

[54] **DETACHABLE CLAMPING ELECTRICAL CONNECTOR**

[75] Inventor: **Norman Davies**, Trafford, Pa.

[73] Assignee: **Westinghouse Electric Corporation**, Pittsburgh, Pa.

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[52] U.S. Cl. **200/48 A, 200/166 B, 339/230**

[51] Int. Cl. **H01h 31/00**

[58] Field of Search **200/166 A, 166 B, 200/48 R, 48 SB, 48 CB, 48 KB, 48 A; 339/124, 224, 229, 230; 287/53; 136/134, 135, 136**

[56] **References Cited**

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Primary Examiner—Herman J. Hohaus

Attorney—A. T. Stratton, W. R. Crout et al.

[57] **ABSTRACT**

An improved detachable clamping electrical connector is provided including a pair of spaced slotted plate portions, each having an aperture therethrough, of generally the same size and configuration as the electrical stud, to which electrical connection is desired. In one embodiment, a slotted U-shaped electrical strap member is provided, having spaced apertures therethrough,

and utilized with clamping means extending through the closed end of the U-bend to clamp the furcations of the connector together and around the associated electrical stud.

In another application of the invention, separate independent spaced slotted plates are provided, each having furcations leading into accommodating apertures, which accommodate the electrical stud, to which electrical connection is desired.

Cleats and a clamping bolt are provided to urge the furcations of the separate slotted plates together to provide firm electrical engagement with the associated electrical stud.

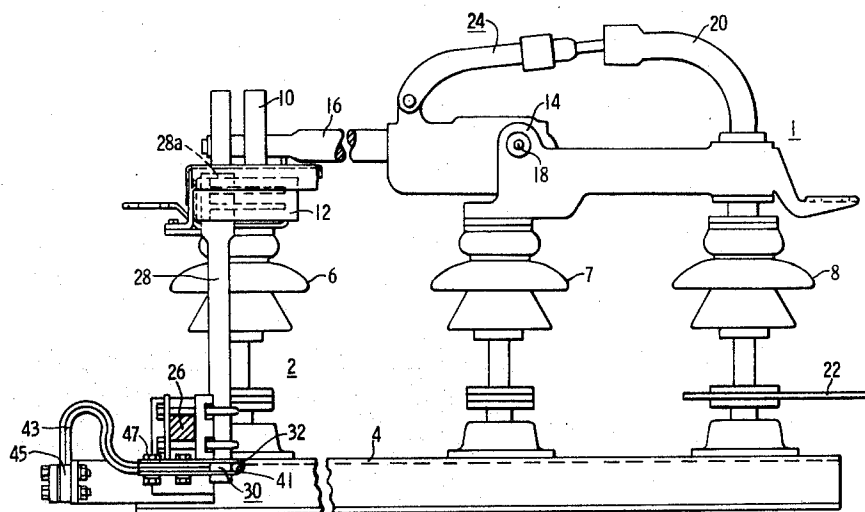
An improved disconnecting switch, having a grounding switch associated therewith, is provided utilizing the aforesaid electrical connector.

