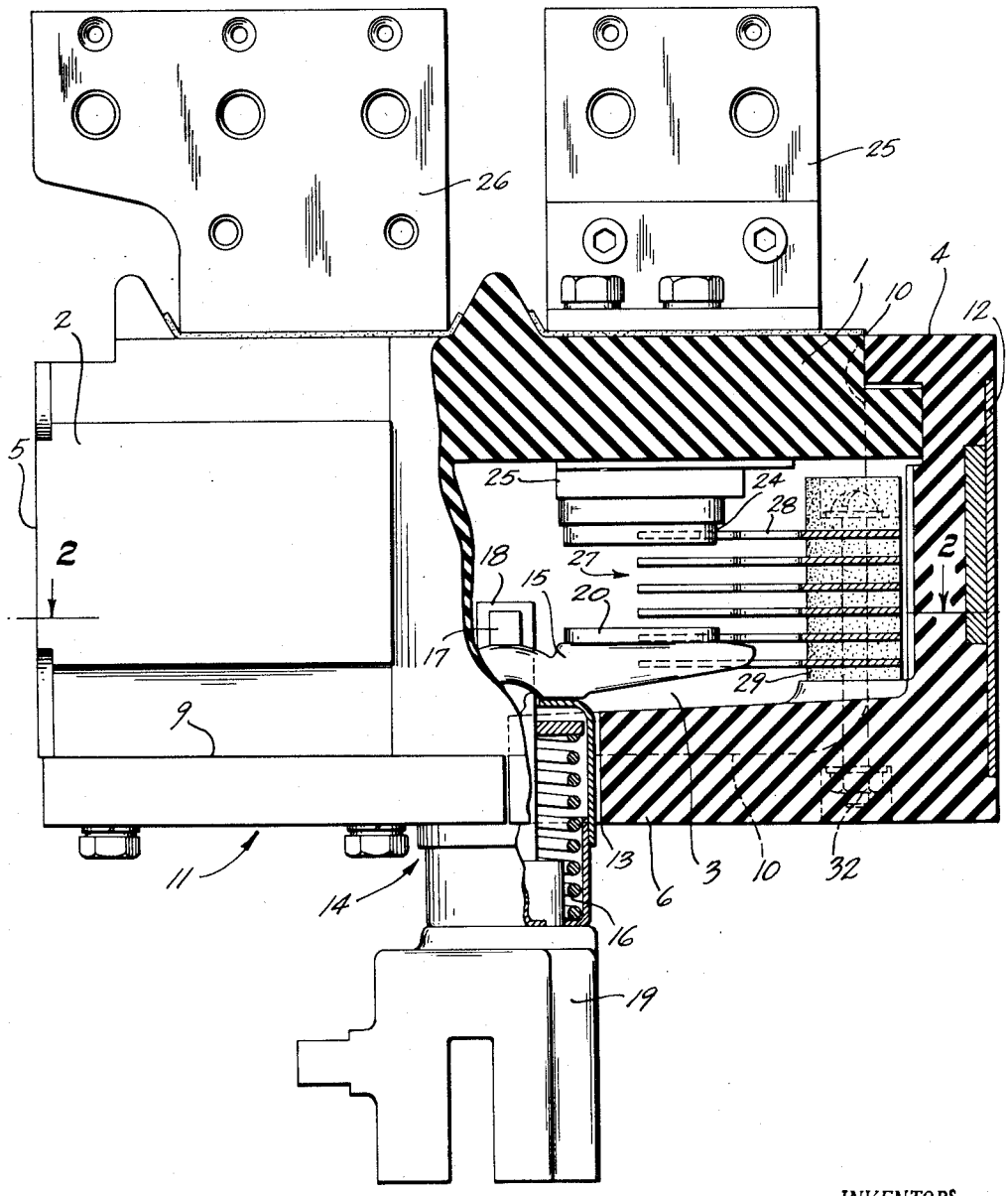
Oct. 20, 1953 L. H. MATTHIAS ET AL 2,656,442

