lug 59 upon the arm 54, thus freeing the lever for downward movement. At the time the hook is inserted in the opening 55 and drawn down to bring about this action, tails 60 on the member 52 are brought up against stops 61 on the arm 54, thus limiting the unlatching movement of the member 52.

Whenever the reverse movement is to take place, the hook, after being inserted in the opening 55, is moved upward and at such time the lug 59 passes freely under the spring pressed lug 57 and is firmly engaged by the latter to hold the lever in its upper position. This upward movement of the lever is limited by a stop 62 upon the forward edge of the frame 16. The downward movement of the lever 22 is limited by its engagement with a stop 63 located at the forward edge of the end frame 17.

From what has been said it will be seen that the operation is very simple. An upward movement of the frame 19 with its tube 11 and contact 14 causes the latter to slip upward over the lower contact 15 and into engagement with the upper contact 13. A movement in the opposite direction causes the upper end of the contact 14 to separate from the upper contact 13 and thus open the switch. At such time the central tube and the actuating parts will occupy the position illustrated in dotted lines in Fig. 2, and, as there shown, the intermediate tube 11 will then have passed entirely out of the upper tube 10. By reason of this separation of the upper end of the intermediate tube from the lower end of the upper tube, it is possible for an attendant to look within the tubes and know positively that the switch contacts 13, 14 are separated.

Referring now to the three-phase switch structure illustrated in Figs. 5 to 7 inclusive, there are three sets of switch tubes and contacts *a*, *b*, *c* mounted upon a wide support 18′. The tube and contact arrangement of these three sets is the same as previously described. The mountings of the upper tubes 10 of each set are also the same, each tube being carried in an end frame 64 secured to the support 18′. The end frames 64 are similar to the frames 16 but do not require the forward extension for cooperation with the hand lever of the single-phase embodiment. The mountings for the lower tubes 12 also the same as those of the single-phase embodiment, each tube being mounted in an end frame 65. The latter is similar to the end frame 17 but does not have the forwardly projecting stop which the frame 17 has.

The intermediate tubes 11 are in this instance all supported by an intermediate frame 66 composed of a main flange plate 67 apertured for the reception of the tubes 11 and at such apertures provided with a flanged ring 68 which is secured to the plate 67 by any suitable means as the bolts 69 and associated nuts. The frame 66, thus composed, is provided with two angular arms 70 which are secured at their lower ends to the plate 67 by suitable bolts 71 and nuts 72. The upper ends of the arms 70 are extended rearward and apertured to slip over the guide rods 21 which are mounted in upper and lower brackets. The upper brackets 40 are the same as in the case of the single phase construction. The lower brackets 73 are similar to the brackets 41 but each is provided with a bearing 74 for a transverse operating shaft 75.

The operating shaft 75 is provided with crank arms 76 firmly secured in place by transverse pins 77. The outer ends of these crank arms are connected by links 78 to the opposite ends of the frame 66. Cotter pins 79, 80 hold the links 78 in place upon pivot pins 81 and upon the trunnions 82 upon the intermediate frame 66. As the shaft 75 is rocked, the crank arms 76 are actuated to move the intermediate frame 66 up and down and thereby reciprocate all the intermediate tubes 11 to make and break circuit for the three phases in the manner previously described in connection with the single-phase structure.

The shaft 75 may be rocked in any suitable way. In the present instance a connecting rod 83 is pivotally connected at its upper end to a crank arm 84 secured to the shaft 75, and at its lower end to a similar crank arm 85 upon an operating shaft 86. Cotter pins 87, 88 and pivot pins 89, 90 cooperate in forming the pivotal connections of the rod 83 with the crank arms.

The various parts, other than the insulating tubes 10, 11, 12 and conducting contacts 13, 14, 15 are composed of metals of suitable compositions for the purposes intended.

In the practice of my invention, obviously, many changes may be made in the details disclosed without departing from the invention. I therefore aim to cover all the alterations and modifications which rightly come within the scope of my invention, by the terms of the appended claims.

I claim:

1. An electric switch comprising two end insulating tubes, an intermediate insulating tube in telescopic relation to said end tubes, terminal electric contacts within and mechanically connected to said end insulating tubes respectively, an intermediate electric contact within and mechanically connected to said intermediate insulating tube and operative to electrically connect and disconnect said terminal contacts, end frames to which said end tubes are mechanically connected and by which said end tubes are held in alignment, an intermediate frame to which said intermediate tube is mechanically connected, said intermediate tube being in alignment with said end tubes, a support, mechanical means for relatively moving said tubes telescopically to relatively actuate said contacts to make and break circuit, and guiding means carried by said support and operatively connected to one of said frames to maintain said tubes and contacts in alignment during the operations of the switch.

