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[56]

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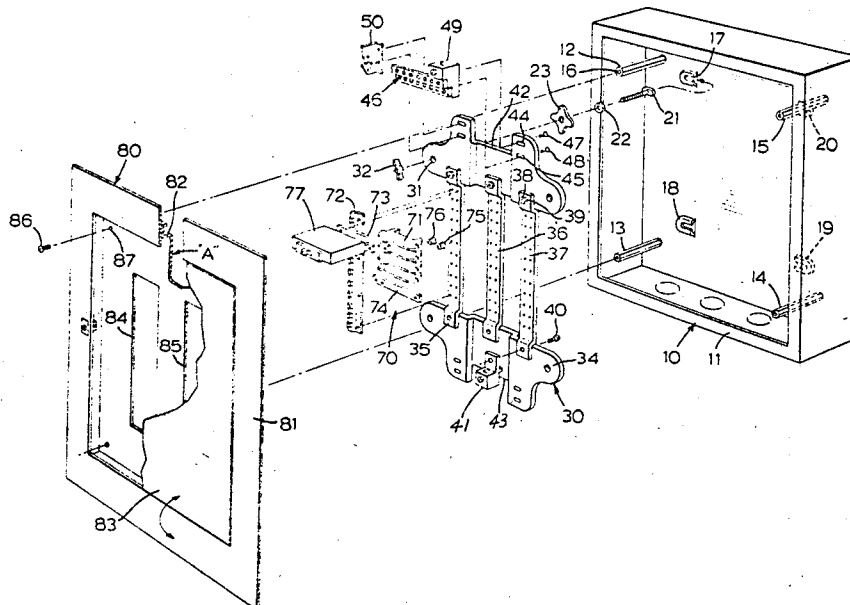
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[54] **PANELBOARD WITH INSULATIVE CIRCUIT  
 BREAKER SUPPORTS MOUNTED ON THE BUS  
 BARS**  
 12 Claims, 9 Drawing Figs.

[52] U.S. Cl. .... 317/119,  
 16/164, 49/398, 317/120  
 [51] Int. Cl. .... H02b 1/04  
 [50] Field of Search ..... 49/398,  
 400; 16/164; 317/117—120

**ABSTRACT:** A panelboard comprises an elongated bus bar having insulating breaker support means supported on the bus bar and a plurality of circuit breakers supported in a column with each breaker supported at one end thereof on the insulating breaker support means. The panelboard comprises a stationary part and a movable cover with an improved concealed hinge movably supporting the cover on the stationary part.