ARC EXTINGUISHING ELECTRICAL SWITCH APPARATUS

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Fig. 1



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ARC EXTINGUISHING ELECTRICAL SWITCH APPARATUS

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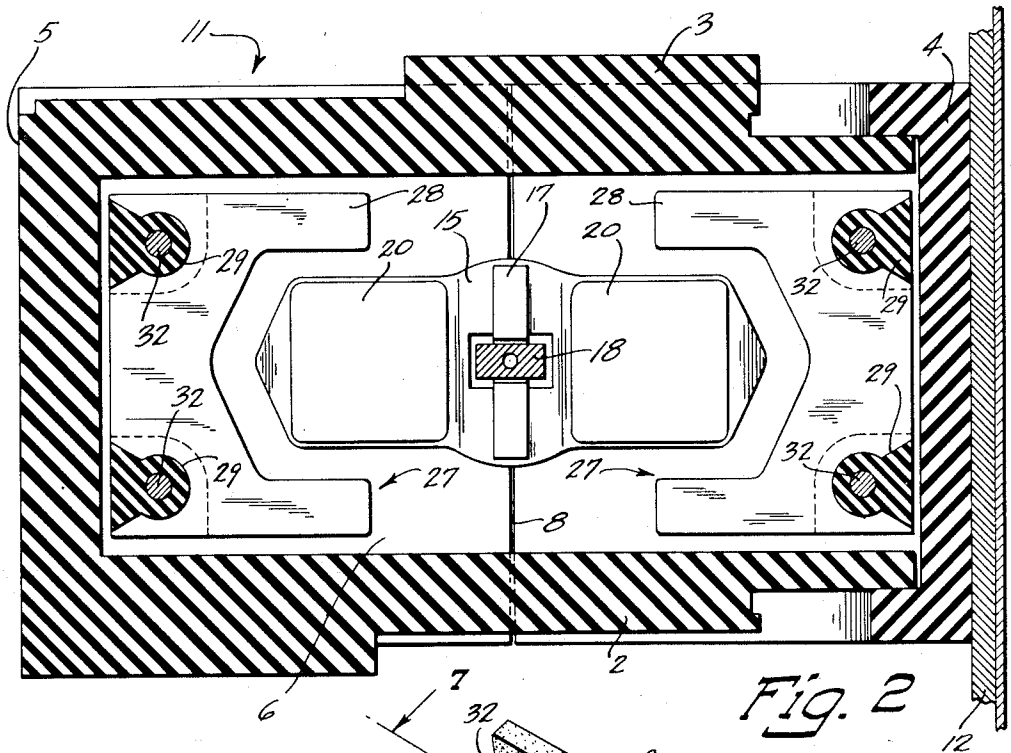