2. An electric switch comprising two end insulating tubes, an intermediate insulating tube in telescopic relation to said end tubes, terminal electric contacts within and mechanically connected to said end tubes respectively, an intermediate electric contact within and mechanically connected to said intermediate tube and operative to electrically connect and disconnect said terminal contacts, a support, end frames secured to said support and fixedly supporting said end tubes in alignment, an intermediate frame secured to said intermediate tube and movably mounted on said support for telescopic reciprocation with reference to said end tubes, and means for moving said intermediate tube and contact to and fro to make and break circuit through said terminal contacts.

3. An electric switch comprising two end insulating tubes, an intermediate insulating tube in telescopic relation to said end tubes, terminal electric contacts within and mechanically connected to said end tubes respectively, an intermediate electric contact within and mechanically connected to said intermediate tube and operative to electrically connect and disconnect said terminal contacts, a support, end frames secured to said support and fixedly supporting said end tubes in alignment, an intermediate frame member secured to said intermediate tube, a plurality of arms extending from said frame member toward said support, a plurality of guide rods secured to said support and extending parallel to the axis of said aligned tubes, said rods and arms having sliding engagement with each other, and means for moving said intermediate tube and contact to and fro to make and break circuit through said terminal contacts.

4. An electric switch comprising two end insulating tubes each having an apertured transverse wall at its outer end, an intermediate insulating tube in telescopic relation to said end tubes, said intermediate tube having an apertured transverse wall at an intermediate point in its length, terminal electric contacts within said end tubes respectively, an intermediate electric contact within said intermediate tube, the three contacts in said three tubes extending each through the aperture ot the wall of the tube in which it is located and each being firmly secured therein, the intermediate contact operating to electrically connect and disconnect said terminal contacts, end frames to which said end tubes are mechanically connected and by which said end tubes are held in alignment, an intermediate frame to which said intermediate tube is mechanically connected, said intermediate tube being in alignment with said end tubes, a support, mechanical means for relatively moving said tubes telescopically to relatively actuate said contacts to make and break circuit, and guiding means carried by said support and operatively connected to one of said frames to maintain said tubes and contacts in alignment during the operations of the switch.

5. An electric switch comprising two end insulating tubes each having an apertured transverse wall at its outer end, an intermediate insulating tube in telescopic relation to said end tubes, said intermediate tube having an apertured transverse wall at an intermediate point in its length, terminal electric contacts within said end tubes respectively, an intermediate electric contact within said intermediate tube, the three contacts in said three tubes extending each through the aperture of the wall of the tube in which it is located and each being firmly secured therein, the intermediate contact operating to electrically connect and disconnect said terminal contacts, a support, end frames secured to said support and fixedly supporting said end tubes in alignment, an intermediate frame secured to said intermediate tube and movably mounted on said support for telescopic reciprocation with reference to said end tubes, and means for moving said intermediate tube and contact to and fro to make and break circuit through said terminal contacts.

6. An electric switch comprising two end insulating tubes each having an apertured transverse wall at its outer end, an intermediate insulating tube in telescopic relation to said end tubes, said intermediate tube having an apertured transverse wall at an inter-

mediate point in its length, terminal electric contacts within said end tubes respectively, in intermediate electric telescoping sleeve contact within said intermediate tube, the three contacts in said three tubes extending each through the aperture of the wall of the tube in which it is located and each being firmly secured therein, the intermediate contact slipping along telescopically over one of said terminal contacts and into and out of telescopic engagement with the other to electrically connect and disconnect said terminal contacts, end frames to which said end tubes are mechanically connected and by which said end tubes held in alignment, an intermediate frame to which said intermediate tube is mechanically connected, said intermediate tubes being in alignment with said end tubes, a support, mechanical means for relatively moving said tubes telescopically to relatively actuate said contacts to make and break circuit, and guiding means carried by said support and operatively connected to one of said frames to maintain said tubes and contacts in alignment during the operations of the switch.

7. An electric switch comprising two end insulating tubes each having an apertured transverse wall at its outer end, an intermediate insulating tube in telescopic relation to said end tubes, said intermediate tube having an apertured transverse wall at an intermediate point in its length, terminal electric contacts within said end tubes respectively, an intermediate electric sleeve contact within said intermediate tube, the three contacts in said three tubes extending each through the aperture of the wall of the tube in which it is located and each being firmly secured therein, the intermediate contact slipping along telescopically over one of said terminal contacts and into and out of telescopic engagement with the other to electrically connect and disconnect said terminal contacts, a support, end frames secured to said support and fixedly supporting said end tubes in alignment, an intermediate frame secured to said intermediate tube and movably mounted on said support for telescopic reciprocation with reference to said end tubes, and means for moving said intermediate tube and contact to and fro to make and break circuit through said terminal contacts.

