

Dec. 29, 1942.

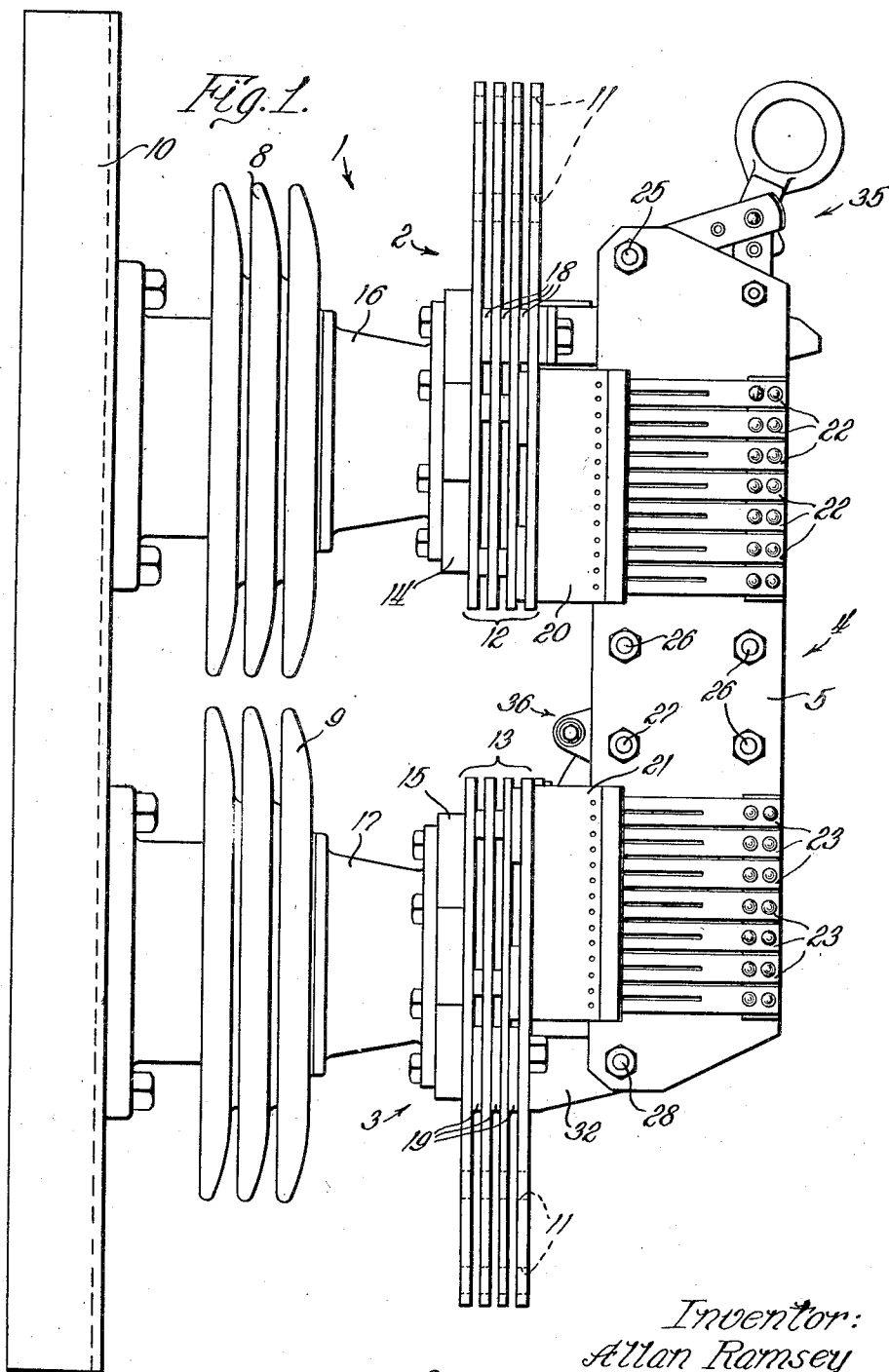
A. RAMSEY

2,306,565

SWITCH

Original Filed Dec. 14, 1936

4 Sheets-Sheet 1



Inventor:
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By *Manufacturer's Representative*