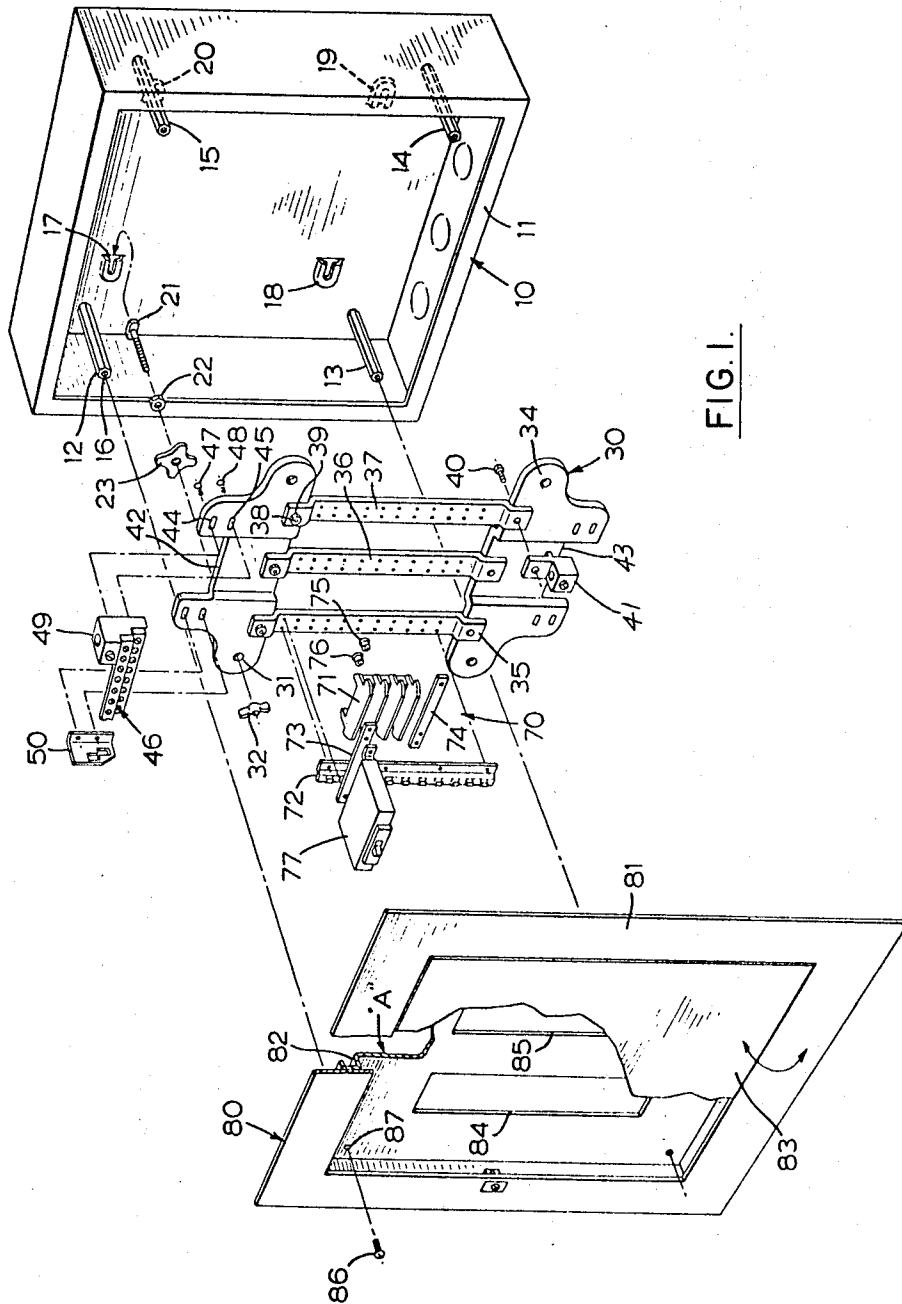
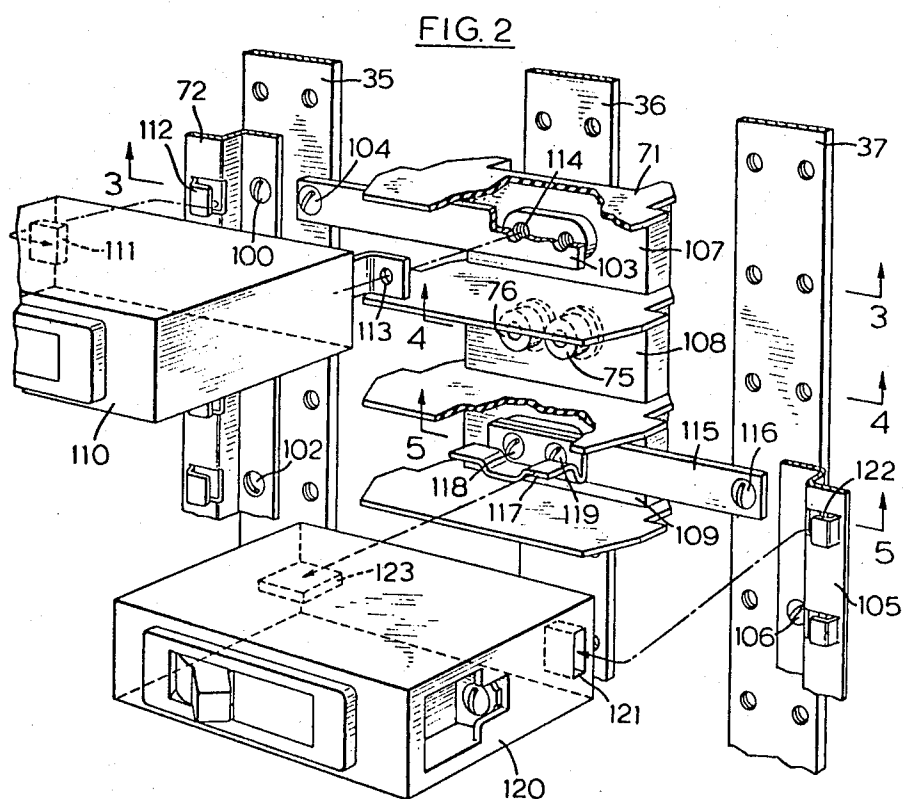
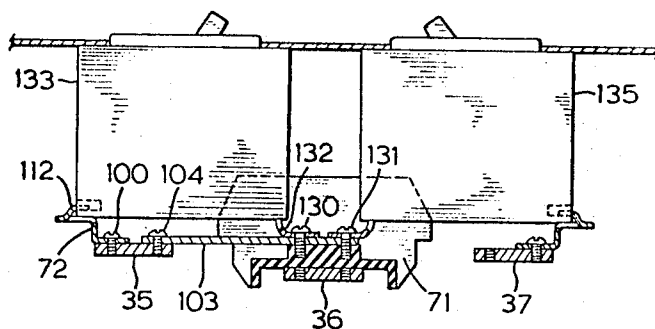


FIG. 1.



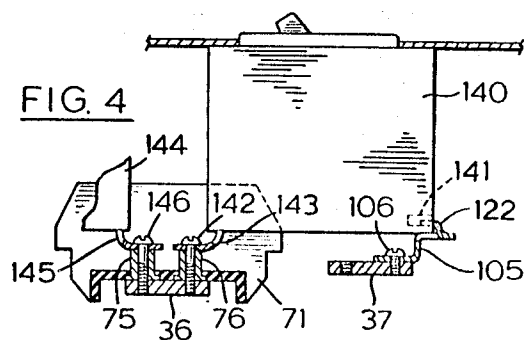
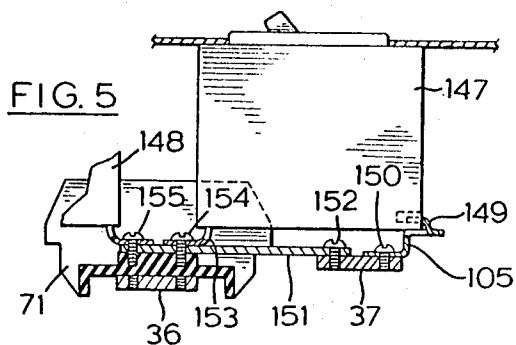
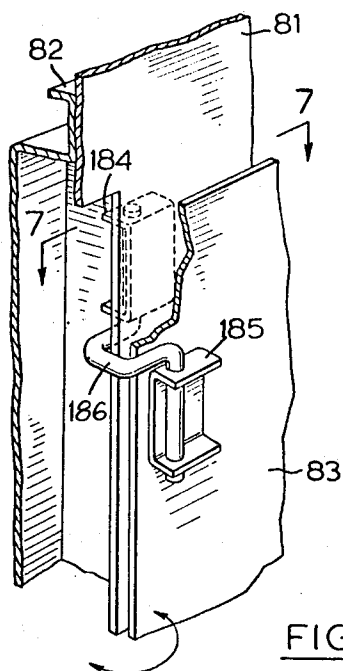
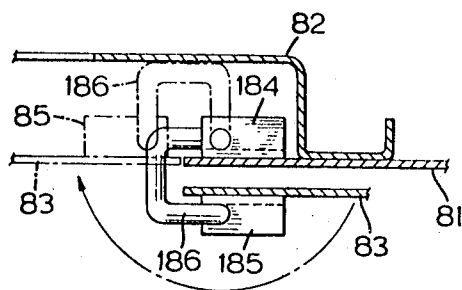