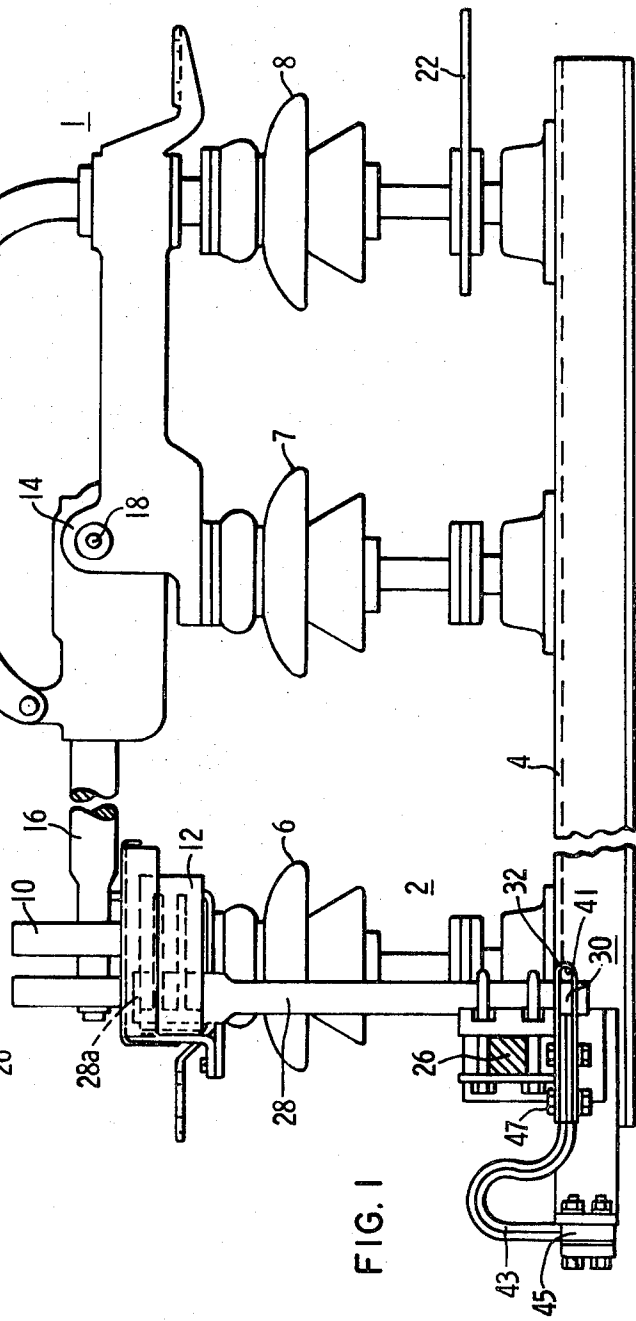
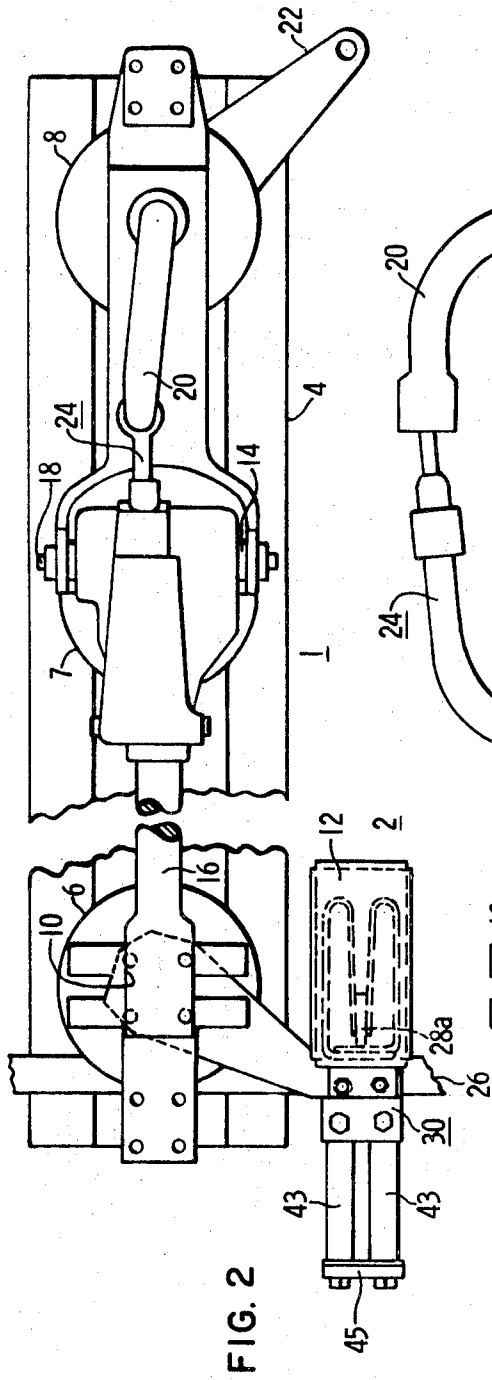
The improved electrical connector may be associated with a terminal bushing having electrical connection thereto provided by the aforesaid detachable electrical connector.

The invention may be applied to a bus-riser attached to the main disconnecting contacts of a circuit breaker, again having the improved electrical connector attached to the primary disconnecting stud portion thereof.

The invention may be applied, importantly, to the connecting stud of a vacuum-type circuit breaker to make rigid good electrical connection therewith, either at the stationary contact end, or at the movable-contact end of the vacuum circuit breaker.