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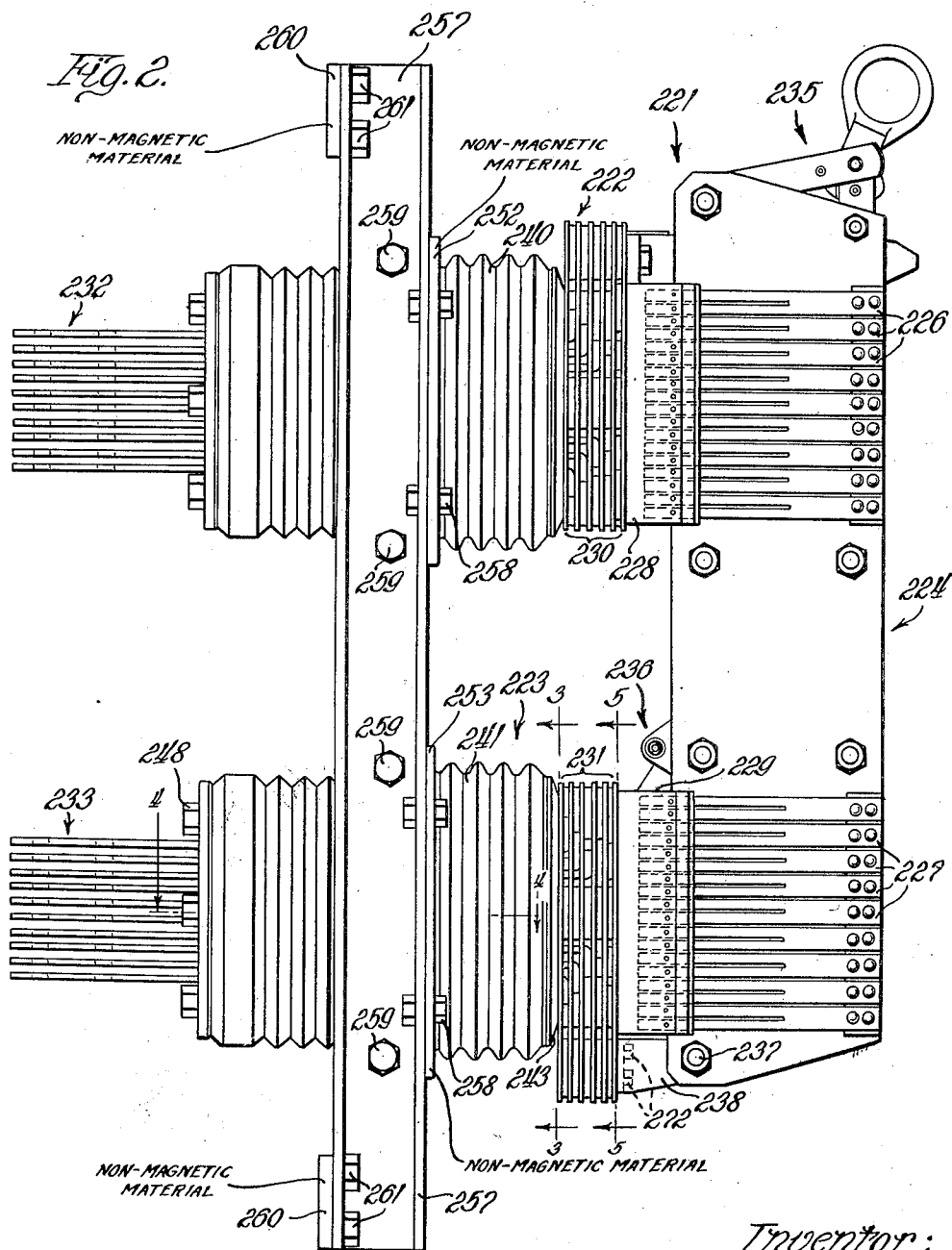
Dec. 29, 1942.

A. RAMSEY

2,306,565

SWITCH

Original Filed Dec. 14, 1936 4 Sheets-Sheet 2



Inventor:
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Dec. 29, 1942.