FIG. 9

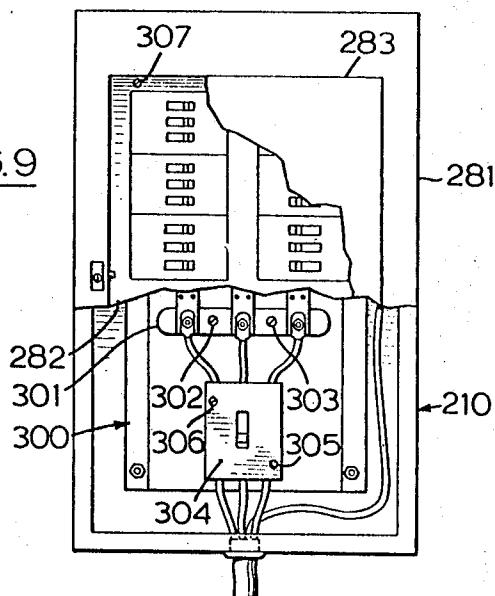
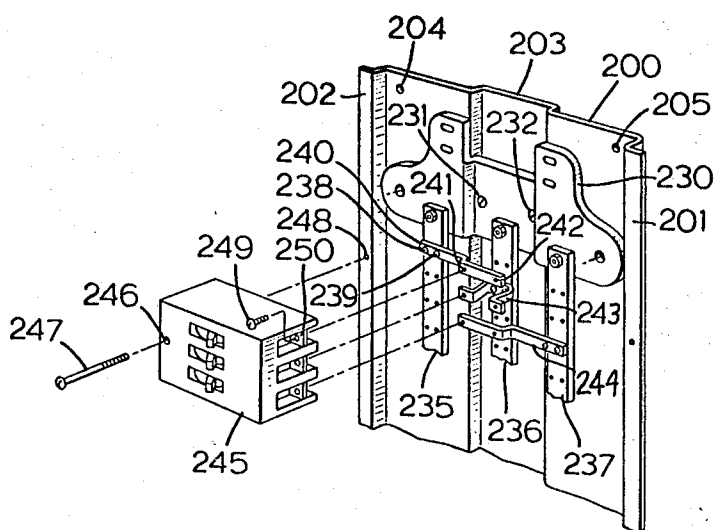


FIG. 8

## PANELBOARD WITH INSULATIVE CIRCUIT BREAKER SUPPORTS MOUNTED ON THE BUS BARS

This application relates to an improved lighting and distribution panelboard which incorporates features which lead to greater flexibility in ultimate use because of the ability to be adapted to receive various circuit breaker assemblies without requiring substantial alteration. The bus bar structure which is of a simple and rugged construction is readily mountable in a protective enclosure and by making various minor adaptations to the bus bar structure, it is possible to provide an assembly which will receive circuit breakers of various ratings. It is also necessary, at the same time, to provide bus bar assembly which is capable of dissipating heat in accordance with certain standards as set out by regulatory bodies. The novel construction of this panelboard assembly is such as to allow for adequate convection and conduction of heat from the assembly, which heat is generated in all current carrying members of the assembly so that the temperature of all of the current carrying members of the panelboard remain well within the statutory limits.

The panelboard assembly comprises insulating bus bar support means and three elongated bus bars supported on the bus bar support means in a generally parallel relationship. An elongated insulating breaker support member is supported on each of the outer bus bars. A plurality of circuit breakers are supported on the panelboard in two columns. In each column each circuit breaker is supported at one end thereof on the associated insulating breaker support means. Each of the insulating breaker support means comprises a shelf portion that the associated breakers rest on and a separate hook part for each of the breakers with each hook part interengaging with a different one of the breakers.

The panelboard assembly has provision for an entirely new trim member which is attached in a new and different manner to the main body of the panelboard assembly. The trim panel member also functions as the main support for the door which ordinarily provides access to the circuit breaker handle mechanisms in the panelboard, and provision has been made to swing the door 180° from its closed position by use of a concealed hinge.

In the design of distribution panelboards, several important considerations must be kept in view during the design of such structures. Firstly, of course, the panelboard must be both structurally and electrically "safe." This means that the material comprising the outer shell of a panelboard must conform to specific regulations and be of a certain grade and gauge of a material in keeping with the regulations, and be of such particular configuration as to provide sufficient strength to resist collapse by impact or prevent intrusion by foreign objects, accidental or otherwise. At the same time, adequate clearances must be maintained between the electrical current carrying members which are of different electrical potentials and simultaneously provision must be made for the dissipation of heat for any current carrying members. It is quite easily seen that all the above restrictions cause the design of the panelboard to be quite standard, and in the past most panelboard designs have been quite similar.

More and more pressure is being brought upon the panelboard designer to provide a panelboard assembly which will easily adapt to receive circuit breakers of various ratings and architects are specifying panelboard assemblies which will present smooth uninterrupted exposed faces for locations where the panelboard assembly must be acceptable aesthetically.

This panelboard is able to accomplish the above objectives by providing a bus bar structure which is quickly and easily mounted in the main body of the panelboard assembly by means of a pair of phenolic end pieces to which is attached the bus bar structure. The bus bar structure is attached to the main body of the panelboard assembly by means of four mounting bolts. A trim cover which is provided to cover the exposed circuit breaker assemblies is fastened to the panel-

board body by means of four additional mounting bolts. A door which is actually a part of the trim cover member is held to the trim member by a concealed hinge which is of a special design to allow the door to swing 180° in the closed position. The exposed portion of the panelboard assembly is made so as to form a smooth continuous uninterrupted face with the only discontinuity being the handle which is used to operate the concealed latch in the door assembly. A further elucidation of the invention will be found with the aid of the accompanying drawings, in which:

FIG. 1 is an exploded view of the panelboard assembly, showing the main components necessary for an understanding of the invention.