5 Claims, 14 Drawing Figures





SHEET 2 OF 5

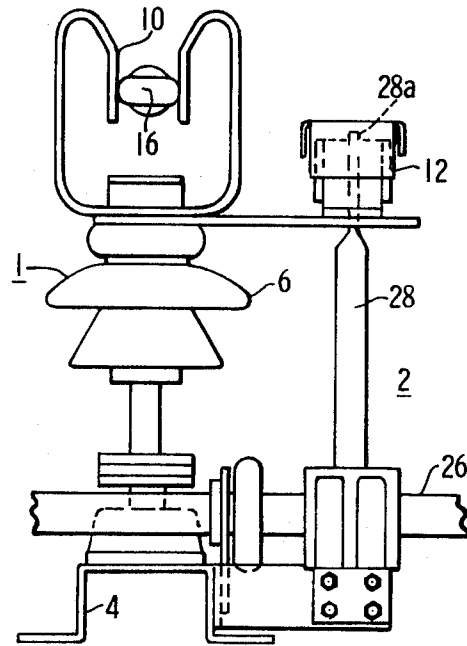


FIG. 3

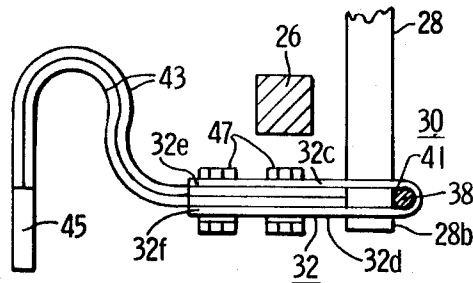


FIG. 4

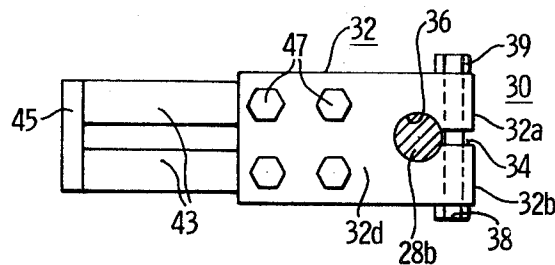


FIG. 5

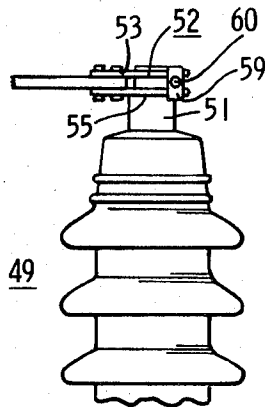