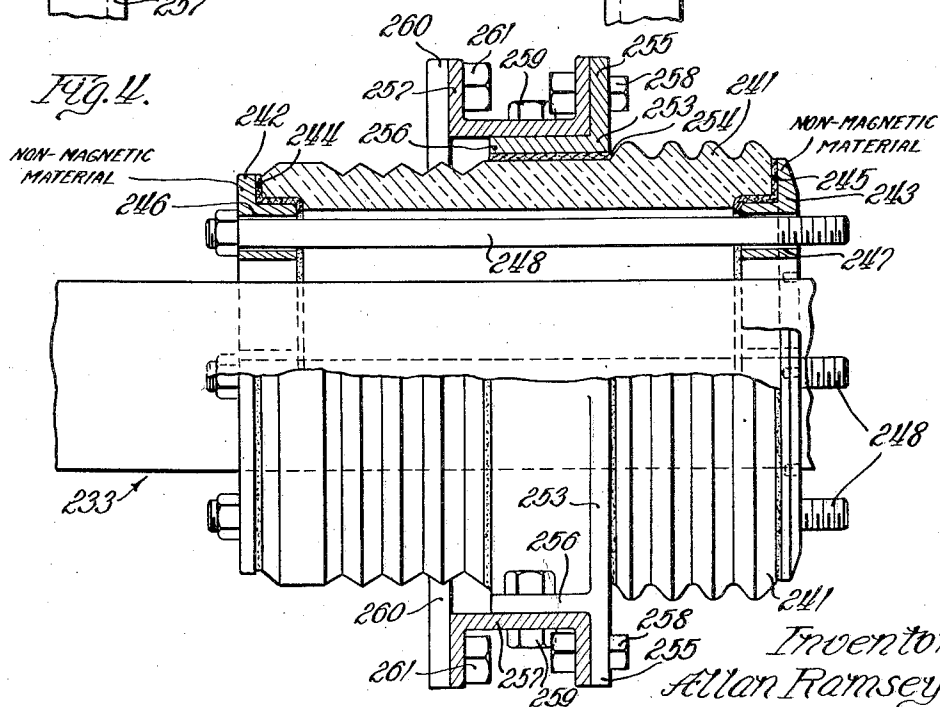
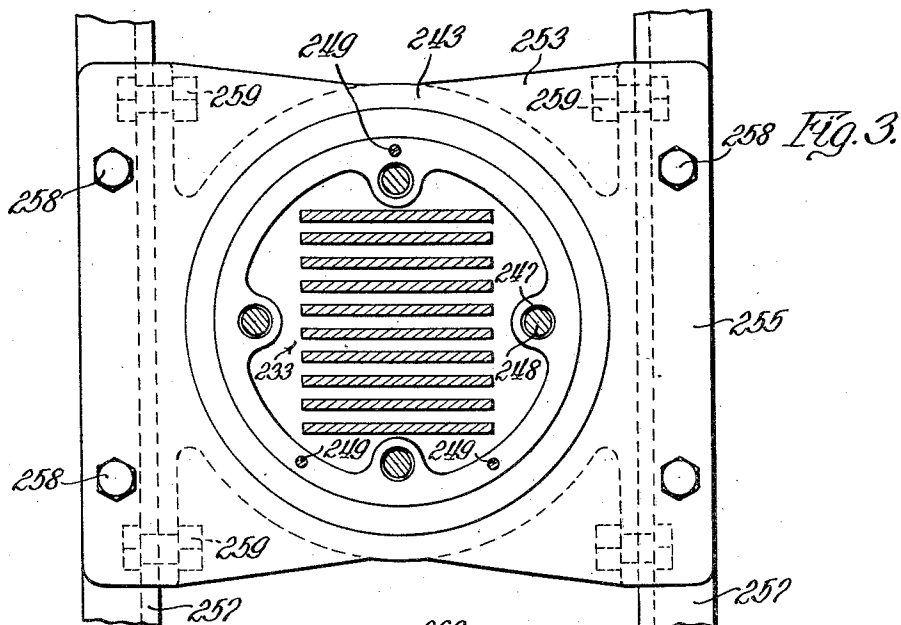
A. RAMSEY

2,306,565

SWITCH

Original Filed Dec. 14, 1936

4 Sheets-Sheet 3



250
261
257
259
255
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UNITED STATES PATENT OFFICE

2,306,565

SWITCH

Allan Ramsey, Evanston, Ill.

Original application December 14, 1936, Serial No. 115,692, now Patent No. 2,226,386, dated December 24, 1940. Divided and this application February 28, 1940, Serial No. 321,176

15 Claims. (Cl. 200—162)

My invention relates, generally, to electrical connecting means and it has particular relation to connections to high amperage conductors and means for mounting the same. This application is a division of my copending application, Serial No. 115,692, filed December 14, 1936, Patent 2,226,386, December 24, 1940.

Considerable difficulty has been experienced in providing satisfactory rear connections for high amperage switches, for example switches having a capacity of the order of 2,000 to 10,000 amperes. It has been customary to use a solid slab of copper for mounting on an insulator or on a switch board that is provided with switch jaws extending from one side and short lengths of copper bars extending from the other side. These copper bars are sweated into slots in the rear face of the copper slab and are further secured thereto by means of transverse pins. In another construction, a copper casting is made having a rearwardly extending portion that is slotted by a milling operation to afford a connection to the power bus. These constructions have been unsatisfactory because of the inability thereof to dissipate the heat that is generated therein because of the current flow therethrough. In many instances the heat dissipating qualities of the terminal members of a high amperage switch form one of the factors that limit its capacity more than would otherwise be necessary.

The mounting of high amperage switches that are connected in alternating current circuits has presented considerable difficulty. It is undesirable to employ support members formed of magnetic material, if they are positioned with reference to the electrical circuit in such manner that eddy currents may be set up therein because of the alternating character of the magnetic field surrounding the switch and the conductors connected thereto. At the same time that this factor must be considered, it is also necessary to so design the support structure for the high amperage switch that it will have sufficient strength to withstand the severe stresses that are set up under short circuit conditions. Thus a suitable balance must be maintained between the use of relatively cheap support members formed of magnetic material having high strength and the use of more expensive non-magnetic materials which may have somewhat less strength. Ordinarily, the cost item will be of more importance than the strength item, since high strength non-magnetic materials are available in the open market. However, they are expensive.