Fig. 2

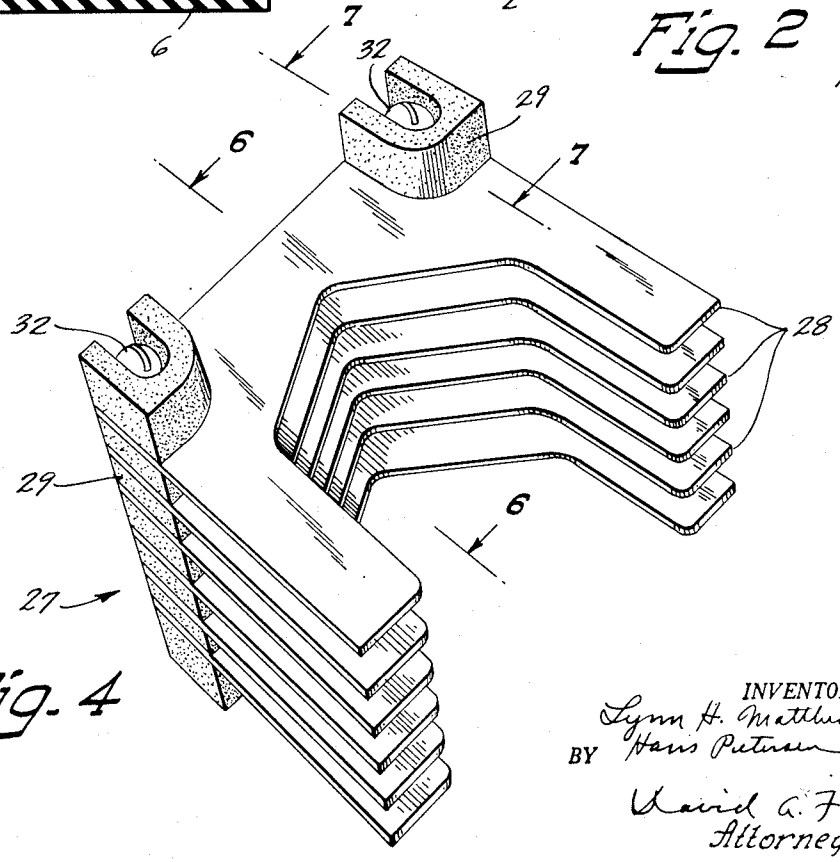


Fig. 4

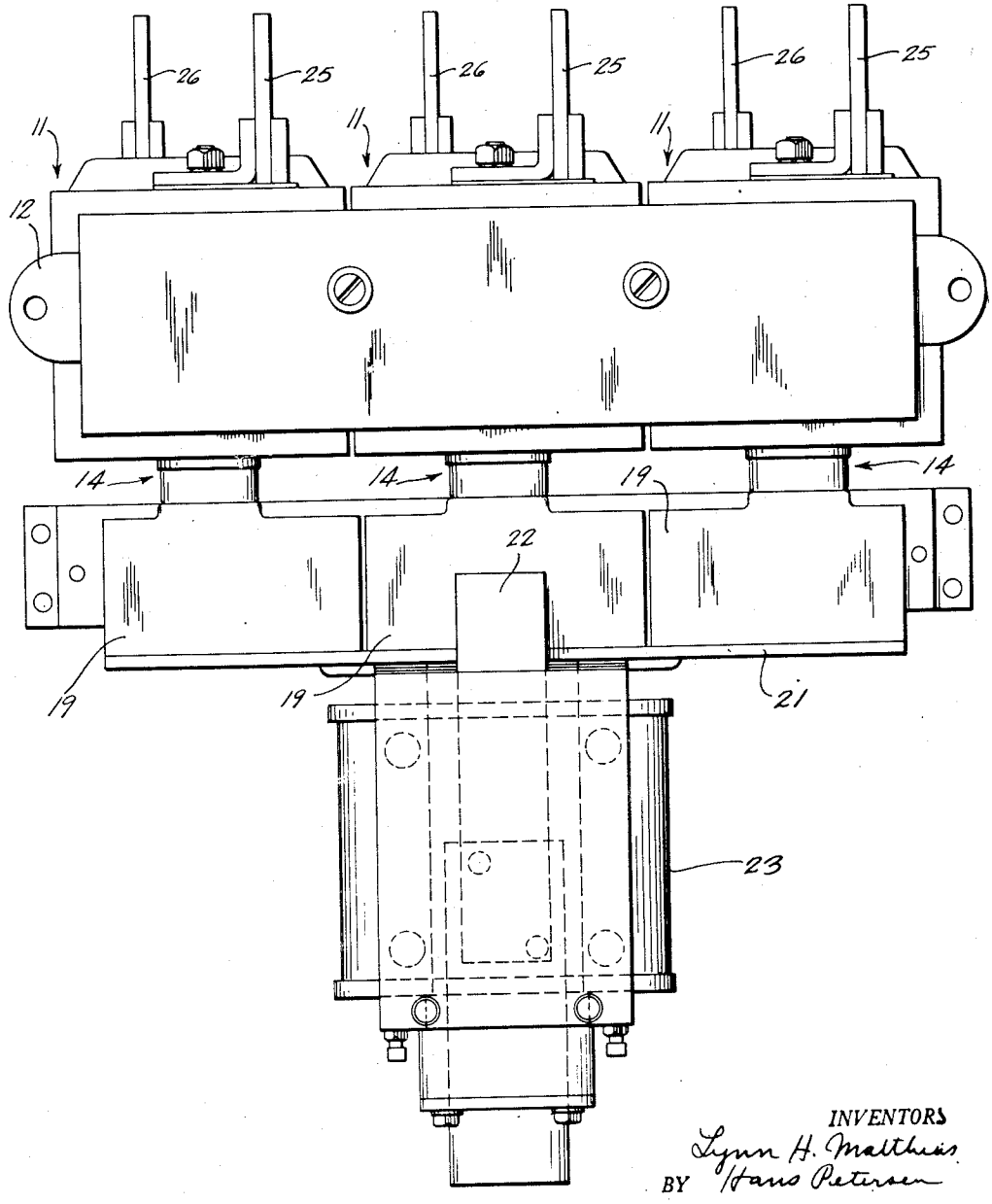
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ARC EXTINGUISHING ELECTRICAL SWITCH APPARATUS