FIG. 2 is an enlarged exploded view having partial sections in some of the components of the main bus bar structure of an assembly which utilizes circuit breakers of a relatively low rating.

FIG. 3 is a view of the interior of the panelboard showing the connection of "bolt on" circuit breakers which are being energized from one of the two outside bus bars.

FIG. 4 is a view of the interior of the panelboard showing the connection of a "bolt on" breaker which is being energized from the center bus bar.

FIG. 5 is a view of the interior of the panelboard which shows a "bolt on" circuit breaker being energized from the opposite exterior bus bar to that being shown in FIG. 3.

FIG. 6 is a partial sectional projection showing the hinge assembly which permits the door to swing 180° from the closed position.

FIG. 7 is an enlarged plan view of the hinge assembly showing the door in the both open and closed position.

FIG. 8 shows the interior elements of the panelboard assembly which is necessary for the adaption of the panelboard assembly in order to receive circuit breakers of a much larger rating than those which have been shown previously.

FIG. 9 is a view of the panelboard assembly when it is desired to protect the entire bus bar structure with a single circuit breaker, which is included in the panelboard assembly.

Referring now to FIG. 1, a rectangular boxlike structure, 10 is shown which is the main body of the panelboard assembly. Member 10 is composed of sheet steel of a particular gauge, and has a turned over flange portion 11 on the forward face thereof. The front face of member 10 is otherwise completely open in order to receive a bus bar structure.

Four mounting posts 12, 13, 14 and 15 are attached to the rear of the panel member 10 by any convenient means. It is envisioned that the attachment of the four mounting posts will be by bolts or welding, or any other suitable means. Each of the posts 12, 13, 14 and 15 is provided with a tapped hole in the forward facing end of the post.

There are also four stamped out portions in the rear face of the panelboard body 10, which are shown as 17, 18, 19 and 20. The stamped out portions 17, 18, 19 and 20 are provided for the attachment of the bolts which are used to subsequently fasten the bus bar assembly to the main body 10. Only one of the bolts is shown, but it is obvious that it is necessary to have four such bolts as shown as 21 in order to fasten the assembly to the main body 10. Bolt 21 is provided with a flat elongated head so that it may be accepted in the stamped out area 17 of the body 10, and will be restrained from twisting when installed in stamped out portion 17. Bolt 21 is secured in stamped out area 17 by nut member 22 which is tightened securely against the forward face of the stamped out area 17. Also fitted on bolt 21 is an adjustable nut member 23. Nut member 23 is provided a specially shaped exterior contour in order to be easily adjusted by the fingers of the person installing the panelboard. Nut 23 acts as a spacer on bolt 21 to provide a stop for the bus bar assembly in order to provide the necessary clearance between the bus bar assembly and the rear face of the body 10.

The bus bar assembly 30 is shown having two phenolic end pieces 33 and 34, which are fastened together by three bus bars, 35, 36 and 37. The bus bars are bolted to the phenolic

end pieces by bolts and nuts such as are shown by 38 and 39, which are shown attaching bus bar 37 to phenolic end piece 33. It will be seen that each bus bar is manufactured with a series of two tapped holes passing through each bar at spaced vertical intervals. In the assembly of this structure, it is necessary that each set of tapped holes in the three bus bars be in the same horizontal plane. The bus bars may be composed of either aluminum or copper, whichever is most convenient. It is also seen that bus bar 36 is in a different vertical plane than the bus bars 37 and 35. The reason for this will appear obvious later on in the disclosure. The bus bar assembly 30 is attached to the main body member 10 by the passage of four bolts such as that shown as 21 through holes shown as 31 for bolt 21. The phenolic end piece 33 is adjusted against stop nut 23 until the desired clearance is obtained between the bus bars 35, 36, 37 and the rear face of body member 10. The two phenolic end pieces 33 and 34 are then secured tightly against the adjustable stop nuts similar to that shown as 23 by means of four wing nuts, one of which is shown as 32.

It will be noted that bus bar 37 is attached to end piece 30 by means of a bolt 40 which passes through cable clamp 41 so as to secure the bus bar 37 to the phenolic end piece 30, while simultaneously attaching clamp 41 to bus bar 37 to ensure good contact between the cable clamp and the bus bar 37. The shaping of the phenolic end pieces is very important in that portions shown as 42 and 43 are cut out central portions in the dropped center section of each phenolic end piece. This shaping allows for dissipation of heat by changing the position of the center bus bar 36 and allows for convection to increase the dissipation of heat in the bus bar assembly. The phenolic end pieces are also provided with additional holes, only two of which will be described, these being 44 and 45, which are used for the attachment of the neutral bus assembly 46 by means of bolts 47 and 48, which are passed through holes 44 and 45 and are tapped into the neutral bus assembly block 49. Block 49 also serves as a cable clamp for the neutral cable connection to the neutral bus assembly.

Similarly, end piece 50 is bolted to the left-hand side of end piece 33. This secures the neutral bus assembly 46 in a position at the top of the bus bar structure 30. It is noted that end piece 50 is a sheet metal member which is made so that the neutral bus assembly 46 will easily pass through the slot provided in end piece 50 for rapid attachment thereto.

