United States Patent

[11] 3,612,790

[72] Inventor **Edmund W. Kuhn**
Pittsburgh, Pa.

[21] Appl. No. **887,498**
[22] Filed **Dec. 23, 1969**
[45] Patented **Oct. 12, 1971**
[73] Assignee **Westinghouse Electric Corporation**
Pittsburgh, Pa.

[54] **HIGH-VOLTAGE ELECTRIC SWITCH HAVING IMPROVED SUPPORTING BASE**
8 Claims, 7 Drawing Figs.

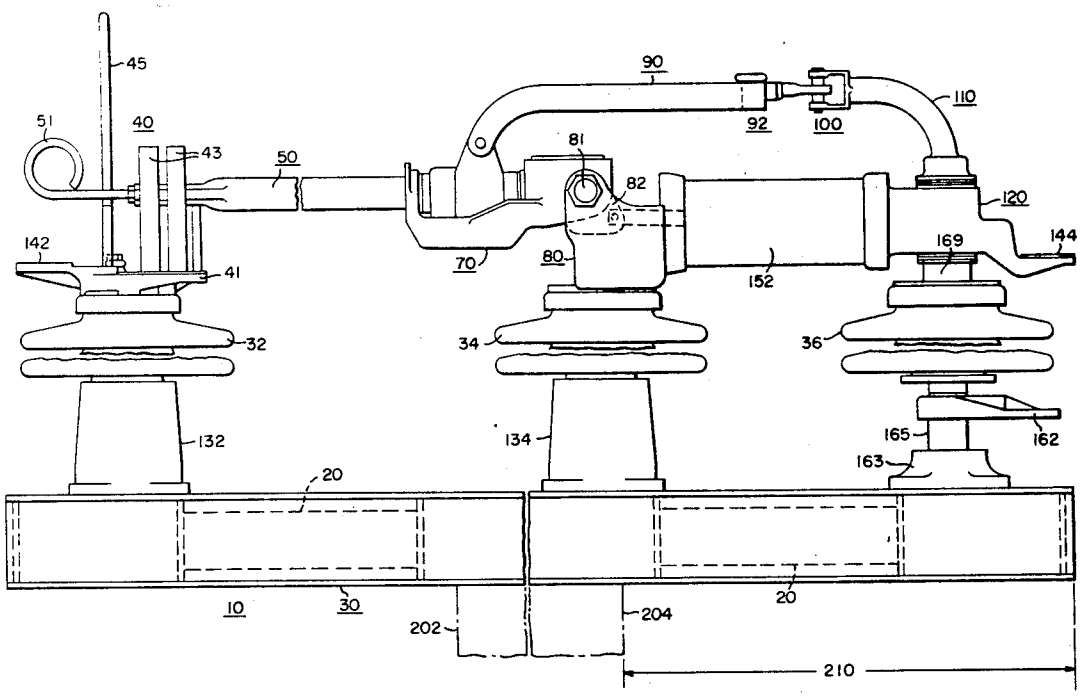
[52] **U.S. Cl.** **200/48**
[51] **Int. Cl.** **H01h 31/00**
[50] **Field of Search** ..... 200/48, 48 RP

[56] **References Cited**
UNITED STATES PATENTS

3,070,674	12/1962	Gusow	200/48 RP
3,284,590	5/1968	Hondalus	200/48 RP
3,316,366	4/1967	Silvy et al.	200/48 RP

Primary Examiner—Herman J. Hohauser
Attorneys—A. T. Stratton and C. L. McHale

ABSTRACT: A high-voltage electric switch comprising a plurality of spaced insulator stacks having a switch blade movably supported thereon and a contact jaw supported on one of the other insulator stacks and disposed in the path of movement of the switch blade. The insulator stacks are mounted on a common supporting base which includes a pair of generally parallel channel members and a pair of reinforcing members disposed between said channel members and spaced from the ends of said channel members.