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Fig. 3



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ARC EXTINGUISHING ELECTRICAL SWITCH APPARATUS

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Fig. 5

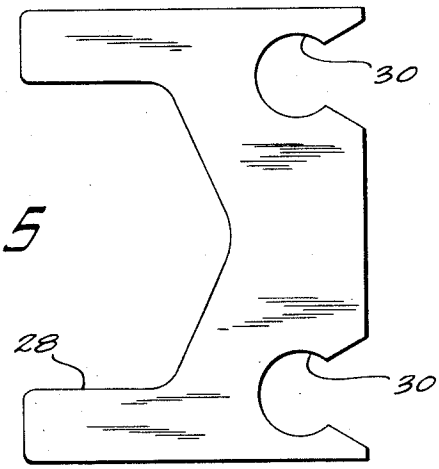


Fig. 6

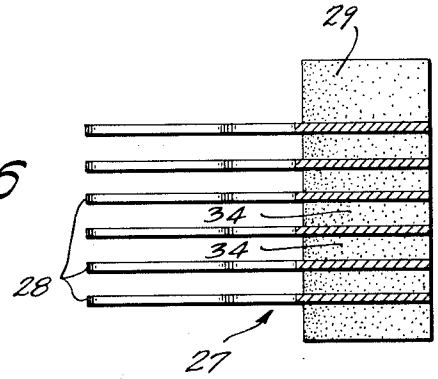
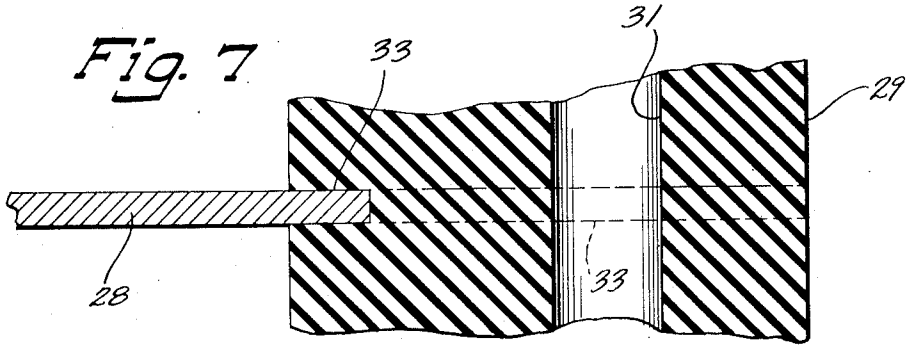


Fig. 7



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2,656,442

UNITED STATES PATENT OFFICE

2,656,442

ARC EXTINGUISHING ELECTRICAL SWITCH APPARATUS

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Application November 13, 1950, Serial No. 195,276

7 Claims. (Cl. 200—144)

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This invention relates to arc extinguishing apparatus intended for use as an aid in the interruption of large electrical currents by electric switches, circuit breakers and the like, and it resides in an improved arc de-ionizing and cooling apparatus comprising a plurality of spaced, substantially parallel, metallic plates, rigidly united and held in the desired spaced, open pile relation and electrically insulated from one another by means of a rigid mineral dielectric substance, composed of an indurated compound of finely divided hydrated aluminosilicic acid and finely divided alkaline earth base material, chemically interacted in the presence of one another and of water while in contact with said plates, so as to become adhesively bonded thereto; the adherently united assemblage being adapted to be located in position with reference to separable electric contacts so as to accept, cool and de-ionize arc products propelled thereinto and formed by movement of said electrical contacts while under load; the assemblage forming, if desired, a unitary replaceable structure easily removed from or installed in a complete switch or other circuit interrupting structure.

Heretofore assemblages of spaced substantially parallel plates, in open pile relation, disposed adjacent an electrical circuit gap at which an arc may be formed, have been employed with success as a means for receiving, cooling and de-ionizing the arc products which are formed, to aid in extinguishing the arc. The several spaced metallic plates must be rigidly held in the desired position and must be electrically insulated from one another in order to attain the result desired. Usually the assemblage is mechanically clamped in assembled form by through-bolts employing insulating material in the form of washers to preserve the spacing desired and to interpose the electrical insulation which is essential. A disadvantage of such structures arises out of the difficulty of setting up sufficient clamping pressure to insure a permanently rigid structure without imposing destructive stresses on the somewhat brittle electrical insulation material which must be employed. A further disadvantage resides in the difficulty of insuring the absence of all small access voids through which the arc might penetrate to make electrical contact with the mechanical through-bolts which are employed.