FIG. 6

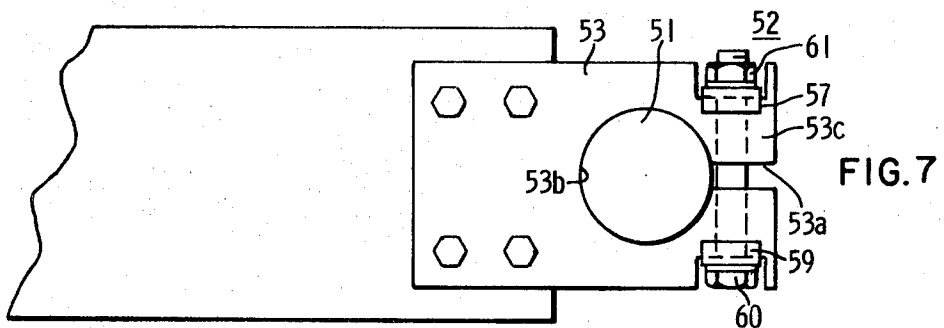


FIG. 7

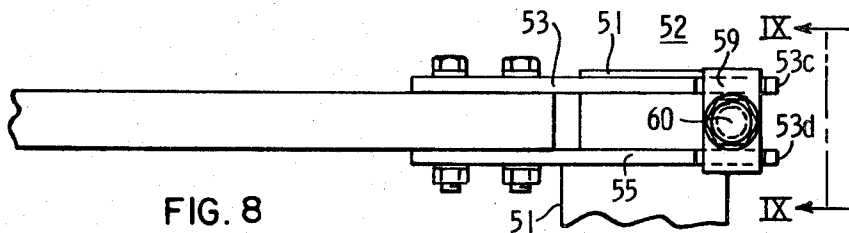


FIG. 8

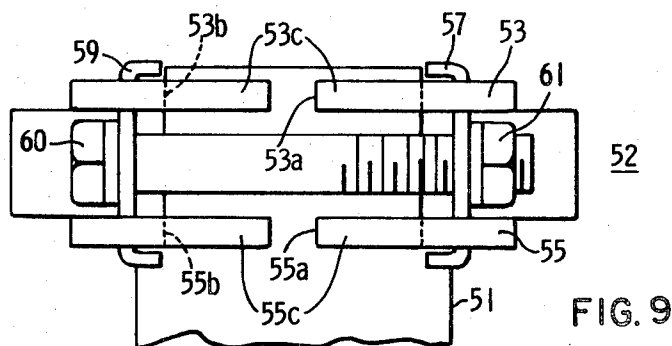
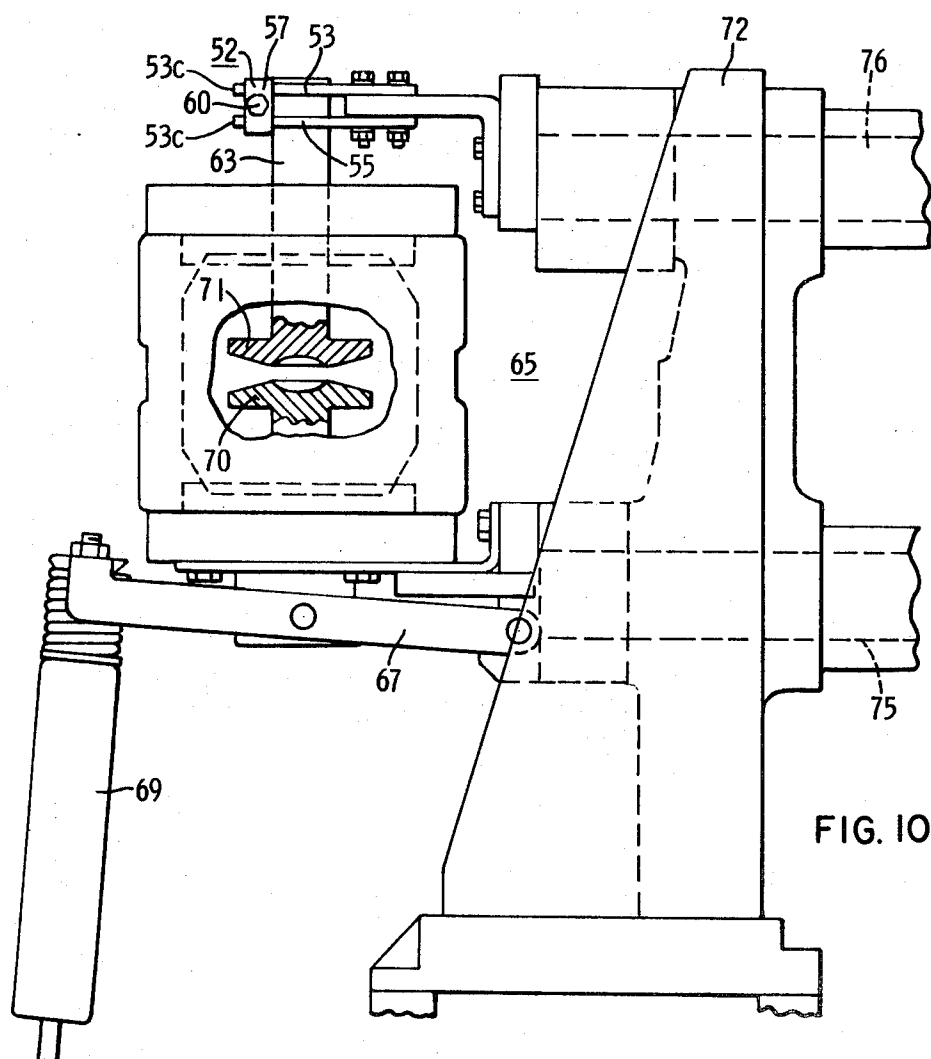
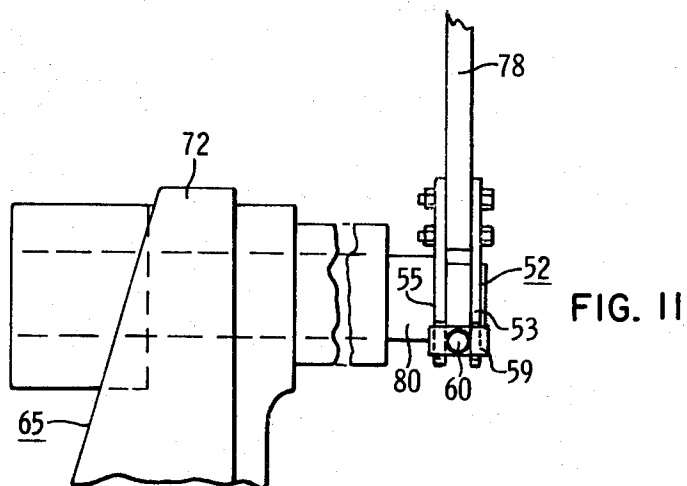