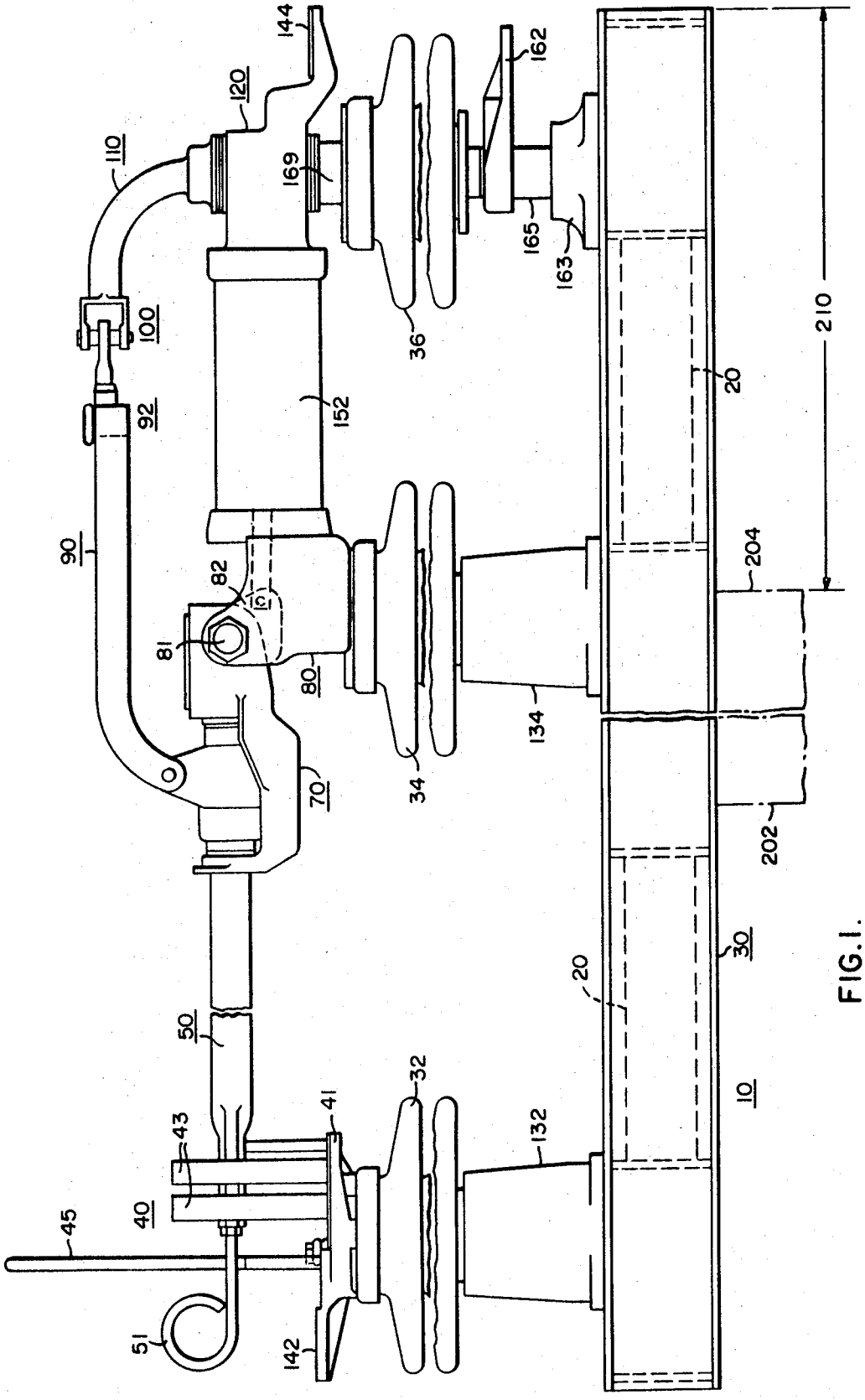

144
120
110
169
162
165
163
36
100
92
152
210
20
90
204
82
81
80
134
34
70
202
50
30
20
32
41
43
132
10
40
45
51
142

FIG. 1.

FIG.2.

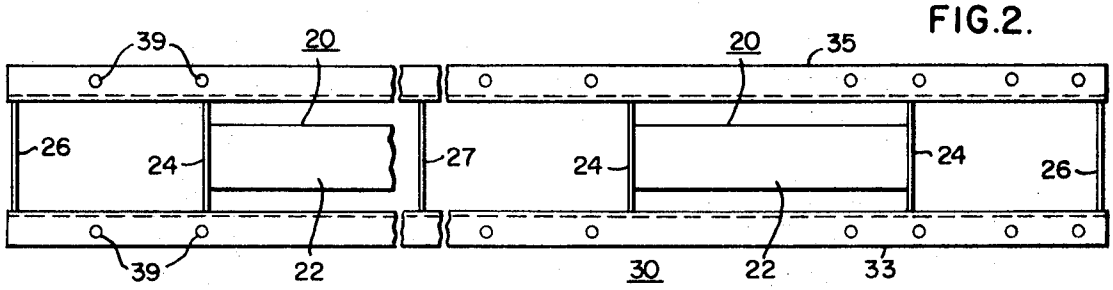


FIG.3.

