Dec. 18, 1956 D. W. DOW ET AL 2,774,804

STUD POSITIONING JIG WITH CONTINUOUS SELF-BAKING ELECTRODE AND METHOD OF POSITIONING CONTACT STUDS THEREIN

Filed Nov. 20, 1952 2 Sheets-Sheet 1

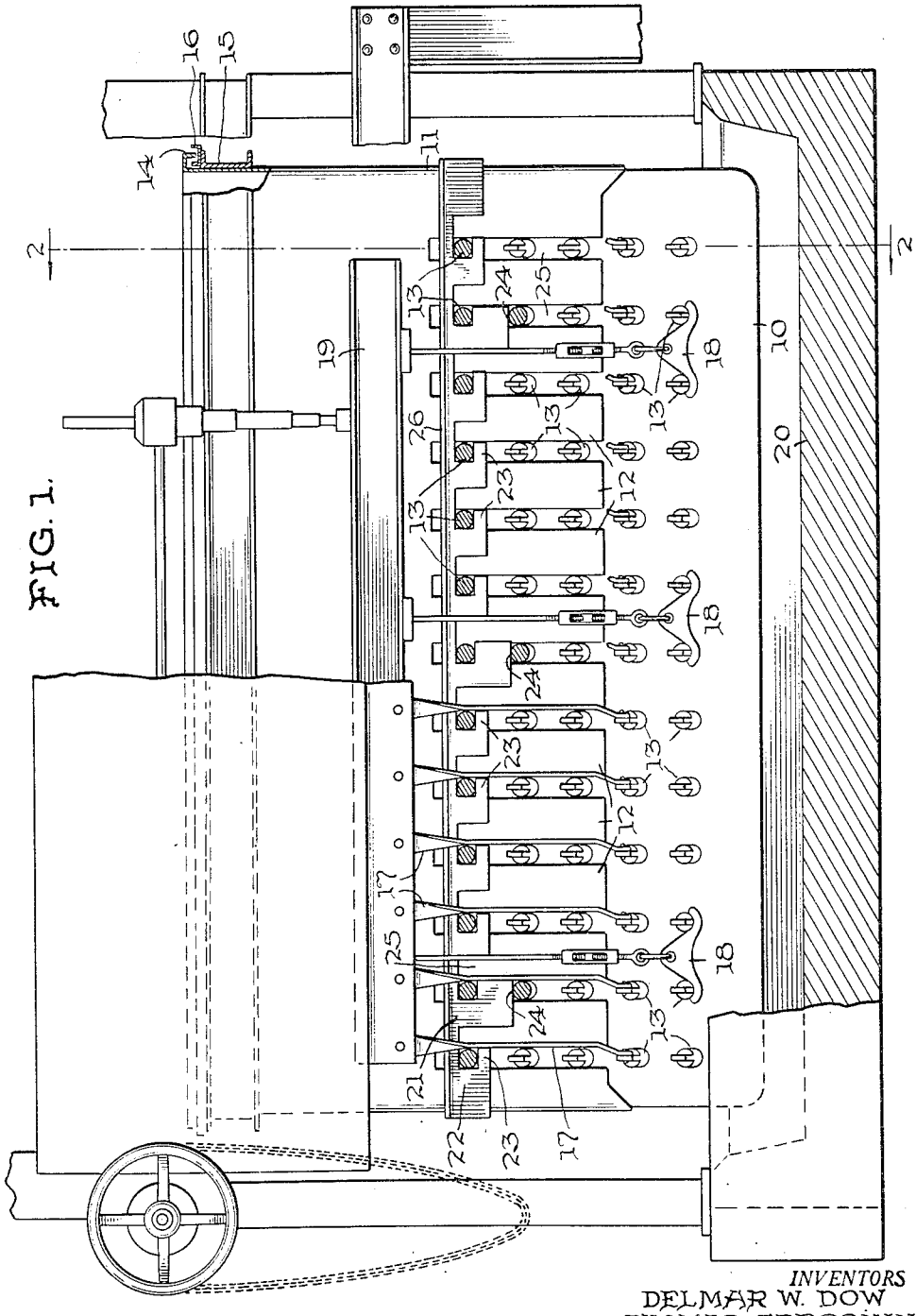


FIG. 1.