FIG. 9



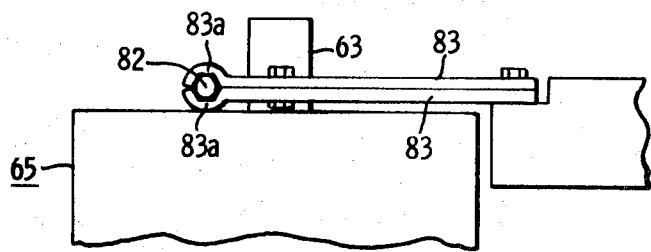


FIG. 12

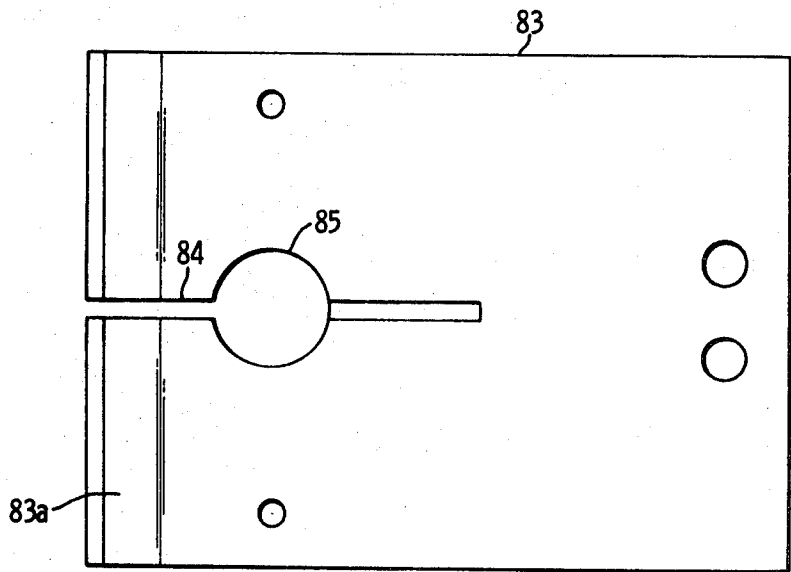


FIG. 13

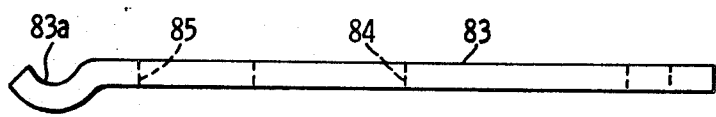


FIG. 14

DETACHABLE CLAMPING ELECTRICAL CONNECTOR

CROSS-REFERENCE TO RELATED APPLICATIONS

Applicant is not aware of any related applications pertinent to the present invention.

BACKGROUND OF THE INVENTION

There are many applications where a good and inexpensive electrical connector is desired to be associated with a stationary stud, or a rotatable moving stud of switchgear applications. For example, in a disconnecting switch having associated therewith a rotatable grounding switch-blade, a good electrical connection must be supplied to the relatively stationary end of the grounding switch blade, which will assure good electrical connection thereto, even though vibration, and opening and closing shocks, due to operation of the switch structure may tend to effect loosening of the electrical connection.

It is, therefore, desirable to provide an improved inexpensive and readily attachable and detachable electrical connector to a conductor stud, which will maintain firm electrical contact to the stud to minimize contact resistance therebetween. As well known by those skilled in the art, erosion and corrosion of the parts must be combatted by a firm clamping engagement of the electrical parts together to minimize contact resistance therebetween.

In one arrangement, which has been utilized in the past, a breaker stud has had the end portion thereof threaded, and to this threaded end has been threadedly secured an electrical bus-bar riser, which has been slotted, and has an aperture to accommodate the threaded end of the breaker stud. The arrangement has been such that the bus-bar riser has been threaded onto the threaded end of the breaker stud, and a clamping bolt has been provided at the furcated end of the slotted bus-bar riser to clamp the furcations together. This has, however, involved several expensive manufacturing processes, such as threading the breaker stud and the bus-bar, milling, drilling and tapping operations.

SUMMARY OF THE INVENTION

In accordance with a preferred embodiment of the present invention, a pair of spaced slotted plate portions have apertures provided therethrough to accommodate the stud portion of the associated apparatus; and clamping means, including at least one detachable clamping bolt, is provided to clamp the free ends of the furcations of the spaced plates portions together for good electrical contact with the electrical stud.

In accordance with another embodiment of the present invention, there is associated with a slotted U-shaped strap portion a clamping bolt, which extends through the closed end of the U, and secures the furcations of the slotted U-shaped strap together for firm electrical contact with the associated electrical stud.