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Some have attempted to employ dielectric or insulating substances, the primary ingredients of which are composed of organic resins, for the purpose of obtaining sufficient mechanical strength and for the purpose of adhesively bonding the insulation material to the metallic plates to avoid the difficulties above mentioned. Such structures have their shortcomings also, since the insulating material is exposed to the very hot arc products, and pyrolysis which ensues results in the formation of a conductive carbonaceous film on the surface of the insulating material. This conductive film defeats the purpose of the insulating material and the arc extinguishing properties of the structure become impaired to the point where circuit interruption is interfered with rather than aided. By reason of these shortcomings of structures employing organic resin materials, unitary assemblages of arc de-ionizing plates imbedded in and adhesively bonded by such insulating materials have met with little success.

It is an object of this invention to provide a unitary assemblage of spaced, arc de-ionizing plates, electrically insulated from one another and rigidly held by an insulating material adhesively bonded to the plates, which insulating material is not subject to thermal decomposition resulting in the formation of electrically conductive substances.

Another object of this invention is to provide a unitary assemblage of arc de-ionizing plates which may be easily inserted in or removed from a switch structure, as a unitary part, to facilitate repair or replacement of the arc de-ionizing assemblage.

The foregoing and other objects and advantages of this invention will appear from the description following which is set forth by reference to the accompanying drawings forming a part hereof in which there is set forth by way of illustration and not of limitation one form in which the apparatus of this invention may be constructed.

In the drawings:

Fig. 1 is an end view in elevation and partly in section of an electrical switch of the type employing an enclosed arc chamber and in which an arc de-ionizing assemblage constructed in accordance wtih this invention is employed,

Fig. 2 is a top plan view in section of the switch shown in Fig. 1, viewed through the plane 2—2 indicated in Fig. 1,

Fig. 3 is a front view in elevation showing three switches of the type shown in Figs. 1 and 2 mounted together to be operated by a single magnet actuator to form a three phase line contactor, representing one typical form of apparatus in which the arc de-ionizing assemblage of this invention may be employed,

Fig. 4 is a perspective view of one of the arc de-ionizing assemblages employed in the switches shown in Figs. 1 to 3 inclusive,

Fig. 5 is a detailed top plan view of one of the metallic plates employed in making up the arc de-ionizing assemblage shown in Fig. 4,

Fig. 6 is an end view in elevation and in section of the arc de-ionizing assemblage shown in Fig. 4 viewed through the plane 6—6 there indicated, and

Fig. 7 is an enlarged detailed fragmentary view in section of the arc de-ionizing assemblage shown in Fig. 4 viewed through the plane 7—7 there indicated.

In the drawings, in Figs. 1 to 3 inclusive, there is shown one form of electrical switch in which the arc de-ionizing assemblage of this invention may be employed to advantage. It is to be understood, however, that the improved apparatus of this invention may be employed effectively as an aid to the extinguishing of an arc originating from separable contacts which are moved while under load whether or not such contacts are a part of a structure which corresponds in form to that which is shown.

The switch shown in the figures noted is made up of an insulating arc enclosing housing 11 having a top wall 1, end walls 2 and 3, front and rear walls 4 and 5 and a bottom wall 6. The housing 11 is parted along the juncture lines 8, 9 and 10 to facilitate access to the interior thereof.

A plurality of housings 11 as above described may be assembled as shown in Fig. 3 and clamped and held in place by a clamping bar 12 which serves as well to maintain the separable parts of the housings in closed relation. Extending upwardly through the bottom wall 6 of each housing 11 is an opening 13 which admits a vertically actuatable movable contact carrier 14, upon the upper end of which there is mounted an electrically conductive, movable contact, bridge bar 15. The contact carrier 14 includes a housed spring 16 which acts to urge the bridge bar 15 upwardly against a key 17 engaged in a hole in the upper end of a stem 18 forming a part of the carrier 14. The lower end of the stem 18 is imbedded in and rigidly held by an insulating carrier jaw 19 mounted below the carrier 14 as shown.