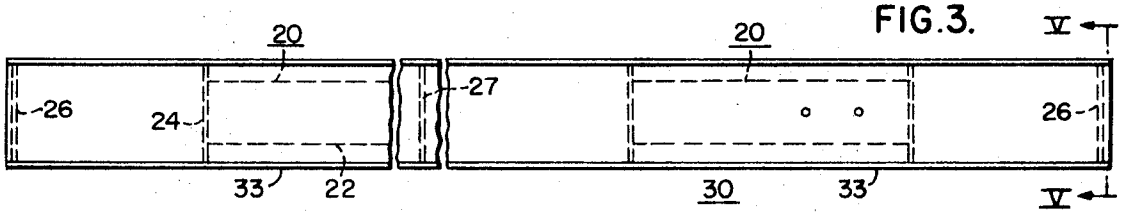


FIG.4.

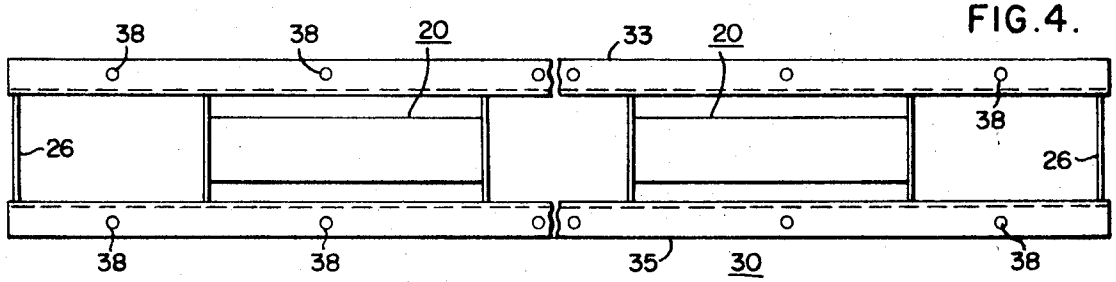


FIG.6.

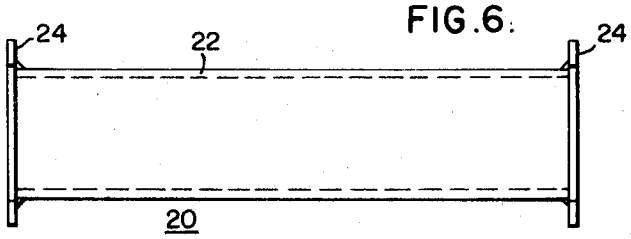
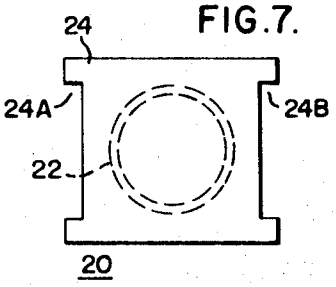


FIG.7.



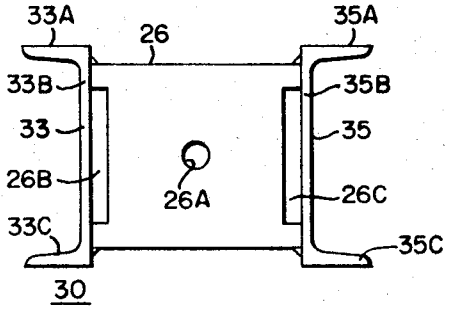


FIG.5.

HIGH-VOLTAGE ELECTRIC SWITCH HAVING IMPROVED SUPPORTING BASE

BACKGROUND OF THE INVENTION

This invention relates to high-voltage electric switches and, more particularly, to supporting base structures which form part of such switches.

In the construction of certain types of high-voltage switches such as polyphase or three-phase disconnecting switches, a plurality of pole units or switch units is mounted or supported on a common supporting structure in side-by-side relation. Each pole unit of such a switch normally includes a supporting base on which a plurality of spaced insulator stacks is mounted or secured with a switch arm or contact arm movably supported on one or more of the insulator stacks and a contact jaw supported on one of the other insulator stacks.

It has been found that in the operation of such a polyphase switch, when a short circuit or abnormal operating condition occurs in the electrical system in which the switch is connected, the supporting base of each pole unit of the switch is subjected to torsional or twisting stresses or forces due to the interacting effects between adjacent pole units.