INVENTORS
DELMAR W. DOW
THOMAS TREGONING
BY
James E. Toomey
ATTORNEY

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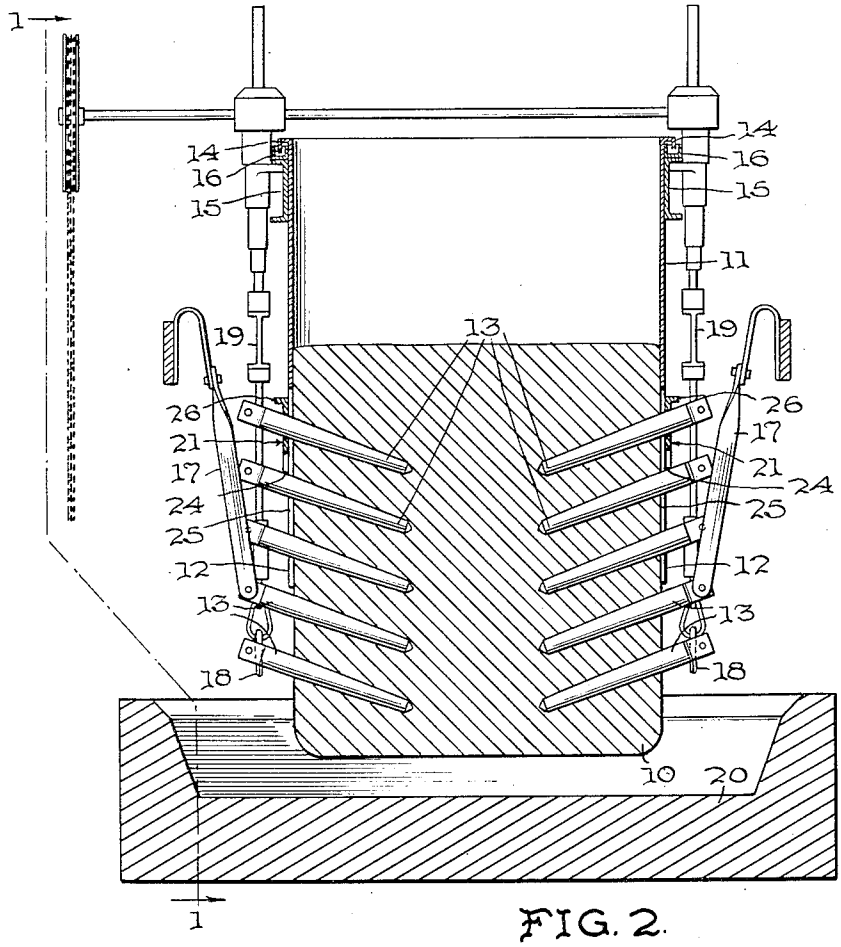


FIG. 2.

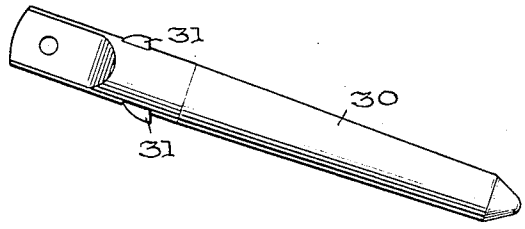


FIG. 3.