The present invention has particular applicability to disconnecting-switch structures in which, for example, a grounding switch blade is utilized, which is rotatable into its open and closed-circuit positions. At the relatively stationary end of the rotatable grounding switch blade, there may be used, to advantage, the improved electrical connector of the present application.

Accordingly, it is a general object of the present invention to provide an improved disconnecting-switch structure having an improved electrical connector associated with the movable blade portion thereof.

Another object of the present invention is the provision of an improved electrical connector of inexpensive construction, and readily fabricated in an expensive manner, and involving relatively few component parts.

Still a further object of the present invention is an improved vacuum-type circuit interrupter having an improved electrical connection associated with either the stationary or movable contacts thereof.

Still a further object of the present invention is the provision of an improved bus-riser arrangement, which may be detachably connected to the primary disconnecting contact of the breaker.

Further objects and advantages will readily become apparent upon reading the following specification, taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a high-voltage disconnecting switch having associated therewith an improved grounding switch, to which the improved electrical connector of the present invention is applied, the disconnecting switch being illustrated in the closed-circuit position, and the grounding blade also being shown in the closed-circuit position;

FIG. 2 is a top plan view of the disconnecting switch of FIG. 1, again the high-voltage disconnecting switch-blade being shown in the closed-circuit position, and portions of the grounding blade being omitted for clarity;

FIG. 3 is an end elevational view of the disconnecting-switch structure of FIGS. 1 and 2, the high-voltage disconnecting switch-blade being shown in the closed-circuit position, and also the grounding blade being shown in the closed-circuit position.

FIGS. 4 and 5 illustrate detailed views of the improved electrical connector applied to the lower end of the rotatable grounding blade of FIG. 3;

FIG. 6 illustrates the upper end of a terminal-bushing structure illustrating an application of the improved electrical connector of the present invention;

FIG. 7 is an enlarged top plan view of the electrical connector of FIG. 6, showing the improved clamping construction;

FIG. 8 is a side elevational view of the electrical connector of FIG. 7;

FIG. 9 is an end elevational view of the electrical connector shown in FIG. 8, taken substantially along the line IX-IX of FIG. 8;

FIG. 10 illustrates a vacuum-type circuit interrupter with the contacts illustrated in the open-circuit position, and illustrating an application of the electrical connector to the upper stationary contact stud of the breaker;

FIG. 11 shows a bus-riser attachment to the primary stationary disconnecting contacts of the interrupter of FIG. 10, utilizing the improved electrical connector of the present invention, as connecting to upwardly-extending bus structure, the latter extending into cubical connectors, not shown.

FIG. 12 illustrates a further form of clamping connector; and.

FIGS. 13 and 14 illustrate, to an enlarged scale, the separate formed slotted clamping plates used in the modified clamping arrangement of FIG. 12.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1-3 illustrate a high-voltage disconnecting-switch structure 1 having incorporated therewith a grounding-switch structure 2, of the general type as set forth in U.S. Pat. No. 3,316,366, issued Apr. 25, 1967, to George Sivy and Victor F. Sabol, and assigned to the assignee of the instant application. As shown in FIGS. 1 and 2, it will be noted that, generally, there is surmounted upon a base member 4, preferably of channel-shaped construction, upstanding insulator stacks 6, 7 and 8, which support the live component parts of the disconnecting-switch structure 1, as shown more clearly in FIG. 1. At the upper end of the insulator stack 6 is provided a break-contact structure 10, and extending laterally thereof the stationary contact structure 12 for the grounding switch structure 2. The center insulating stack 7 supports the hinge-contact assembly 14 for the rotatable main switch-blade 16, which may be rotated about the pivot axis 18. For effecting the swinging rotative opening and closing motions of the high-voltage switch-blade structure 16 there is provided a crank-member 20, supported at the upper end of the third insulator stack 8. It will be noted that the third insulator stack 8 is adapted for rotative movement by a crank-arm 22, which may be mechanically connected to linkage-operating structure, not shown. Thus, by effecting the rotative motion of the crank-member 22 about a vertical axis, the third insulator stack 8 may be rotated, thereby effecting rotative movement of the crank-arm 20 about a horizontal plane, and through the linkage structure 24, effecting swinging upward and opening motion of the high-voltage disconnecting switch-blade 16.

Reference may be made to U.S. Pat. No. 3,194,905, issued July 13, 1965, to Francis W. Jewell and John H. Miles, Jr., and assigned to the assignee of the instant application, for a typical operating mechanism, which may be utilized interiorly of the hinge contact assembly 14 disposed at the upper end of the central, or middle insulator stack 7.