An object of my invention is to ventilate the stationary switch members of the high amperage switch by providing a laminated rather than a solid construction therefor without sacrificing needed mechanical strength.

Another object of my invention is to mount a high amperage alternating current switch on a frame formed of magnetic and non-magnetic materials in such manner that it will be capable of withstanding short circuit stresses and so arranged that substantially no eddy currents will be induced in the frame with economical use of both magnetic and non-magnetic material.

Still another object of my invention is to interconnect two sets of flat bus bar conductors in a new and improved manner.

A further object of my invention is to provide for connecting one set of flat bus bar conductors at right angles to the flat sides of another set of similar conductors.

Still another object of my invention is to provide for front connecting a switch clip base comprising a plurality of flat conductors.

A still further object of my invention is to provide for rear connecting a switch clip base comprising a plurality of flat conductors.

Another object of my invention is to provide for clamping a switch clip having a rear connecting member to a bushing type insulator without using the rear connecting member for mechanical clamping purposes.

Other objects of my invention will, in part, be obvious and in part appear hereinafter.

My invention, accordingly, is disclosed in the embodiments thereof shown in the accompanying drawings, and it comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the constructions hereinafter set forth, and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of my invention, reference may be had to the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a view, in side elevation, of a concrete embodiment of a high amperage disconnecting switch arranged for front connection to an electrical power bus in accordance with this invention;

Figure 2 is a view, in side elevation, of a high amperage disconnecting switch that is arranged for back connection in an alternating current circuit;

Figure 3 is a detail sectional view taken generally along the line 3—3 of Figure 2;

Figure 4 is a detail sectional view taken generally along the line 4—4 of Figure 2;

Figure 5 is a detail sectional view taken generally along the line 5—5 of Figure 2;

Figure 6 is a sectional view taken along the line 6—6 of Figure 5;

Figure 7 is a sectional view taken along the line 7—7 of Figure 6; and

Figure 8 is a view, in end elevation, of the lower stationary switch member of the switch shown in Figure 2, with the switch blade and fulcrum members being omitted.

Instead of using a solid copper slab to form the main parts of the stationary switch members, I construct them of copper bars that are spaced apart in such manner as to permit the free circulation of air therethrough, thereby ventilating them. This laminated construction readily lends itself to the construction of front or rear connected switches, as the case may be.

When a high amperage alternating current switch is mounted on a metallic switch base and arranged for rear connection, it is necessary to so construct the support structure that eddy currents will not be set up therein to such an extent that undue heating takes place. For this purpose I have provided a novel form of switch base that is constructed by using structural members of magnetic material that are readily obtainable on the open market, in combination with certain non-magnetic members, or used in conjunction therewith. A sturdy support structure is thereby provided which is readily capable of withstanding the severe stresses to which the switch may be subjected on the occurrence of a short circuit.

Referring now particularly to Figure 1 of the drawings, it will be noted that the reference character 1 designates, generally, a high amperage disconnecting switch of the type that is known as a front connected switch. The switch 1 comprises stationary switch members, shown generally at 2 and 3, forming the terminal members of a circuit which is bridged by a switch blade, shown generally at 4. Throughout the specification the term "switch blade" will be employed to designate a bridging assembly which may comprise one or more conductors or switch blades. Generally, the blades will be formed of flat copper bars, but, it will be understood, that my invention is not limited to this particular form of conductor. In the embodiment of the invention shown, the switch blade 4 comprises three switch blades one of which is shown at 5, and in the specific embodiment illustrated, they are formed of copper bars three-eighths of an inch thick, five inches wide, and twenty-one inches long.

The stationary switch members 2 and 3 are mounted on suitable insulators 8 and 9 which, in turn, may be mounted, as illustrated, on a suitable channel base 10. It will be understood that the voltage of the circuit in which the switch 1 is connected will determine the type and size of the insulators 8 and 9 that are used. The particular switch illustrated is designed for use on a 7,500 volt alternating current circuit, and it has a continuous carrying capacity of 4,000 amperes.