8. An electric switch comprising relatively movable telescopic insulating tubes providing an enclosed arc chamber and a restricted passage from atmosphere to said chamber, cooperating electric contacts secured respectively in said tubes in alignment with said tubes to make and break circuit in said chamber, and means for relatively moving said tubes and their associated contacts, one tube and its contact on the one hand and the other tube and its contact on the other hand, to thus make and break circuit, the ends of said tubes extending beyond the contacting ends of said contacts to maintain said enclosing chamber at the time said contacts break circuit whereby a stream of outside air is continuously applied to said chamber and its contents at the time an arc is drawn therein and the circuit broken by the separating contacts.

9. An electric switch comprising relatively movable telescopic insulating tubes providing in a collapsed condition of said tubes an inclosed arcing chamber connected to atmosphere by a restricted channel, each of said tubes having an apertured transverse wall, cooperating electric contacts within said tubes respectively, each said contact extending through the aperture of the wall of the tube in which it is located and being firmly secured therein, the end of the corresponding tube extending beyond the contacting end of said contact in each case, whereby the aforesaid inclosed arcing chamber with its connection to atmosphere is provided, and means for moving said tubes telescopically to make and break circuit by said contacts within the said arcing chamber provided by the overlapping ends of the telescoping tubes.

10. An electric switch comprising cooperating fixed and movable telescopic insulating tubes providing in a collapsed condition of said tubes an inclosed arcing chamber connected to atmosphere by a restricted channel, a transverse apertured wall forming the end of one of said tubes, a similar wall located at an intermediate point in the other of said tubes, means for moving said movable tube axially with reference to said fixed tube, and electric contacts axially positioned in said tubes respectively, one contact passing through each of said apertures and being firmly secured therein, the end of the insulating tube extending in each case beyond the contacting end of the associated contact, whereby the aforesaid inclosed arcing chamber with its connection to atmosphere is provided, said contacts thereby making and breaking circuit within the said arcing chamber surrounded by the overlapping ends of said tubes, in response to full throw movements of said movable tube.

11. An electric switch comprising relatively movable insulating tubes, a terminal electric contact secured within one of said tubes, a second electric contact in line with said terminal contact, an intermediate electric telescoping sleeve contact secured within a second of said tubes, said sleeve contact being movable telescopically to and fro over said second contact and telescopically into and out of engagement with said first mentioned terminal contact in response to the operative reciprocations of said second tube, and mechanical means for reciprocating said second tube to make and break circuit between said first mentioned and sleeve contacts.

12. An electric switch comprising an up-

per insulating tube of largest diameter, said tube having a closed upper end and an open lower end, a second insulating tube aligned with and below said upper tube and relatively movable along their common axis into a closed position wherein said tubes occupy practically their most fully contracted telescopic position and the upper open end of said second tube most closely approaches the inside of the closed upper end of said upper tube, the latter tube fitting within the former with sufficient looseness to provide a small channel for outside air to the chamber formed at the upper end of the telescoping tubes, terminal electrical contacts within and mechanically connected to said upper and second insulating tubes respectively, whereby said contacts are mechanically and operatively movable with said tubes along said common axis, said terminals contacting most effectively when said tubes are in said most fully contracted position, and mechanical means for moving and guiding said tubes and contacts to make and break circuit at said terminal contacts, the telescopic action between said upper and second tubes providing during the circuit breaking operation a continued stream of outside air impinging against the arc and into the mixture of gases formed thereby and by so doing greatly assisting in the extinguishment of the arc and in the complete rupture of the circuit.

13. An electric switch comprising an upper insulating tube of largest diameter, said tube having a closed upper end and an open lower end, a second insulating tube aligned with and below said upper tube and relatively movable along their common axis into a closed position wherein said tubes occupy practically their most fully contracted telescopic position and the upper open end of said second tube most closely approaches the inside of the closed upper end of said upper tube, the latter tube fitting within the former with sufficient looseness to provide a small channel for outside air to the chamber formed at the upper end of the telescoping tubes, terminal electrical contacts within and mechanically connected to said upper and second insulating tubes respectively, whereby said contacts are mechanically and operatively movable with said tubes along said common axis, said terminals contacting most effectively when said tubes are in said most fully contracted position, mechanical means for moving and guiding said tubes and contacts to make and break circuit at said terminal contacts, the telescopic action between said upper and second tubes providing during the circuit breaking operation a continued stream of outside air impinging against the arc and into the mixture of gases formed thereby and by so doing greatly assisting in the extinguishment of the arc and the complete rupture of the circuit, a fixed additional electrical terminal and mechanically flexible means for electrically connecting said electrical contact within said second insulating tube to said additional electrical terminal.

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