INVENTORS
DELMAR W. DOW
THOMAS TREGONING
BY
James E. Toomey
ATTORNEY

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STUD POSITIONING JIG WITH CONTINUOUS SELF-BAKING ELECTRODE AND METHOD OF POSITIONING CONTACT STUDS THEREIN

Delmar W. Dow, Tacoma, and Thomas Tregoning, Puyallup, Wash., assignors to Kaiser Aluminum & Chemical Corporation, Oakland, Calif., a corporation of Delaware

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17 Claims. (Cl. 13—18)

This invention relates to electric furnaces employing electrodes of the continuous or self-baking type, and more particularly relates to a positioning means for positioning contact studs in a continuous electrode of the so-called channelless type horizontal stud continuous electrode as employed in the electrolytic reduction of alumina.

Heretofore, continuous electrodes employing horizontal contact stud suspension means have been characterized as channelled and channel-less types. The channelled type continuous electrode forming and suspension means is exemplified in Legeron Patent No. 2,169,563. The latter developed channel-less type electrode, to which this invention applies, is exemplified in Sem et al. Patent No. 2,337,279 and Hagerup-Larssen Patent No. 2,339,230. The channel-less type of construction, such as is shown in the latter two patents, has several advantages over the channelled construction, in that the channel-less construction is simpler and more cheaply constructed and allows greater operational efficiency due to elimination of the heavy channels or beams and the time consuming and difficult disassembling, handling and reassembling necessary when the channelled or beamed structure is employed. However, one serious disadvantage is presented in operation of the channel-less type pot. When the contact studs are inserted into the unbaked portion of the electrode, and until the contact studs are baked in place in the electrode, a considerable tendency has been encountered for the contact studs to get out of alignment because of their relatively greater weight and because of magnetic field effects caused by current flow in the current conductors and furnace bath. Stated otherwise, there is a pronounced tendency for the individual studs to move more or less rapidly than the electrodes so that by the time the studs are held in place by baking of the electrode the studs are then no longer correctly horizontally and vertically aligned to properly and equally distribute the weight of the electrode when they are utilized as suspension means and to properly distribute the current density across the lower face of the electrode during subsequent operation of the furnace.

It is an object of this invention to present a means of controlling the position of the contact studs utilized in channel-less type horizontal stud continuous electrode furnaces so that such contact studs will be properly positioned in the selected horizontal and vertical arrangement until they are baked into the electrode.

It is a further object of this invention to present a positioning jig of simple construction for controlling the position of horizontally arranged contact studs in the unbaked portion of a continuous electrode.

It is a further object of this invention to present a light weight contact stud positioning jig for use with channel-less type continuous electrodes, so designed as to facilitate its removal from guiding position for a given horizontal row of contact studs and its placement in new guiding position for a successive row of horizontal studs.

It is a further object of this invention to present a method of positioning contact studs in horizontal and vertical alignment in a channel-less, horizontal stud type continuous electrode and of retaining said contact studs in such positions of alignment until said contact studs become baked-in by operation of the furnace.

It has been found that the tendency for the contact studs inserted in the unbaked portion of a channel-less type electrode to deviate from proper relative position may be eliminated by use of a contact stud positioning jig supported in proper guiding and position retention position by means of a vertically movable portion of the electrode, such as the successively lower horizontal row of contact studs. It has been further found that this contact stud positioning jig may be so designed as to allow simple removal from guiding position for a given horizontal row of contact studs and simple placement in new position for a successive row of contact studs.

To illustrate a specific embodiment of the invention, reference is made to the accompanying figures which are schematic in character and partly in section, with various details of the channel-less type electrode and electric furnace known to the art omitted for the sake of clarity of illustration.

Figure 1 is a side elevational view of a portion of an electric furnace utilizing a channel-less type continuous electrode and showing a specific form of contact stud positioning jig in operative position. The view of Figure 1 is taken generally along the line 1—1 of Figure 2 with various parts shown in section.

Figure 2 is an end elevational view of the partial furnace construction illustrated in Figure 1, generally along the line 2—2 of Figure 1, with various parts shown in section.