In order to support each pole unit of such a polyphase switch both during normal and abnormal operating conditions such as that just indicated, various types of supporting base constructions have been proposed for such switches. One type of base structure which has been proposed for this type of switch includes a plurality of extruded aluminum structural members, such as described in U.S. Pat. No. 3,284,590. An important disadvantage of such a base structure is that it has been found to be prohibitive in cost. Another type of base structure which has been employed in polyphase switches of the type described includes a plurality of structural steel members and plates which are welded or bolted together, such as shown in U.S. Pat. No. 3,316,366 which issued Apr. 25, 1967 and is assigned to the same assignee as the present application. A base structure of the latter type has been found to have certain disadvantages in that it is relatively complicated in construction and requires a number of metal joining and forming operations to form a base structure having adequate resistance to the torsional stresses of the type described which may result during the operation of a polyphase or three-phase switch.

SUMMARY OF THE INVENTION

In accordance with the invention, a high-voltage electric switch includes a switch blade or contact arm having one end movable into and out of engagement with an associated contact jaw. The switch blade and the contact jaw are supported on a plurality of spaced insulator stacks which are supported on and secured to a common supporting base. The base comprises a pair of elongated, metallic channel members, each of which includes a pair of spaced integral sidewall or flange portions connected by a bight portion. The channel members are disposed generally parallel to and spaced from one another with the corresponding sidewall or flange portions of the respective channel members projecting away from those of the other channel member in opposite directions. The base also includes a pair of reinforcing members disposed adjacent to and spaced from each of the opposite ends of the base. Each reinforcing member includes an elongated tubular member which is disposed between and generally parallel to the associated channel members. The tubular member is preferably circular in cross section and is formed from a metallic material which is preferably steel.

Each reinforcing member also includes a pair of generally rectangular metallic plates which are disposed between and generally transversely with respect to the associated channel members and which are secured to the opposite ends of the associated tubular member. The pair of plates of each reinforcing member are also secured at the opposite sides thereof by suitable means, such as welding, to the respective channel members, more specifically to the bight portions of said channel members. In addition to the above pair of reinforcing members, the base also includes a pair of generally rectangular, metallic reinforcing plates which are disposed between the associated channel members substantially at the opposite ends thereof generally transversely with respect to said channel members. The latter reinforcing plates are secured at the opposite sides thereof to the associated channel members by suitable means, such as welding.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects of the invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. **1** is a partial view, in side elevation, of a high voltage electric switch structure embodying the principal features of the invention;

FIG. **2** is a top plan view of a portion of the supporting base which forms part of the switch structure shown in FIG. **1**;

FIG. **3** is a side elevational view of the supporting base shown in FIG. **2**;

FIG. **4** is a bottom view of the supporting base shown in FIGS. **2** and **3**;

FIG. **5** is an enlarged end elevational view taken along the line V—V in FIG. **3**, of the supporting base shown in FIGS. **2**, **3** and **4**;

FIG. **6** is an enlarged view in side elevation of a reinforcing member which forms part of the supporting base shown in FIGS. **2** through **5**; and

FIG. **7** is an enlarged view in end elevation of the reinforcing member shown in FIG. **6**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings and FIG. **1** in particular, there is shown a high-voltage disconnecting switch assembly **10** which normally forms one pole unit of a polyphase or three-phase high-voltage switch structure which includes a plurality of disconnecting switch assemblies each having the construction of the disconnecting switch assembly **10** and supported on a common supporting structure which may include a plurality of structurally supporting cross members, as indicated diagrammatically at **202** at **204** in FIG. **1**. In such a polyphase switch structure, a plurality of pole units, such as the disconnecting switch assembly **10**, is mounted in side-by-side spaced relation upon the common supporting structure.