Cooperating with the live-break end 10 of the disconnecting-switch structure 1 is the grounding switch 2, which is actuated by the rotation of a horizontally-extending operating shaft 26, more clearly illustrated in FIG. 3 of the drawings. Thus, rotation of the operating shaft 26 (FIG. 3) effects swinging opening and closing motions of the grounding switch-blade 28 into and out of contacting engagement with the upper live stationary contact assembly 12, which makes engagement and disengagement with the upper free end 28a of the grounding disconnecting switch-blade 28.

It is necessary to provide a good electrical connection to the lower relatively stationary end of the grounding switch-blade 28. The improved electrical connector 30 of the present invention accomplishes this task. As shown more clearly in the detailed views of FIGS. 4 and 5, it will be observed that there is provided a U-shaped strap member 32 having a slotted intermediate portion 34, which leads into accommodating apertures 36, which accommodate the lower end 28b of the grounding switch-blade 28. A clamping bolt 38 and nut 39, shown more clearly in FIG. 5, extends

through the closed U-portion 41 of the U-shaped strip 32, and clamps the two furcations 32a, 32b of the plate portions 32c and 32d together in a manner more clearly shown in FIG. 5 of the drawings.

Flexible shunts 43, brazed to a plate portion 45, may be interposed between the free ends 32e, 32f of the furcations of the U-shaped strap member 32, and may be bolted together by suitable clamping bolts 47, as shown more clearly in FIG. 5 of the drawings.

From the foregoing description, it will be apparent that there has been provided an improved electrical connector 30, which assures good and secure mechanical and electrical attachment to the lower end 28b of the grounding switch-blade 28.

It will be apparent that not only could the improved electrical conductor 30 of the present invention be applied to the lower end of the movable grounding switch-blade 28, but, additionally, the improved electrical connector 30 could be applied, if desired, to the rotating swinging high-voltage disconnecting blade 16 to assure good electrical connection thereto.

FIGS. 6-9 illustrate another application of the present invention, FIG. 6 illustrating the upper portion of a terminal bushing, the details of which may be learned from a study of U.S. Pat. No. 3,529,072, issued Sept. 15, 1970, to Charles F. Sonnenberg and James H. Frakes, and assigned to the assignee of the instant application. This patent illustrates a typical terminal bushing, but it will be obvious to those skilled in the art, that the improved electrical connector 30 of the present invention could be applied to any terminal-bushing structure, which has an externally-extending stud portion, such as the stud 51 of FIG. 6.

FIGS. 7-9 illustrate a modification of the invention involving the use of spaced conducting plates 53, 55, each having a slotted portion extending into an aperture, which accommodates the stud portion 51 of the terminal bushing 49 of FIG. 6. As shown, a pair of spaced conducting flat plates 53, 55 have slots 53a, 55a, which lead into apertures 53b, 55b, conformed to closely surround the terminal stud 51. Notches 53c, 55c, are stamped, or otherwise formed, in the flat plates 53, 55 to accommodate U-shaped cleats 57, 59. These cleats 57, 59 have holes therein to receive a clamping bolt 60 and nut 61. This clamps the furcations 53c, 55c together to thereby firmly clamp the sides of the holes 53b, 55b to the sides of the terminal-bushing stud 51.

FIG. 9, which illustrates an end view of the electrical connector 52 of FIG. 8, more clearly illustrates the cooperation between the cleats 57, 59 and the clamping bolt 60, as shown.

FIG. 10 illustrates the application of the improved electrical connector of the present invention to the upper stationary contact stud 63 of a vacuum-type circuit interrupter 65. Reference may be made to U.S. Pat. application Ser. No. 709,013, filed Feb. 28, 1968, now U.S. Pat. 3,603,753, issued Sept. 7, 1971 to Russell E. Frink, and assigned to the assignee of the instant application, for an understanding of the working of the switch. Generally, as will be obvious to those skilled in the art, upward rotative movement of the operating lever 67, as effected by upward movement of the insulating operating rod 69, effects upward closing movement of the movable contact 70 into abutment with the stationary contact 71 to make electrical connection through the switch 65. Correspondingly, downward movement of the insulating operating rod 69 affects

counterclockwise rotative movement of the contact lever 67 to thereby effect downward opening motion of the movable contact 70 downwardly away from the stationary contact 71 to effect opening of the switch 65. The base portion 72 is, in the particular switch structure, made of porcelain, as set forth in U.S. Pat. No. 3,437,554 — James R. Gamble, and electrically isolates the primary disconnecting contact studs 75 and 76 leading to the stationary and movable contacts 70, 71 of the switch.