The bus bars forming the circuit in which the switch 1 is connected are connected to the stationary switch members 2 and 3 and secured thereto by suitable bolts positioned in apertures 11 that are located in the ends of clip bases 12 and 13. As shown, the clip bases 12 and 13 are of

laminated construction, being formed by a plurality of copper bars which not only readily interfit with the bus bars of the power circuit, but also provide a construction which may be readily ventilated. The clip bases 12 and 13 are suitably bolted to adapters 14 and 15 which, in turn, are bolted to caps 16 and 17 on the insulators 8 and 9. The copper bars forming the clip bases 12 and 13 are spaced apart by spacers such as illustrated at 18 and 19. When the clip bases 12 and 13 are assembled, these spacers are positioned between the bars and riveted thereto in locations which correspond to the positions of the bolts that are provided for securing them to the adapters 14 and 15, and also those bolts which are used for mounting the various parts on the outer sides thereof. The arrangement and construction of the clip bases 12 and 13 and the manner in which the parts thereof are soldered together will be illustrated and described in further detail hereinafter. At the present time it is sufficient to indicate that the clip bases are formed of a plurality of copper bars that are spaced apart in such manner as to permit the free circulation of air therebetween for cooling purposes. It will be obvious that the adapters 14 and 15 may be omitted, and that the clip bases 12 and 13 may be bolted directly to the caps 16 and 17. However, in order to facilitate construction and to employ insulators 8 and 9 that were available in the open market, the arrangement described hereinbefore was used.

Mounted on the outermost bar of the clip bases 12 and 13 are switch clips 20 and 21 for receiving contact fingers 22 and 23 therebetween. The switch clips 20 and 21 are generally of U-shape with outflared edges to facilitate the insertion of contact fingers 22 and 23. As illustrated, the switch clips 20 and 21 are mounted on the clip bases 12 and 13 by suitable bolts.

It will be recalled that the switch blade 4 comprises three switch blades. These blades are assembled as a unit and secured in such relation by a bolt 25 at the upper end, by bolts 26 and 27 intermediate the ends and by a bolt 28 at the lower end.

It will be observed that the switch blade 4 is hinged on the bolt 28 as an axle, and that it is positioned in suitable fulcrum members one of which is shown at 32 that are secured by suitable bolts to the clip base 13. It will be understood that the switch blade 4 swings about the bolt 28 as an axis to open and close the circuit between the stationary switch members 2 and 3 by movement of the contact fingers 22 and 23 into and out of engagement with the switch clips 20 and 21, respectively. The fulcrum members 32 do not fit closely into the spaces between the switch blades, but they are somewhat narrower to permit self-alignment between the fingers 22 and 23 on the blades and the clips 20 and 21 on the base.

With a view to operating the contact fingers 22 and 23 into and out of engagement with the switch clips 20 and 21, and to latch them in the closed position, a combined operating and latching mechanism, shown generally at 35, is provided at the upper end of the switch blade 4.

Since the switch blade 4 is composed of individual blades of copper having a relatively massive section and, consequently, considerable weight, it is desirable to provide some means for retarding the movement of the switch blade 4 to the open position under the influence of gravity after the contact fingers 22 have been moved out of engagement with the switch clips 20 and

21. For this purpose brake assemblies, shown generally at 36, are provided between the switch blades for effecting this function.

The details of construction of the operating and latching mechanism 35 and of the brake assemblies 36 are set forth in my copending application, referred to hereinbefore, of which this application is a division.

Because of the particular bus construction and arrangement, it is often desirable to provide for connecting one or both of the stationary terminal members of a high amperage disconnecting switch at the rear rather than at the front. In Figure 2 of the drawings, I have shown a high amperage disconnecting switch that is suitable for back or rear connection which embodies the prestressed small area high pressure contact finger construction described in my copending application together with a novel form of clip base and connections thereto. In addition, the particular manner in which the clip bases are mounted on a support structure is new in so far as I am aware. While both stationary terminal members of the switch shown in Figure 2 are adapted for back connection, it will be understood that either or both may be so arranged while the other terminal member is arranged for front connection, as shown in Figure 1 of the drawings.

Referring now particularly to Figure 2, it will be observed that a high amperage disconnecting switch is there shown generally at 221. The switch 221 comprises a pair of spaced apart aligned stationary switch members 222 and 223 that are arranged to be bridged by a switch blade, shown generally at 224. The particular embodiment of the switch 221 shown is adapted for continuously carrying 6,000 amperes, and it is provided with four blades near each end of which nine pairs of contact fingers 226 and 227 are secured for contact engagement with switch clips 228 and 229 that are mounted respectively on clip bases 230 and 231. The rear connections are provided by a plurality of conductor members 232 and 233 in the form of flat copper straps that are individually connected to the plates or laminations forming the clip bases 230 and 231, in a manner which will be presently set forth. It will be understood that the arrangement of the contact fingers 226 and 227 and the cooperating switch clips 228 and 229 may be as described in my copending application. A combined operating and latching mechanism, shown generally at 235 at the upper end of the switch blade 224, may be provided and constructed similar to the mechanism 35 shown in Figure 1 for prying the switch blade 224 into and out of the switch closed position, and for locking it in the switch closed position. In like manner, a brake, shown generally at 236, may be provided that is similar to the brake assembly shown at 36 in Figure 1 of the drawings. At its lower end, the switch blade 224 is rotatably mounted by means of a transversely extending bolt 237 on fulcrum members 238 that are suitably secured to the clip base 231.