The disconnecting switch assembly **10** comprises three spaced insulator stacks **32**, **34** and **36** which are mounted upon a common supporting base **30** which will be described in detail hereinafter. The operating parts of the disconnecting switch assembly **10** which are mounted at the upper ends of the insulator stacks **32**, **34** and **36**, as viewed in FIG. **1**, are described in detail in U.S. Pat. No. 3,194,905 which issued July 13, 1965 to F. W. Jewell et al. and which is assigned to the same assignee as the present application. Each of the insulator stacks **32**, **34** and **36** comprises a plurality of insulators which are preferably formed from porcelain or other suitable electrically insulating material. The number of insulators required in each of the insulator stacks **32**, **34** and **36** depends upon the voltage of the electrical system in which the disconnecting switch **10** is applied. As illustrated, the insulator stacks **32** and **34** may be mounted upon the fixed pedestals or spacers **132** and **134**, respectively, which, in turn, may be secured to the top of the associated supporting base **30**. As described in the last mentioned patent, the insulator stack **36** is mounted upon a shaft **165**, he lower end of which is rotatably mounted in a bearing member **163** which is secured to the top of the associated supporting base **30**. As shown in FIG. **1**, an operating lever or crank arm **162** may be secured to the shaft **165** at the lower end of the insulator staff **36** to rotate the insulator stack **36** with the crank arm **162** being adapted for connection or coupling to any conventional means for operating the crank arm **162** to effect rotation of the associated shaft **165** and the insulator stack **36** about its own longitudinal axis. A shaft **169** is secured to and extends upwardly from the upper end of the

insulator stack **36** to thus form an operative extension of the shaft **165** which is provided at the lower end of the insulator stack **36** in order to positively connect the crank arm **162** and the insulator stack **36** to the balance of the operating mechanism of the disconnecting switch assembly **10** which will be described hereinafter. The shaft **169** passes through an opening provided in the terminal end casting or member **120** which is substantially aligned with the axis of rotation of the shaft **169** and the insulator stack **36** and has mounted at the upper end thereof a crank arm **110** which is rotatable with the shaft **169** and which extends generally at an angle or generally transversely with respect to the axis of rotation of the shaft **169**.

As illustrated in FIG. **1**, the disconnecting switch **10** includes a generally U-shaped relatively stationary contact assembly or break jaw assembly **40** which is mounted on and secured to the top of the insulator stack **32**. The stationary contact assembly **40** includes a plurality of pairs of spaced contact jaws **43** which are mounted on and interconnected by an associated base member **41** which is forged or cast from an electrically conducting material, such as copper, and which is secured to the top of the insulator stack **32** by suitable means such as a plurality of bolts (not shown). A terminal pad **142** which is adapted to receive a terminal connector may be formed integrally with or secured to one side of the base member or terminal casting **41**. Where desired, a relatively stationary arcing horn **45** may also be secured to the terminal casting **41**.

In order to provide an electrically conducting path between the stationary contact assembly **40** and the electrically conducting parts of the disconnecting switch **10** which are mounted on top of the insulator stack **34** when the switch **10** is in a closed circuit operating condition, as shown in FIG. **1**, a movable switch blade or contact arm **50** is provided. The blade **50** is elongated in shape and includes a main body or central portion which may be generally tubular in configuration and which is formed from an electrically conducting material, such as copper or aluminum. The blade **50** also includes an end portion at its left end which may be generally rectangular in cross section to provide high-pressure contact areas which are adapted to engage the contact jaws **43** of the stationary contact assembly **40**. Where desired, a relatively movable arcing horn **51** may be mounted at the free or left end of the blade **50** which is adapted to cooperate with the relatively stationary arcing horn **45** previously mentioned.

In order to support the blade **50** for rotation about its own axis and for arcuate movement about an axis which extends generally perpendicular to the axis of the blade **50**, as viewed in FIG. **1**, the right end of the blade **50** may be secured to a generally tubular crank member **60** for movement therewith, as described in detail in the Jewell et al. patent previously mentioned. In order to support the crank member **60**, as well as the blade **50**, for rotation about a common axis which extends longitudinally of the blade **50**, a hinge member **70** having a generally tubular portion is provided and the crank member **60** is rotatably supported on said hinge member, as described in the Jewell et al. patent previously mentioned. An electrically conducting path may be provided between the crank member **60** and the hinge member **70** by one or more resilient electrically conducting members (not shown) disposed between the crank member **60** and the tubular portion of the hinge member **70**.

In order to support the hinge member **70** for rotation about an axis which is generally perpendicular to the axis of the blade **50** and to support the blade **50** which is assembled with the hinge member **70** as just indicated for arcuate movement or travel about said axis, the spaced arms **82** (only one shown) of the hinge support member or frame **80** are disposed on opposite sides of the hinge member **70**. The hinge member **70** includes a pair of hinge portions which project generally perpendicularly with respect to the axis of the tubular portion of the hinge member **70** with the hinge member **70** being pivotally supported between the arms **82** of the hinge support frame **80** by electrically conducting hinge pins or studs **81** as described in the Jewell et al. patent. The electrically conducting hinge pins **81** which support the hinge member **70** may be electrically connected to the hinge member **70** by one or more resilient electrically conducting members (not shown) which may be disposed inside the generally tubular hinge portions of the hinge member **70** to engage both the hinge member **70** and the hinge pins **81** which are secured to the arms **82** of the hinge support frame **80**. In order to provide an electrically conducting path between the hinge support member **80** and the terminal casting **120**, an electrically conducting tubular member **152** may be provided which structurally and electrically connects the hinge support member **80** and the terminal end member **120**. The electrically conducting member **152** may also serve as a housing for a counterbalancing mechanism which is described in detail in U.S. Pat. No. 3,074,474 which issued Feb. 26, 1963 to E. F. Beach et al. and which is assigned to the same assignee as the present application.