With reference to FIG. 10, it will be noted that again there is provided the mechanical and electrical connector attachment 52, as illustrated more clearly in FIGS. 7-9 of the drawings. As before, spaced slotted plates 53, 55 have accommodating apertures 53b, 55b provided therein to receive the stud portion 63 of the stationary contact 71; and the mounting bolt 60, acting through the cleats 57, 59 effects clamping inward engagement of the furcations 53c, 55c, of the plates 53, 55 into good electrical attachment.

FIG. 11 illustrates a bus-riser arrangement in which the upwardly-extending bus-bar 78 is electrically connected to the primary disconnecting contact 80 of the circuit-breaker structure 65, as shown in FIG. 10. It will be noted that the base supporting portion 72 of FIG. 11 may be the same type of base structure 72, as shown in FIG. 10, and the primary disconnecting contact 80 of the circuit-breaker structure 65 may be electrically connected to the bus-bar riser 78, as shown in FIG. 11. Again, the clamping structure may be as illustrated in FIGS. 7 through 9 of the drawings.

From the foregoing description, it will be apparent that the improved detachable electrical connector 30, 52 of the present invention has wide application, in the instant application being illustrated as used with terminal-bushing structures, disconnecting-switch structures, circuit-breaker structures and bus-riser attachments to breaker structures.

The electrical joint structure 30, 52 of the present invention has many advantages. It eliminates the expensive manufacturing processes, as required heretofore, such as threading, milling, drilling and tapping operations. The plate portions are of such cross-section, that they may be fabricated by inexpensive stamping methods; and a more efficient electrical joint may be achieved by clamping bolts 38, 60. For example, the clamping bolt 38 or 60 may be slightly increased from $\frac{3}{8}$ inch diameter clamping bolt to a $\frac{1}{2}$ inch diameter clamping bolt, having a clamping force twice that achieved with the formerly-used three-eighths inch diameter clamping bolt of prior-art connectors. Material savings are also realized with the improved electrical connector arrangement of the present invention.

The improved electrical connector arrangement of the present invention has resulted in considerable cost savings being realized, using this split clamp-type of arrangement over existing designs.

FIGS. 12-14 illustrate a further embodiment of the invention, in which each connector plate 83 is provided

with a recess portion 83a, which accommodates the clamping bolt 82, as shown more clearly in FIG. 12 of the drawings. It will be noted that again each connector plate 83 is provided with a slot 84 and an aperture 85, which closely surrounds the stud portion 63 of the stationary-contact end of the vacuum "bottle" 65.

It will be observed that by the provision of the recess portion 83a, the cleats 57 may thereby be omitted entirely, as shown more clearly in FIG. 12 of the drawings. The functioning of the connector plates 83 is as described hereinbefore.

Although there have been illustrated and described specific structures, it is to be understood that the same were merely for the purpose of illustration, and that changes and modifications may readily be made therein by those skilled in the art, without departing from the spirit and scope of the invention.

I claim as my invention:

1. A detachable clamping heavy-current electrical connector adaptable for making a good clamping electrical connection to an electrical stud, comprising, in combination, a pair of abutting separable flat independent plates formed of a relatively heavy plate material and each plate having an aperture therethrough of generally the same size and configuration as the electrical stud to which connection is desired, a slot in each separable independent plate communicating with the aperture in the respective separable plate, each separable plate having a semicircular groove provided therein at one end of the respective plate and disposed transversely of the respective slot, said slot in each plate opening to the edge of the plate, means for securing said pair of flat plates in abutment, and clamping means comprising at least one detachable clamping bolt for clamping the free ends of the furcations of the abutting plates together for good electrical contact with the electrical stud, and said detachable clamping bolt being encompassed and guided by the cooperating semicircular grooves provided by the abutting separable plates.
2. The combination of claim 11, wherein an additional slot is provided diametrically opposite the slot in each flat plate on the opposite side of the respective aperture therein.

3. An electrical connector joint including means defining a terminal stud, a pair of slotted and apertured conducting clamping plates with the apertures conforming to the cross-sectional configuration of said terminal stud, a pair of cleats straddling the opposite furcations of the clamping plates, and a clamping bolt extending through both cleats and disposed between the furcated ends of the two clamping plates.

4. The electrical connector joint combination of claim 3, wherein the terminal stud has a round cross-sectional configuration and the apertures in the clamping plates are also round and of substantially the same diameter as the diameter of the terminal stud.

5. The combination of claim 3, wherein the cleats are apertured U-shaped members.

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