It will be observed that the conductor members 232 and 233 are mounted in spaced apart relation in and extend through tubular insulator bushings 240 and 241. The bushings 240 and 241 are formed preferably of porcelain, thereby requiring that special consideration be given to the manner in which the conductor members 232 and 233 and the clip bases 230 and 231 connected thereto are mounted thereon. In

Figure 4 of the drawings, the preferred construction in connection with the insulator bushing 241 is illustrated. It will be understood that the arrangement and construction of the insulator bushing 240 is identical with that of the bushing 241 and, therefore, a description of the latter will serve for both.

As shown in Figure 4, the insulator bushing 241 is provided with seating rings 242 and 243 at each end that are formed of non-magnetic metal. Since the switch 221 is intended for connection in an alternating current circuit, it is desirable that no complete magnetic circuit be positioned around the circuit formed by the conductor members 233 for the purpose of avoiding stray losses and undue heating. The seating rings 242 and 243 are cemented, as indicated at 244 and 245, to the ends of the porcelain insulator bushing 241, and they are each provided with four registering clearance holes 246 and 247. Stud bolts 248 extend through these registering clearance holes 246 and 247 and into suitable tapped holes in the laminated clip base 231. Suitable nuts are provided at the outer ends of the stud bolts 248 that are drawn up to secure the clip base 231 in position. This method of securing the clip base to the insulator 241 avoids the use of the conductor members 233 as mechanical clamping means.

Since it is highly desirable that the switch clips 228 and 229, carried by the clip bases 230 and 231, be maintained in substantial alignment throughout the life of the switch 221, dowel pins 249 are positioned in suitable drilled holes that extend through the clip base 231, for example (Figures 3 and 8), and into the retaining ring 243. In this manner, any tendency for the clip base 231 to shift relative to the seating ring 243, as permitted by the clearance holes 247, is avoided, and the desired substantial alignment is accurately maintained.

It is essential that a substantial support structure be provided for mounting the insulator bushings 240 and 241 in the desired alignment. Moreover, the mounting must be such that the switch structure will be capable of withstanding the severe stresses to which it may be subjected under short circuit load conditions. For this purpose, each of the insulator bushings 240 and 241 is provided midway the ends thereof with support rings 252 and 253 that are formed of non-magnetic material for the reasons set forth hereinbefore. As indicated in Figures 3 and 4, the support ring 253 is secured to the outer surface of the insulator bushing 241 by a suitable cement, as indicated at 254. It will further be observed that the support ring 253 is provided with outwardly extending flanges 255 and downwardly extending flanges 256 at right angles thereto for interfitting with side frame members 257 in the form of channel-shaped structural members. It will be understood that angles rather than channels may be employed. With a view to providing relatively high strength and, at the same time, an economical construction, the side frame members 257 may be formed of steel. When the side frame members 257 are positioned as shown in the drawings, their magnetic properties are not of importance, since they are not positioned as to be materially affected by the magnetic field generated by the alternating current flowing through the circuit in which the switch 221 is connected. Bolts 258 and 259 are provided for securing the support ring 253 to the side frame members 257, as indicated. If it

is desired to provide additional transverse members between the side frame members 257 in addition to the support rings 252 and 253, end frame members 260 may be provided and secured to the ends of the side frame members 257 by suitable tap bolts 261. The end frame members 260 are formed of non-magnetic material in order to prevent the induction of eddy currents therein and in the side frame members 257, as will be readily understood. Suitable apertures may be provided in the end frame members 260 for mounting the entire switch assembly in a suitable support structure.

It will be obvious that the switch 221 may be mounted for rear connection on a switchboard panel rather than for mounting in the open type of framework as illustrated in Figure 2. In such case the insulators 240 and 241 would be omitted, and in lieu thereof suitable apertures would be provided in the switchboard panel and the necessary holding means would be provided to secure the switch 221 in position, as will be readily understood.

As indicated hereinbefore, it is desirable to provide a ventilated construction for the base that supports the switch clips rather than to provide a solid block from which the heat generated therein is not readily dissipated. For this purpose each clip base is constructed of a plurality of plates or laminations of copper that are spaced apart by suitable spacers positioned at selected positions therebetween in such manner as to permit the circulation of air there-through to effect the desired ventilation. The spacers are located in such positions that tapped holes may be provided for mounting the clip base on the supporting structure and for securing the switch clips thereto. A typical type of ventilated clip base construction is illustrated in Figures 5 through 8, to which reference will now be had. The clip base 231 there shown is similar in construction to the clip bases 12 and 13 shown in Figure 1 of the drawings. In the present embodiment, the clip base is arranged for rear connection rather than for front connection as shown in Figure 1. Otherwise the features of construction are essentially the same.