In order to operatively connect the crank arm **110** which is mounted on the shaft **169** which is secured to the top of the rotatable insulator stack **36** and the crank member **60** and to actuate the movement of the blade **50** during opening and closing operations of the disconnecting switch **10**, the disconnecting switch **10** includes the operating link **90** which is pivotally connected to the crank member **60**, the slip joint **92** and the universal joint **100** which operatively connects the slip joint **92** to the crank arm **110**. The slip joint **92** and the universal joint **100** are described in detail in the Jewell et al. patent previously mentioned.

In general, the supporting base **30** of the disconnecting switch **10** is provided to support the weights of the insulator stacks **32**, **34** and **36**, as well as the weights of the parts of the disconnecting switch **10** which are mounted at the top of the respective insulator stacks, and also to resist the torsional or twisting stresses which result in the supporting base **30** where the disconnecting switch **10** forms one pole unit of a polyphase or three-phase switch structure due to the interaction of the respective pole units of such a polyphase switch structure during short circuit or other abnormal operating conditions. As previously indicated, the insulator stacks **32**, **34** and **36** are supported on the supporting base **30** in spaced relation and are disposed generally perpendicular to the overall supporting base **30** as shown in FIG. **1**.

More specifically, the supporting base **30** comprises a pair of elongated channel members **33** and **35** which are disposed generally parallel to and spaced from one another, as best shown in FIGS. **2** through **5**. The channel members **33** and **35** are preferably formed from a metallic material, which is preferably steel. Each of the channel members **33** and **35** includes a pair of spaced integral sidewall or flange portions, as indicated at **33A** and **33C** for the channel member **33** and as indicated at **35A** and **35C** for the flange member **35**, which are interconnected by an associated bight portion as indicated at **33B** and **35B** for the channel members **33** and **35**, respectively. As shown in FIG. **5**, the channel members **33** and **35** which make up the supporting base **30** are assembled with the corresponding pairs of side wall portions **33A** and **33C** and **35A** and **35C**, respectively, projecting outwardly or away from one another in opposite directions. The bight portions **33B** and **35B** of the channel members **33** and **35**, respectively, are disposed in back to back relation and spaced from one another as shown in FIG. **5**.

In order to provide the supporting base **30** with adequate structural strength to resist the torsional stresses which may result during the operation of the disconnecting switch **10**, as previously mentioned, a pair of reinforcing members **20** is disposed adjacent to the opposite ends of the supporting base **30** and spaced from said opposite ends, as best shown in FIGS. **2** through **4**. Each of the reinforcing members **20** includes an elongated tubular member **22** which is disposed between and generally parallel to the associated channel members **33** and **35**. Each of the reinforcing members **20** also includes a pair of generally rectangular plates **24** which are disposed between

and generally transversely or perpendicularly with respect to the channel members **33** and **35**, as shown in FIGS. **2** through **4**. Both the tubular member **22** and the associated generally rectangular plates **24** of each of the reinforcing members **20** are formed from a metallic material which is preferably steel. The tubular member **22** of each of the reinforcing members **20** is preferably circular in cross section and the associated generally rectangular plates **24** are secured to the opposite ends of the associated tubular member **22** by suitable means, such as welding, as shown in FIGS. **6** and **7**. The generally rectangular plates **24** of each of the reinforcing members **20** are, in turn, secured at the opposite sides thereof to the bight portions of the associated channel members **33** and **35** by suitable means, such as welding, as best shown in FIG. **5**. It is to be noted that each of the generally rectangular plates **24** which form part of the reinforcing members **20** includes a pair of recesses **24A** and **24B** at the opposite sides thereof to limit the portions of the plates **24** which must be welded to the associated channel members **33** and **35** at the sides of each of said plates. If the recesses **24A** and **24B** were not provided in each of the generally rectangular plates **24**, the entire sides of each of said plates would have to be welded to the associated channel members **33** and **35** respectively in order to avoid the entrapment of certain solutions or liquids which are normally employed in the galvanizing of the entire supporting base **30** after the reinforcing members **20** are assembled with and secured to the associated channel members **33** and **35** as shown in FIGS. **2** through **4**.