The general construction of the circuit breaker assemblies and the method of attachment to the bus bar structure will now be described. The assembly necessary for the attachment of the circuit breaker assemblies to the bus bar structure is generally labeled 70. This includes a segmented insulator 71 which is composed of bakelite, heat resistant plastic or some other suitable insulating material which is shaped in such a manner that the rear portion is channelled out to provide a loose sliding fit over the bus bar 36. The insulator is segmented on the front, having horizontal channels (as opposed to the vertical channel on the rear portion) so as to separate the forward facing portion of the insulator 71 into various segmented areas. An insulated circuit breaker receiving member 72 is shown having holes provided which are aligned with the holes provided in the bus bar 35, this being to facilitate the attachment of bus bar receiving member 72 to the bus bar 35 by screws. A bus adapter 73 is provided to be electrically connected to bus bar 35 and carry current to one segment of insulator 71, preferably the top as shown in FIG. 1. The second bus adapter member 74 is provided to be attached to bus bar 37 and to conduct electrical currents into one of the forward segments of insulator 71, preferably the lower segment as shown in FIG. 1. Electrical spacers 75 and 76 are made of electrically conductive material and are suitably received in the rear portion of insulator 71, in a recess behind the front center segment shown in insulator 71.

The circuit breaker shown as 77 may then be connected to any one of the segments merely by fastening one end of circuit breaker to the receiving member 72 and by bolting the opposite end to the appropriate segment of insulator 71. The actual installation will be described in detail later.

The trim panel 80 actually is composed of two pieces, the stationary portion which is fastened to main body member 10 which is composed of a forward facing sheet metal portion 81 to which is spot welded or joined by any other suitable means a second portion 82, which is formed by stamping out, or some other suitable metal forming operation to provide the contour as shown in the broken away section at the top of the panel assembly 80 labeled "A." A door, 83, which is shown in partial cutaway view is also attached to the stationary trim portion by a pair of special hinges which will be described later. Member 82 has two punched out portions shown as 84 and 85, which are necessary for access to the operating handles of the circuit breakers when the trim member 80 has been installed by attachment to body member 10.

The attachment of the trim member 80 to the body member 10 is by means of four bolts similar to that shown as 86, passing through four holes similar to that shown as 87 in member 82 and subsequently are threaded into the posts which are shown as 12, 13, 14 and 15. The four bolts similar to 86 provide a quick, speedy and rigid attachment for the trim member 80 to the body member 10, and yet provide no visible indications from the exterior of the method of attachment of the trim member 80 to the body member 10, when the trim member is finally attached and the door is closed.

Reference will now be made to FIG. 2, which shows the attachment of circuit breakers of two dissimilar types to the bus bar structure. The attachment of a "bolt on" circuit breaker to the bus bar assembly will be described first. The bus bars 35, 36, 37 are shown in partial section in this view and are in the same spaced relationship as shown in FIG. 1, that is, bus bar 36 is physically located a small distance behind the plane passing through bus bars 35 and 37. As stated previously, all the bus bars are provided with a series of carefully spaced, tapped holes passing completely through the bus bar. It is noted that each bus bar is provided with two holes located in the same horizontal plane and spaced equidistantly from the center of each bus bar.

A circuit breaker attachment member 72 is shown bolted to bus bar 35 by means of bolts 100 and 102. Member 72 is an electrically insulating member which may be composed of heat resistant plastic, insulated sheet steel or any other suitable material which will conform with safety regulations. Member 72 is provided with a stamped out hook portion 112 which is necessary to attach the circuit breaker into the bus bar assembly. It is noted that not all the tapped holes in bus bar 35 on the left-hand side are required for the attachment of member 72. However, for manufacturing ease, it is generally easier to provide a pair of holes at regularly spaced intervals regardless of whether or not the holes will be used in the ultimate assembly of the structure.

Also attached to bus bar 35 adjacent bolt 100 is a bus adapter 103 which is electrically connected to bus bar 35 by bolt 104. Member 103 may be aluminum or copper or any other suitable electrical conductor, and member 103 is necessary to carry current from bus bar 35 to the topmost segment 107 of insulator 71 shown abutting bus bar 36.

Connected to bus bar 37 is a circuit breaker receiving member 105 which is identical with that shown as 72. Member 105 is shown connected to bus bar 37 by means of bolt 106, and has a hooked out portion 122 necessary for receiving circuit breaker 120. Insulator 71 which has a channelled out section at the rear portion thereof is made to fit neatly over bus bar 36 and provision is made to attach insulator 71 in place to bus bar 36 while providing three different electrical potentials to the three forward separated segments of insulator 71.

Segment 107 of insulator 71 is arranged to be energized from bus bar 35 by means of bus adapter 103. Because bus bar 36 is set back in a vertical plane behind bus bars 35 and 37 by an amount equal to the thickness of insulator 71 in the segment 107, the bus adapter will fit squarely upon the face provided in segment 107. Segment 108 is provided with two apertures so that conductive spacers 75 and 76 may pass entirely through insulator 71 and be exposed at the forward face of segment 108. Conductive spacers 75 and 76 have a pair of

shoulders which will be abutted against bus bar 36 and which are larger than the aperture provided in segment 108 for the passage of the forward portions of spacers 75 and 76.

In order to connect a "bolt on" circuit breaker into the assembly provided, the circuit breaker 110 which is provided with a standard recess 111 is hooked over hook 112 in bus bar receiving member 72, and a suitable bolt is passed through hole 113 of the energizing terminal of circuit breaker 110, and through a suitable clearance hole in bus adapter 103; into tapped hole 114 in insulator segment 107. The bolt used to attach circuit breaker 110 to insulator 71 must be short enough to fit in hole 114 which, of necessity, must be a blind hole so as not to contact bus bar 36. It is thus seen that circuit breaker 110 is now being energized from bus bar 35 and is completely insulated from bus bar 36. If it were desired to energize circuit breaker 110 from bus bar 36, the circuit breaker would be hooked to the hook in circuit breaker receiving member 72 directly below that shown as 112, and a bolt would be passed through hole 113, through the hole provided in spacer 76, and threaded into the tapped hole provided on the left-hand side of bus bar 36, located immediately behind conductive spacer 76.