Secured to the ends of the bridge bar 15, in upwardly facing position and in firm electrical contact with said bridge bar are movable contacts 20 composed preferably of silver alloy. The movable contacts 20 are arranged to be moved vertically by the several carriers 14 which join through the jaws 19, as shown in Fig. 3, with an actuator bar 21, secured to the armature 22 of an actuating magnet 23.

Positioned to be engaged by the movable contacts at the upper end of their vertical movement are stationary contacts 24, one of which appears in Fig. 1. The stationary contacts 24, also preferably formed of silver alloy, are electrically and mechanically secured to terminal lugs 25—26 which extend upwardly to the exterior of the

housings 11 as shown. Near the upper end of movement of the carriers 14 the movable contacts 20 are brought into contact with the stationary contacts 24 and upon further movement of the carriers 14 the springs 16 become compressed to establish the necessary contact pressure between the movable and the stationary contacts.

Disposed adjacent to and partially surrounding the gaps existing between the movable contacts 20 and their respective contacts 24, when in open position, are arc extinguishing assemblages, designated generally by the numeral 27. As appears more clearly in Figs. 4 to 7 inclusive the arc extinguishing assemblages 27 are made up of a plurality of roughly U-shaped metallic plates 28, held in open pile, spaced, parallel relation by moulded insulating columns 29. In accordance with this invention the insulating columns 29, extending transversely of the pile formation, are composed of an indurated compound formed by chemical interaction, in the presence of water, of aluminosilicic acid and alkaline earth base material such, for example, as is set forth and disclosed in United States Patents Numbers 1,852,672, 1,877,960, and 1,942,770.

In accordance with said disclosures, either naturally occurring or artificially produced materials, high in aluminosilicic acid, may be employed, such as clays or shales and the minerals halloysite or indianite as naturally occurring materials, or fly ash resulting from combustion in powdered form of certain coals as an artificially produced material. The aluminosilicic acid is mixed in stoichiometric proportions with magnesia or lime and then heated in the presence of water. The composition may be mixed with comparatively inert fibre fillers, such as asbestos fibre, to strengthen the finished composition. The mixed material is preferably briqueted under substantial pressure in moulds of the desired shape to produce the conformation of the article to be formed and is then subjected to heat under conditions suitable for the maintenance of the necessary water content which participates in the indurating reactions which occur. The substance resulting is, and at times hereinafter is referred to as, hydrated alkaline earth aluminosilicate.

In constructing the arc extinguishing assemblages 27 the metallic plates 28 may be placed in a suitable mould as inserts, which mould may also provide a cavity for the formation of the columns 29. The mixture of aluminosilicic acid and alkaline earth base material, with requisite water, may then be introduced into the mould and there briqueted to form the columns 29. The plates 28 as shown more clearly in Fig. 5 are cut away at 30 to provide for vertical continuity of the column material. Suitable inserts may also be employed to form vertical openings 31 through which attachment screws 32 may be passed. The material, having been thus formed into the desired shape, may then be subjected to heat under conditions avoiding removal of water whereupon the ingredients chemically interact forming a hard tough dense dielectric substance suitable to resist attack by arc products. At the same time substantially all voids between the column material and the plates 28 are eliminated and a strong adhesive bond is formed along the interfaces 33 by reason of the inherent properties of the reacting substances. This adhesive bond is such as to render the assemblage 27 a rigid unitary structure sealed against any substantial

access of arc products at and along the interfaces 33.

The surfaces of the columns 28 indicated at 34 in Fig. 6, are, in use, exposed to attack by arc products, but such attack does not result in the formation of a carbonaceous or other conductive film because of the absence of organic substances. Thus the assemblages 27 remain effective to electrically subdivide the arc and to perform the cooling and de-ionizing function intended throughout long periods of use.

In the type of switch illustrated in the drawings the current passes downwardly through one of the lugs, for example, 25 to a contact 24, thence through a contact 20 thence horizontally across the bridge bar 15 thence upwardly through a contact 20 and a contact 24 and thence upwardly through a lug 26. This U-shaped electrical path is such as to create a magnetic field which, upon separation of the contacts, tends to propel the arcs which are formed outwardly into the spaces between the plates 28 of the assemblages 27, thus causing the arc to be subjected to the extinguishing function intended. To aid in this action the plates 28 are preferably formed of ferro-magnetic material which serves to orient and concentrate the flux so as to accentuate the arc propelling forces. It is contemplated, however, that arc extinguishing assemblages constructed in accordance with this invention may employ non-magnetic plates and may be positioned to receive arc products propelled thereinto by means of magnetic fields arising from other circuit configurations and from sources other than the current flow itself. The arc extinguishing assemblages of this invention may also be used in situations where the arc is propelled thereinto with or without the aid of magnetic effect by convection either naturally or artificially induced or by any other suitable means.