As indicated in Figure 8, the switch clips 229 are mounted on the outermost plate or bar of the switch clip base 231 by screws 264, two of which are positioned at each end thereof. The screws 264 are positioned in tapped holes that extend through the top two plates forming the clip base 231. Spacers 265, in the form of flat copper straps, are positioned between these two plates to space them apart and to provide sufficient body for the tapped holes. Additional small square spacers 266 are provided between each of the plates forming the clip base 231 in alignment with the stud bolts 258, and suitable tapped holes are provided therein. As shown more clearly in Figure 6, the spacers 265 and 266 are secured in position by means of rivets 267, 268 and 269 of suitable length, as required. Additional spacers 270 are provided in alignment with the fulcrum members 238, and tapped holes 271 are provided therein for bolts 272.

It will be noted that the construction of the switch clip 231, as described thus far, is such as to permit the circulation of air between the plates, with the result that any heat that is generated therein is readily dissipated. If the clip base were arranged for front connection, the plates forming it would be provided with suitable extensions to permit the connection of conduc-

tors thereto as indicated in Figure 1 of the drawings. For such a construction the various spacers and plates forming the switch clip base would first be tinned and then assembled with a suitable flux therebetween. The various lengths of rivets will be inserted as required. The entire assembly is then subjected to sufficient heat to cause the tinned surfaces to be sweated together, thereby forming a substantially unitary construction.

Advantage is taken of the open type of construction of the clip bases for ventilating purposes to provide a novel form of connection thereto for a rear connected disconnecting switch. While this form of connection is illustrated and has particular utility in connection with clip bases, it will be understood that it may be employed for making connections between the various connections in a bus structure. For example, the laminations or plates forming the clip base may be considered as a part of a bus conductor to which a connection is to be made. In either case, a ventilated type of construction results that reduces the number of hot spots that might otherwise be present if the conventional type of connection were made.

As illustrated more clearly in Figures 6 and 7 of the drawings, the innermost plate or lamination of the clip base 231 is provided with a rectangular opening 275 having a width that is slightly greater than the width of the conductor members 233. The outermost conductor members 233 have the ends thereof turned in opposite directions as indicated at 276, and they are secured to the next plate or lamination of the clip base 231 as by rivets 277. Each succeeding plate or lamination is provided with a rectangular aperture having the same width as the aperture 275, but having successively shorter lengths, excepting the outermost lamination, and the ends of the next succeeding pair of conductors 233 are turned outwardly and secured in position by rivets. It will be understood that the engaging surfaces of the plates or laminations forming the clip base 231 and the outwardly turned ends of the conductor members 233 will be tinned, and a suitable flux will be inserted therebetween during the assembly process. The entire clip base 231 with the rearwardly extending conductor members 233 is then heated to the necessary temperature to sweat the various engaging surfaces together, as will be readily understood. It will be apparent that this construction provides a very intimate contact engagement between the clip base and the conductor members associated therewith, while at the same time it retains the advantages of the spaced apart relationship for ventilating purposes. As a result, the actual amount of material that is used in constructing the clip bases for a given current carrying capacity may be considerably reduced over that required when the conventional type of construction is used.

Instead of employing a laminated construction for the conductor members 232 and 233, a solid threaded cylindrical conductor may be employed. Such a construction would not provide the relatively large radiating surface that is provided by the laminated construction. However, it may be desirable to use it in some instances. In such case, correspondingly threaded apertures would be provided in the clip bases 230 and 231, and the cylindrical conductor members, on being screwed into them, would be sweat-soldered in position.

Since certain further changes may be made in the above constructions and different embodiments of the invention may be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In a high amperage switch, in combination, a plurality of spaced apart conducting plates, a plurality of spacers interposed between said plates at selected positions in such manner as to permit circulation of air therebetween, a support member extending from one side of said plates, holding means extending from said support member into said plates and spacers from one side, switch clip means extending at right angles from the other side of said plates, and holding means extending from said clip means into said plates and spacers.

2. In a high amperage switch, in combination, a plurality of flat conductors disposed in spaced apart relation and having aligned apertures, a plurality of additional flat conductors disposed in spaced apart relation in said apertures and in contact engagement with said first named conductors and extending at right angles from one side thereof, and switch clip means secured to and extending at right angles from the other side of the first mentioned flat conductors for receiving a switch blade.

3. In a high amperage switch, in combination, a plurality of flat conductors disposed in spaced apart relation and having aligned apertures of uniform width, the aperture in each succeeding conductor being shorter than the aperture in the preceding conductor, a plurality of additional flat conductors of uniform width disposed in spaced apart relation in said apertures and in contact engagement with said first named conductors and extending at right angles from one side thereof, and switch clip means secured to and extending at right angles from the other side of the first mentioned flat conductors for receiving a switch blade.