This method of fastening has two advantages. Because of the forward face of spacer 76 passing completely through the insulator 71, a suitable conductive area is established between spacer 76 and circuit breaker 110, which keeps the heat generated at the junction of circuit breaker 110, and spacer 76 to a minimum. Also when the bolt is passed through the clearance hole provided in spacer 76, spacer 76 is then permanently located on and secured firmly to bus bar 36. This serves as a means of indexing insulator 71 with respect to the tapped holes in bus bar 36. The aperture made in segment 108 for the passage of conductive spacers 75 and 76 may be quite loose in order to facilitate assembly of the entire structure, however, the clearance is not critical.

Segment 109 is arranged to be energized by electrical energy from bus bar 37. A bus adapter member 115 which is similar in all respects to that shown as 103 is bolted by means of bolt 116 to member 37 in the tapped hole provided. Member 115 is arranged to have two holes in the end opposite the end attached to bus bar 37 so that a pair of bolts 118 and 119 may be used to secure the member 117, which is preferably called a "stab connector" and bus adapter 115 in good conducting relationship. Bolts 118 and 119 pass through clearance holes in "stab connector" 117 and through clearance holes in bus adapter 115 and into two tapped blind holes in insulator 71, similar to those shown in segment 107, one of which is labeled 114. The bus adapter 115 and "stab connector" 117 and insulator 71 are rigidly coupled together to form a complete unit. For the connection of a "stab on" circuit breaker, shown here as 120, it is necessary to pass recess 121 over hook 122 provided in member 105. The circuit breaker 120 is then pivoted about hook 122 in order to force "stab connector" 117 into spring loaded recess 123. This type of circuit breaker is quite standard, and the construction provides adequate assurance that suitable contact will be made with "stab connector" 117 by the electrical conductors which are spring loaded to recess 123.

FIG. 3 is a partial sectional view showing the general connections necessary for the energization of a pair of circuit breakers from one of the outside bus bars. The circuit breakers 133 and 135 are shown energized from bus bar 35, which is shown having bus adapter 103 connected by bolt 104 into the bus bar 35. The cross-sectional view of one of the segments of insulator 71 such as 107, is provided to give the reader a better understanding of the connection to "bolt on" circuit breakers with the associated bus adapter and insulator 71. It is noted that the circuit breakers 133 and 135 are rigidly connected to insulator 71 by means of the blind tapped holes provided in insulator 71 and simultaneously good electrical connection is assured between the connector portions of the circuit breakers such as is shown as 132 for circuit breaker 113 and the bus adapter 103. It is noted that bolts 130 and 131

are of such a length as to fall far short of passing through the insulator 71.

FIG. 4 provides a partial sectional view of the attachment of a circuit breaker of the "bolt on" type when it is desired to energize the circuit breaker from the center bus bar. The attachment to circuit breaker receiving member 105 to bus bar 37 is quite standard and will not be described further. It is the connection between the energizing terminal 143 of circuit breaker 140 to the bus bar 36 which is of interest. Conductive spacer 76 is arranged so that the shoulder butts against the bus bar 36. Conductor 143 is arranged to have a clearance hole through which is passed bolt 142. Bolt 142 also passes through a clearance hole in conductive spacer 76. Bolt 142 is threaded into the tapped hole in bus bar 36 and is tightened a sufficient amount to ensure good electrical contact between the bus bar 36, the conductive spacer 76 and the energizing terminal 143 of circuit breaker 140. As stated previously, it is through the arrangement of positioning the conductive spacers 75 and 76 in insulator 71 which indexes insulator 71 with respect to the tapped holes in a bus bar 36.

Referring now to FIG. 5, circuit breaker 147 is shown being energized from bus bar 37. In this instance, the bus adapter 151 is attached to bus bar 37 by bolt 152. The bus adapter 151 extends into a segment of insulator 71 such as 109 to provide the proper potential to that particular segment of insulator 71. Bolt 154 passes through energizing terminal 153 of the circuit breaker 147, and through bus adapter 151 into the blind tapped hole provided in insulator 71. Similarly, the adjacent circuit breaker 148 is attached to bus adapter 151 by screw 155.

It is thus seen that a series of breakers may be located in two columns adjacent one another in this construction, and if the bus bar assembly is energized by three phase alternating current as is quite common, the breakers are energized in pairs in an orderly sequence from each of three phases.

Insulator 71 may have as many segments as possible, or it may be a modular-type construction so that the basic module is composed of three segments and any number of basic modules may be used in the construction. The same reasoning applies to the circuit breaker attaching devices shown as 72 and 105.

Referring now to FIG. 6, wherein the hinge assembly is shown, it will be noted that the hinge assembly provided will permit the door to swing 180° from the closed position, yet when in the closed position, the door covers the hinge assembly completely, thus giving no indication of a hinge while viewing the exposed face of the completed panel assembly. Stationary trim member 81 is shown in partial section, as is the formed metal section 82 which is joined to trim portion 81. A U-shaped channel portion 184 is attached to the rear side of trim portion 81 by welding or any other suitable method so that the bight of the U-shaped channel 184 rests against the interior of the trim member 81. Similarly, an identical U-shaped channel member 185 is welded or joined by any other suitable means to the inside of the door 83 in such a manner that the bight of the U-shaped channel section 185 is attached rigidly to the interior of the door, as shown in FIG. 6. A hinge pin 186 is passed through two holes provided in the U-shaped channel 184, and also through two similar holes in U-shaped channel 185 to provide the required pivot for the door. It will be observed from FIG. 7, that the central portion of the hinge pin is formed in such a manner as to provide the necessary clearance to eliminate any interference between the stationary trim member 81 and the door 83. It will also be noted that when the door is closed, the hinge pin member 186 and the two channels 184 and 185 are concealed.