By reason of the unitary nature of the assemblages 27 they may be easily attached as by the attachment bolts 32 and in case of damage may be quickly removed as a unit and replaced by an undamaged assemblage. It is preferred that the arc enclosure 11 itself be also formed of the material employed in the columns 29 of the assemblages 27 but any insulating material suitable for an arc enclosure may be employed to form the housing 11.

We claim:

1. In an electric switch for a plurality of phase conductors, a separate circuit interrupter for each said phase conductor comprising an insulating housing; a pair of spaced, stationary contacts mounted within said housing; terminals connected to said stationary contacts extending to the exterior of said housing; a movable contact bridge bar disposed within said housing including a pair of electrically joined, spaced, movable contacts disposed respectively in facing relation to said stationary contacts, said bridge bar and movable contacts being movable to and from an open position providing a pair of gaps between respective stationary and movable contacts and a closed position with respective stationary and movable contacts in engagement joining the stationary contacts electrically in series; an actuator cooperatively engaging said bridge bar, extending to the exterior of said housing adapted to move said bridge bar to and from open and closed positions; and a pair of arc extinguishing assemblages one each being disposed within said housing adjacent to and spaced from one of said gaps at the ends of said bridge bar in arc receiving relation thereto, said assemblages each comprising a plurality of spaced, substantially parallel, electrically insulated, ferro-magnetic, cooling plates disposed in open pile arrangement with the edges of said plates facing their respective gaps, said plates having aligned openings therein with a columnar mounting and insulating member extending therethrough, said member having integral flanges thereon disposed between and separating said plates.

2. A switch in accordance with claim 1 wherein the ferro-magnetic plates forming the arc extinguishing assemblages are substantially U-shaped and are disposed so as to be spaced from and to embrace three sides of the respective gaps to which the same are adjacent.

3. A switch in accordance with claim 1 in which the mounting means is composed of indurated, hydrated alkaline earth aluminosilicate material engaging and supporting said ferro-magnetic cooling plates.

4. In an arc extinguishing apparatus a plurality of spaced facing insulated metallic plates adapted to subdivide arc products propelled therebetween, each of said plates having an opening therethrough disposed in substantial alignment with like openings in the remaining plates, and an insulating and supporting member for said plates for rigidly maintaining the spaced insulated relation thereof, said member being composed of a molded insulating material formed to provide a continuous column of said insulating material extending through said aligned openings with flanges of said insulating material integral with said column spreading laterally therefrom between adjacent plates in contact with the facing surfaces of said plates.

5. In an arc extinguishing apparatus a plurality of spaced facing insulated metallic plates adapted to subdivide arc products propelled therebetween, each of said plates having an opening therethrough disposed in substantial alignment with like openings in the remaining plates, and an insulating and supporting member for said plates for rigidly maintaining the spaced insulated relation thereof, said member being composed of hydrated alkaline earth aluminosilicate material molded to provide a continuous column of said material extending through said aligned openings with flanges of said material integral with said column spreading laterally therefrom between adjacent plates in contact with the facing surfaces of said plates.

6. In an arc extinguishing apparatus a plurality of spaced facing insulated metallic plates adapted to subdivide arc products propelled therebetween, each of said plates having an opening therethrough disposed in substantial alignment with like openings in the remaining plates, and an insulating and supporting member for said plates for rigidly maintaining the spaced insulated relation of the same, said member comprising a continuous column extending through said aligned openings with flanges integral with said column spreading laterally therefrom between adjacent plates in contact with the facing surfaces of said plates, said member being composed of a compound formed and rendered rigid by chemical interaction of a mixture of aluminosilicic acid, alkaline earth base material and water while said reacting mixture is in contact with said plates whereby an adhesive bond is formed be-

tween said member and said plates during hardening thereof.

7. An apparatus in accordance with claim 6 wherein the continuous column of said insulating and supporting member is provided with an attachment opening extending longitudinally therethrough, said attachment opening being spaced throughout its length from said plates by material of said member.

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