4. In a high amperage switch, in combination, a plurality of flat conductors disposed in spaced apart relation and having rectangular aligned apertures therein of uniform width, the aperture in each succeeding conductor being shorter than the aperture in the preceding conductor, a plurality of additional flat conductors having a width substantially equal to that of said apertures and disposed therein in spaced apart relation in contact engagement with said first named conductors and extending at right angles from one side thereof, and switch clip means secured to and extending at right angles from the other side of the first mentioned flat conductors for receiving a switch blade.

5. In a high amperage switch, in combination, a plurality of flat conductors disposed in spaced apart relation and having rectangular aligned apertures therein of uniform width, the aperture in each succeeding conductor being shorter than the aperture in the preceding conductor, a plurality of pairs of additional flat conductors having a width substantially equal to that of said apertures and disposed therein in spaced apart relation, each pair being individual to one of said first named conductors and extending at right angles from one side thereof and having the ends turned oppositely for contact engage-

ment therewith, means holding said conductors in contact engagement, and switch clip means secured to and extending at right angles from the other side of the first mentioned flat conductors for receiving a switch blade.

6. In a high amperage switch, in combination, a plurality of conducting plates disposed in spaced apart relation and having aligned apertures, a plurality of conductor members disposed in spaced relation in said apertures, connected to said plates and extending at right angles from one side thereof, and generally U-shaped switch clip means secured to and extending at right angles from the other side of said plates for receiving a switch blade.

7. In a high amperage switch, in combination, a plurality of conducting plates disposed in spaced apart relation and having aligned apertures of uniform width, the aperture in each succeeding plate being shorter than the aperture in the preceding plate, a plurality of conductor members disposed in spaced relation in said apertures for contact engagement with said plates and extending at right angles from one side thereof, and generally U-shaped switch clip means secured to and extending at right angles from the other side of said plates for receiving a switch blade.

8. In a high amperage switch, in combination, a hollow insulator bushing, a plurality of conducting plates disposed at one end of said bushing in spaced apart relation and having aligned apertures of uniform width, the aperture in each succeeding plate being shorter than the aperture in the preceding plate, a plurality of pairs of conductor members having a width substantially equal to that of said apertures and disposed therein in spaced apart relation and extending through said bushing, each pair being individual to one of said plates and having the ends turned oppositely for contact engagement therewith, and switch clip means secured to and extending at right angles from said conducting plates for receiving a switch blade.

9. A support for a switch clip base having conductor means extending rearwardly therefrom comprising, in combination, a hollow insulator bushing through which said conductor means extends, a seating ring secured to each end of said bushing, and retaining means extending through said bushing and seating rings and into said clip base.

10. A support for a switch clip base having conductor means extending rearwardly therefrom comprising, in combination, a hollow insulator bushing through which said conductor means extends, a seating ring of non-magnetic material cemented to each end of said bushing and having registering clearance holes, and stud bolts extending through said bushing and said registering clearance holes and into said clip base.

11. A support for a switch clip base having conductor means extending rearwardly therefrom comprising, in combination, a hollow insulator bushing through which said conductor means extends, a seating ring of non-magnetic material cemented to each end of said bushing

and having registering clearance holes, stud bolts extending through said bushing and said registering clearance holes and into said clip base, and dowel means extending between said clip base and the adjacent seating ring for maintaining a predetermined fixed relation therebetween.

12. A support structure for a pair of spaced apart aligned clip bases having conductor means extending rearwardly therefrom and adapted to form the terminals of an alternating current circuit comprising, in combination, a hollow insulator bushing surrounding each of said conductor means and to which the clip base individual thereto is fastened, a non-magnetic support ring secured to each of said bushings intermediate the ends thereof, and means for mounting said support rings in fixed relation.

13. A support structure for a pair of spaced apart aligned clip bases having conductor means extending rearwardly therefrom and adapted to form the terminals of an alternating current circuit comprising, in combination, a hollow insulator bushing surrounding each of said conductor means and to which the clip base individual thereto is fastened, a non-magnetic support ring secured to each of said bushings intermediate the

ends thereof, a pair of structural side frame members formed of magnetic material and fastened to said support rings along opposite sides thereof, and end frame members formed of non-magnetic material secured to and joining the ends of said side frame members.

14. In a rear connected switch construction, in combination, a switch clip base, conductor means extending rearwardly from said clip base, a hollow insulator bushing through which said conductor means extends, and means other than said conductor means extending through said insulator bushing for clamping said switch clip base to said insulator bushing without mechanically stressing said conductor means therein.

15. In a rear connected switch construction, in combination, a hollow insulator bushing, a switch clip base at one end of said insulator bushing, conductor means extending from said switch clip base through said insulator bushing, and tension means interconnecting the other end of said insulator bushing and said switch clip base and placing said insulator bushing in compression thereby clamping said switch clip base in position without mechanically stressing said conductor means within said insulator bushing.

ALLAN RAMSEY.