FIG. 8 illustrates a circuit breaker of a much larger size than any previously illustrated is to be mounted into the bus bar structure. The bus bar structure is very similar to that illustrated previously as 30 in FIG. 1. However, because of the size of the breakers to be attached to the bus bar structure, it is necessary to mount the entire assembly on a steel backing plate, shown illustrated as 200. Member 200 is a sheet metal

formed assembly which is provided for the attachment of the phenolic end pieces, one of which is shown as 230. Member 200 has two outside flange portions, 201 and 202, which have been drilled and tapped at predetermined spaced locations which will provide support for the end of the circuit breaker assembly remote from the center of the panel. Member 200 also has a dropped center portion 203 which is required because of the shaping of the phenolic end pieces and because of the peculiar location of the center bus bar. It has been found most satisfactory to install a sheet of insulating material the entire length of the member 200 such that the insulating material is between the member 200 and the phenolic end pieces shown as 230. A sheet of mylar has been used, but any other material is deemed to be satisfactory as long as it will conform to the shape of the backing member 200, and yet provide the insulation required. Phenolic end piece 230 is fastened by two bolts 231 and 232 to member 200. Member 200 is fastened to the body member 10 by the passage of four mounting bolts similar to that shown as 21, through holes such as shown as 204 and 205 respectively. The connection is essentially the same as that shown in FIG. 1, i.e. stop nut 23 is threaded onto bolt 21 until the member 200 is located at a desired distance from the rear face of the body member 10, at which time a wing nut such as the one shown as 32 in FIG. 1 is tightened against the forward face of member 200 to permanently locate the body 200 with respect to the rear face of panel 10. The bus bars shown as 235, 236, 237 are attached to the phenolic end pieces in a similar manner to those attached in FIG. 1, and it will be noted that again the center bus bar 236 is displaced rearwardly suitable distance from the bus bars 235 and 237.

Attached to bus bar 235 by two bolts 238 and 239 is a heavy gauge bus adapter 240. Bus adapter is rigidly joined to bus bar 235 in order to ensure good electrical contact, and two holes 241 and 242 which are drilled and tapped completely through the right-hand portion of bus adapter 240. Similarly a U-shaped bus adapter 243 is attached electrically to bus bar 236 by means of the two bolts shown in the right of U-shaped member 243. Similarly member 244 is attached to bus bar 237 by means of the two bolts shown. It will be noted that the bus adapters 238, 243 and 244 are provided with two spaced tapped holes similar to those shown as 241 and 242 in member 238. The faces of the members 238, 243 and 244 which are located in the central portion of the bus bar assembly immediately in front of bus bar 236, are all in the same vertical plane. This is absolutely necessary for the attachment of a circuit breaker of the type shown as 245. A clearance hole 246 is provided in circuit breaker 245 for the passage of bolt 247 through the hole 24, into the tapped hole 248 provided in flange portion 202 of the steel sheet member 200. The opposite end of the circuit breaker is attached to the three members 238, 243 and 244 by means of three screws similar to that shown as 249, which passes through energizing terminal 250 of circuit breaker 245 into hole 241 which is drilled and tapped completely through member 238. Similarly two bolts similar to that shown as 239 are passed through the other two energizing terminals shown below 250 of circuit breaker 245 into the left hand portion of member 243 and the left hand hole of member 244. This provides a rigid attachment of the circuit breaker assembly to both the backing plate 200 as well as the bus bar assembly.

FIG. 9 shows a similar circuit breaker bus bar assembly as that described in FIG. 8, with the exception that the bus bar assembly has been shortened to allow for the insertion of circuit breaker in the lower portion to provide overall protection for the whole bus bar assembly. The panel member 210, (similar to that shown in FIG. 1 as 10) is arranged to have steel backing member 300 (similar to that shown as 200 in FIG. 8) mounted at a specified distance from the rear face of member 210. Located on member 300 is a phenolic end piece 301 which is bolted by means of bolts 302 and 303 to the member 300. Phenolic end piece 301 is quite similar to end piece 30 shown in FIG. 1, with the exception that the lower legs of

member 30 have been removed. End piece 301 provides provision for the center bus bar to be located behind the two outside bus bars. Circuit breaker 304 is thus mounted on member 300 by means of bolts 305 and 306 respectively. The attachment of the trim member is exactly the same as stated previously. Four posts are provided from the rear face of panel member 210 similar to those shown as 12, 13, 14 and 54, panel 10 in FIG. 1. The trim panel is then fastened by four bolts similar to that shown as 307 to the main body member 210.

It is quite obvious therefore, that the bus bar structure as shown in FIG. 1, is by its nature adaptable for reception of circuit breakers of a various size. It is also seen that the main panel assembly is capable of performing various functions without radical changes in the bus bar structure. Conversion to accommodate "bolt on" or "stab connector" type circuit breakers requires but the inclusion of one auxiliary piece of equipment.

By the mere addition of an auxiliary backing plate, larger circuit breakers which are capable of interrupting larger fault currents may be accommodated in the basic structure.

We claim as our invention:

1. A panelboard assembly comprising:

- a. a boxlike enclosure having an access opening therein,
- b. a bus bar structure mounted in said boxlike enclosure, said bus bar structure comprising three bus bars mounted in spaced parallel relationship between a pair of insulating supporting members, the center bus bar being mounted so as to be slightly displaced from the plane which passes through the two outside bus bars, each of the bus bars having a series of tapped holes periodically located along its length, said center bus bar having a segmented insulator mounted thereon and extending substantially the length of said bus bar, a fastening means attached to each of the outside bus bars and extending substantially the length of said bus bar,
- c. a plurality of circuit breakers mounted on said bus bar structure, said circuit breakers being arranged to form two columns consisting of a plurality of circuit breakers mounted in side-by-side relationship in each column, all of said circuit breakers being anchored to the center bus bar segmented insulator assembly, one column of circuit breakers being anchored as well to the fastening means on one of said outside bus bars, the other column of circuit breakers being anchored as well to the fastening means on the other of said outside bus bars,
- d. a trim member connected to said boxlike enclosure for covering said access opening.