In addition to the reinforcing members **20**, a pair of generally rectangular reinforcing plates **26** is disposed substantially at the opposite ends of the supporting base **30** with said plates being disposed between and generally transversely or perpendicularly with respect to said channel members, as shown in FIGS. **2** through **5**. Each of the reinforcing plates **26** is secured at the opposite sides thereof to the respective channel members **33** and **35** by suitable means, such as welding, with the reinforcing plates **26** being formed from a metallic material which is preferably steel. Each of the reinforcing plates **26** includes a pair of recesses **26B** and **26C** at the opposite sides thereof for the same reasons previously described in connection with the plates **24**. Each of the reinforcing plates **26** also includes a central opening, as indicated at **26A**, to permit the mounting of strain insulators (not shown), where desired, to permit the supporting of associated electrical conductors which may be associated with or connected to the disconnecting switch **10**. It is important to note that the reinforcing plates **26** provided substantially at the opposite ends of the supporting base **30** structurally complete a boxlike structure which is formed by the overall supporting base **30** and also assist in providing the supporting base **30** with resistance to the torsional or twisting stresses previously mentioned. Where desired, additional reinforcing plates such as the reinforcing plate **27** may be disposed between and secured to the channel members **33** and **35** at axially spaced locations along the overall length of the supporting base **30** to provide additional rigidity in certain applications.

Referring again to FIG. **1**, it is important to note that the construction of the supporting base **30** permits the mounting of the pole units of a polyphase switch structure, such as the disconnecting switch unit **10**, to be mounted on common structural cross members such as those indicated diagrammatically at **202** and **204** in FIG. **1** with the opposite ends of the supporting base **30** of each pole unit of disconnecting switch **10** overhanging the associated structural cross support members by a predetermined distance, as indicated at **210** in FIG. **1**.

For example, in one typical application of the disclosed construction of the supporting base **30**, each of the reinforcing members **20** was approximately 16 inches long and were each spaced from the adjacent end of the supporting base **30** by approximately 11 inches to permit a maximum overhanging distance of each of the opposite ends of the supporting base of approximately 30 inches where desired. The positioning of the reinforcing members **20** adjacent the opposite ends of the supporting base **30** transmits the torsional stresses or forces which may result during short circuit conditions to the reinforcing members **20** and then to the common supporting structure as indicated diagrammatically at **202** and **204** in FIG. **1** and limits the deflection of the supporting base **30** at different points during such operating conditions to predetermined minimum values which avoid any consequent damage to the disconnecting switch **10** during such operating conditions. The improved torsional rigidity of the supporting base **30** has been found also to result in equal structural restraint of all of the insulator stacks **32**, **34** and **36** regardless of the relative position of the supporting cross members **202** and **204** within a limited range of locations which extends from right at the opposite ends of the supporting base **30** to locations which result in a predetermined overhang distance at each end of said base as previously indicated.

In the overall operation of the disconnecting switch **10**, as described in greater detail in the Jewell patent previously mentioned, when the shaft **165** is rotated by an external means through the crank arm **162**, the blade **50** is first rotated about its own axis to effect a disengagement of the free end of the blade **50** from the contact jaws **43** of the stationary contact assembly **40**. Continued movement of the crank arm **110** in the predetermined direction actuates an arcuate movement of the blade **50** along with the hinge member **70** in a clockwise direction about the axis defined by the hinge pins which support the hinge member **70** until the blade **50** is in a substantially vertical position as viewed in FIG. **1** which is angularly displaced from the position of the blade shown in FIG. **1** by substantially 90°.

During a closing operation of the disconnecting switch **10**, the crank arm **162** is actuated in the opposite direction to thereby actuate the crank arm **110** in such a direction as to first actuate the blade **50** from the substantially vertical position just indicated to a position which is substantially parallel to the supporting base **30** as shown in FIG. **1**. Further rotation of the crank arm **110** then rotates the blade **50** about its own axis to establish contact pressure between the free end of the blade **50** and the stationary contact assembly **40**. In summary, the operating mechanism of the disconnecting switch **10** separates the rotary movement of the blade **50** about its own axis which is necessary to either disengage the left end of the blade **50** from the stationary contact assembly or to actuate said blade to fully engage the stationary contact assembly **40** and the generally arcuate movement of said blade between the open and closed positions just described.