2. A panelboard comprising insulating bus bar support means, bus bar means supported on said bus bar support means, said bus bar means comprising three elongated bus bars supported in a spaced generally parallel relationship providing a center bus bar and a pair of outside bus bars on opposite sides of said center bus bar, a pair of circuit breakers supported in said panelboard in an end-to-end relationship at first ends of said circuit breakers with said first ends being disposed generally over said center bus bar, an insulating member over said center bus bar between said center bus bar and said first ends of said circuit breakers, a first insulating support structure supported on a first of said outside bus bars, a second insulating support structure supported on the second of said outside bus bars, a first of said circuit breakers at the second end thereof being supported on said first insulating support structure, the second of said circuit breakers at the second end thereof being supported on said second insulating support structure, and conducting means connecting each of said circuit breakers at the first end of each of said circuit breakers to said bus bar means.

3. A panelboard according to claim 2, a first hook part on said first insulating support structure, a second hook part on said second insulating support structure, said first circuit breaker at the second end thereof being supported on said first insulating support structure in interengagement with said first

hook part, and said second circuit breaker at the second end thereof being supported on said second insulating support structure in interengagement with said second hook part.

4. A panelboard comprising insulating bus bar support means, a plurality of elongated bus bars supported on said insulating bus bar support means in a spaced generally parallel relationship, insulating breaker support means supported on a first of said bus bars, a plurality of circuit breakers supported on said panelboard aligned in a side-by-side relationship forming a column of circuit breakers with the load end of each of said circuit breakers being supported on said insulating breaker support means, said insulating breaker support means comprising shelf part means and a plurality of spaced hook parts, each of said circuit breakers at the load end thereof resting on said shelf part means and being in interengagement with a different one of said hook parts, and means supporting the line ends of said circuit breakers on said panelboard and electrically connecting the line ends of said circuit breakers to said plurality of bus bars.

5. A panelboard comprising insulating bus bar support means, three elongated bus bars supported on said insulating bus bar support means in a spaced generally parallel relationship providing a center bus bar and a pair of outside bus bars on opposite sides of said center bus bar, three pairs of circuit breakers supported on said panelboard in a side-by-side relationship with the two circuit breakers of each pair being in an end-to-end relationship at the line ends of the two circuit breakers of each pair and with the line ends of said circuit breakers being disposed generally over said center bus bar, an insulating member over said center bus bar between said center bus bar and said line ends of said circuit breakers, a first insulating support structure supported on a first of said outside bus bars, a second insulating support structure supported on the second of said outside bus bars, a first circuit breaker of each of said three pairs being supported at the load end thereof on said first insulating support structure, the second circuit breaker of each of said three pairs being supported at the load end thereof on said second insulating support structure, said six circuit breakers at the line ends thereof being supported over said insulating member, a first conducting means electrically connecting the line ends of a first pair of said pairs of circuit breakers to said first outside bus bar, a second conducting means electrically connecting the line ends of a second pair of said pairs of circuit breakers to said center bus bar, and a third conducting means electrically connecting the line ends of the third pair of said pairs of circuit breakers to said second outside bus bar.

6. A panelboard according to claim 5, said insulating member over said center bus bar comprising insulating means insulating adjacent conducting means of said first second and third conducting means from each other.

7. A panelboard according to claim 5, three hook parts on said first insulating support structure, three hook parts on said second insulating support structure, and each of the circuit breakers of said three pairs of circuit breakers at the load end thereof being in interengagement with a different one of said hook parts.

8. A panelboard comprising insulating bus bar support means, a plurality of elongated bus bars supported on said in-

insulating bus bar support means in a spaced generally parallel relationship, a first insulating breaker support means supported on a first of said bus bars, a second insulating breaker support means supported on a second of said bus bars, a first plurality of circuit breakers supported on said panelboard in a side-by-side relationship forming a first column of circuit breakers with the load end of each of said circuit breakers in said first column being supported on said first insulating breaker support means, a second plurality of circuit breakers supported on said panelboard in a side-by-side relationship forming a second column of circuit breakers generally parallel with said first column of circuit breakers and with the load end of each of said circuit breakers of said second column being supported on said second insulating breaker support means, and means supporting the line ends of said circuit breakers of said first and second columns on said panelboard and electrically connecting the line ends of said circuit breakers of said first and second columns to said plurality of bus bars.

9. A panelboard according to claim 8, each of said first and second insulating breaker support means comprising shelf part means and a plurality of spaced hook parts, each circuit breaker in each of said first and second columns resting at the load end thereof on the associated shelf part means and being in interengagement with a different one of the plurality of hook parts of the associated insulating breaker support means.

10. A panelboard according to claim 8, said plurality of elongated bus bars comprising a third bus bar supported on said insulating support means generally between said first and second bus bars and being generally parallel with said first and second bus bars, insulating barrier means covering said third bus bar, said first and second columns of circuit breakers being in an adjacent end-to-end relationship with the line ends thereof being adjacent each other in proximity to said third bus bar and said insulating barrier means and with the load ends thereof being supported on said first and second insulating breaker support means, conducting means at said line ends of said circuit breakers connecting said circuit breakers to selected ones of said plurality of bus bars, said circuit breakers in said first and second columns being in pairs with each pair comprising a breaker in the first column and a breaker in the second column with each pair being electrically connected to the same bus bar, and said insulating barrier means comprising an insulating barrier between each pair of circuit breakers and any adjacent pair of circuit breakers.

11. A panelboard according to claim 10, each of said first and second insulating breaker support means comprising shelf part means and a plurality of spaced hook parts, and each of said circuit breakers at the load end thereof resting on the associated shelf part means and being in interengagement with a different one of the hook parts of the associated insulating breaker support means.

12. A panelboard according to claim 11, a separate conducting means for each of said pairs of circuit breakers, a first of said conducting means connecting the first pair of said pairs of circuit breakers to said first bus bar, a second of said conducting means connecting a second pair of said pairs of circuit breakers to said second bus bar, and a third of said conducting means connecting a third pair of said pairs of circuit breakers to said third bus bar.