It is to be understood that the teachings of the invention may be applied to other types of high-voltage electric switches whose operating parts may differ from those of the disconnecting switch **10** as illustrated.

The apparatus embodying the teachings of this invention has several advantages. For example, a high-voltage switch construction as disclosed includes an improved supporting base which is uniquely adapted to permit the use of steel structural members in a relatively simple construction while providing the resistance to torsional stresses or forces which are required in a polyphase switch structure due to the interaction of adjacent pole units during certain operating conditions. In addition, the disclosed supporting base construction permits the associated supporting cross members for the adjacent pole units of polyphase switch structure to be mounted either adjacent to the opposite ends of the respective supporting bases of the different pole units or to locate the supporting cross members **202** and **204** inwardly from the opposite ends of the supporting base by a predetermined distance, as indicated by the axially spaced mounting holes **38** which are provided on the lower flange or sidewall portions **33C** and **35C** of the channel members **33** and **35**, respectively as best shown in FIG. **4**. More specifically, the disclosed supporting base construction lends itself to convenient assembly with the supporting cross members indicated diagrammatically at **202** and **204** in FIG. **1** by suitable fastening means

such as a plurality of spaced bolts which may pass through the openings **38** provided in the bottom sidewall portions of the channel members **33** and **35** as shown in FIG. **4**.

The insulator stacks **32**, **34** and **36** may be conveniently secured to the associated channel members and more specifically to the upper sidewall portions **33A** and **35A** of said channel members by suitable fastening means, such as a plurality of axially spaced bolts which pass through the axially spaced openings **39**. It important to note that the disclosed supporting base **30** also provides the necessary rigidity and structural strength to support the weight of each of the insulator stacks **32**, **34** and **36** as well as the switch operating parts which are disposed on top of the respective insulator stacks. In summary, the applicant's construction permits the use of steel structural members to form an improved supporting base for high-voltage electric switches in a relatively less complicated overall structure while providing the necessary resistance to torsional or twisting stresses which may result due to short circuit conditions in the operation of a polyphase or three-phase switch structure having a plurality of pole units disposed in side-by-side relation.

I claim as my invention:

1. A high-voltage electric switch comprising a base, a plurality of spaced insulator stacks mounted on said base, a switch blade movably supported on top of at least one of said insulator stacks a contact jaw supported on top of another of said insulator stacks to be engaged by said blade in one operating position of said blade, said base comprising a pair of elongated, metallic channel members each having a pair of spaced sidewall portions, said channel members being disposed generally parallel and spaced from one another with the sidewall portions of each of said channel members projecting away from those of the other channel member in opposite directions, and a pair of reinforcing members disposed adjacent to and spaced from each of the opposite ends of said base, each reinforcing member including a metallic, elongated tubular member disposed between and generally parallel to said channel members and a pair of generally rectangular, metallic plates disposed between and generally transversely with respect to said channel members, said pair of generally rectangular, metallic plates being secured to the opposite ends of said tubular member and secured at the opposite sides thereof to the respective channel members.

2. The combination as claimed in claim **1** wherein the tubular member of said reinforcing is generally circular in cross section.

3. The combination as claimed in claim **1** wherein an additional pair of generally rectangular, metallic plates are disposed substantially at the opposite ends of said base between and generally transversely with respect to said channel members, said last-mentioned plates being secured at the opposite sides thereof to the respective channel members.

4. The combination as claimed in claim **1** wherein said channel members and said reinforcing members are formed primarily from steel.

5. The combination as claimed in claim **1** wherein each of the sidewall portions of said channel members at the top of said base includes a plurality of spaced openings and a plurality of fastening means is provided to secure said insulator stacks to said base, said fastening means being disposed to pass through the openings in the sidewall portions of said channel members.

6. The combination as claimed in claim **1** wherein the pair of generally rectangular plates of each of said reinforcing members are welded to the opposite ends of the tubular member of said reinforcing member and the sides of said plates are welded to the respective channel members.

7. The combination as claimed in claim **2** wherein an additional pair of generally rectangular, metallic plates is disposed substantially at the opposite ends of said base between and generally transverse with respect to said channel members, said additional pair of plates being secured at the opposite sides thereof to the respective channel members.

8. The combination as claimed in claim **2** wherein the pair of generally rectangular plates of each reinforcing member are welded to the opposite ends of the tubular member of said reinforcing member and the sides of said plates of each member are welded to the respective channel members.