Figure 3 is an enlarged side view of one form of contact stud which may be employed with the continuous electrode and contact stud positioning jig illustrated in Figures 1 and 2.

Referring to Figures 1 and 2, the electrode mass **10**, supplied with electrode paste material at the top of the electrode in a conventional manner, is contained in a stationary casing **11**, which casing in its lower side portions is slotted vertically to provide downwardly depending sections **12**, the cut-out portions allowing for vertical movement of contact studs **13** inserted in the electrode mass **10** downwardly through the casing **11**, and the downwardly depending sections **12** serving to aid in retention of the partially unbaked portion of the electrode mass until the mass has reached the point, during its downward movement, where it has been baked in fixed form. The stationary casing **11** is provided with a suitable flange means **14** which serves to suspend the stationary casing **11** from framework **15**, the flange **14** resting on a suitable sand lock **16** in a conventional manner. Contact studs **13** in the lowermost portion of the electrode mass **10** serve to conduct the electric current to the lower surface of the electrode mass **10** through suitable bus bar means **17** in a known manner, certain of the baked in contact studs **13** also serving as support means for the electrode through suitable vertical suspension means **18** which in turn depend from a vertically movable support frame **19**. The conventional continuous electrode electric furnace further comprises a cathodic bed **20** and suitable ore feeding and gas trapping and vent means, not shown.

A specific embodiment of a light weight contact stud positioning jig for use with the above described horizontal stud channel-less type continuous electrode is shown in operative position in Figures 1 and 2 and comprises, as illustrated, a light weight elongated member **21** having downwardly extending contact stud guide portions **22**, dimensioned to accommodate the vertical dimension of a contact stud and further having depending from said downwardly depending portion **22** a longitudinally extending portion **23**, dimensioned to provide a horizontal

guiding and positioning surface for a contact stud 13. Further, a plurality of the downwardly depending portions 22 are dimensioned so that the lower surface 24 thereof may rest on and be supported by the next lower row of contact studs 13 when the contact stud positioning jig is in proper guiding and retaining position for the row of contact studs 13 about to be inserted in the unbaked portion of the electrode mass 10. In the illustrated embodiment, the relative dimensions of downwardly depending portion 22 and horizontally depending portion 23 are selected to provide a passageway 25 of sufficient dimension to allow the respective positioned contact studs and the contact stud positioning jig to be relatively removable in the general plane of the contact stud positioning jig.

Consideration will now be given to the form of contact stud shown in Figure 3. Although the contact studs 13 illustrated in Figures 1 and 2 have conventional smooth surfaces, it may be found advantageous to utilize contact studs of a form illustrated in Figure 3 wherein the smooth sides 30 are provided with vertically arranged upper and lower raised portions 31 positioned and dimensioned as shown to abut the outward plane surface of the positioning jig to aid in positioning the studs at the proper angle and depth in the electrode mass and to aid in retention of the jig in proper position.

In view of the foregoing description, the manipulation of the light weight contact stud positioning jig during operation of the furnace will be apparent. Operation of the furnace involves removal of the electrode mass 10 from its lower face by oxidation and further involves successive downward vertical movement of the electrode mass 10 to compensate for such removal. During normal operation of the furnace the lowermost row of horizontal contact studs 13 are removed from their functions as current carrying and electrode suspension means as the lower ends thereof approach the lower electrode surface, such removal being accomplished by movement of the bus bars 17 and electrode suspension means 18 to the respective next upper row of contact studs. After these functions have been transferred to said next upper row, the lowermost row of contact studs 13 are removed from the electrode in a manner known to the art and returned to the electrode mass 10 by the formation of an additional horizontal row in the uppermost and unbaked portion of the electrode mass 10. It is in the guiding and the position retention of this newly inserted row of contact studs 13 that the contact stud positioning jig has been found to contribute materially to the operational efficiency of this type of furnace.

Assuming the previous operation of the contact stud positioning jig has properly aligned a horizontal row of contact studs 13 until they are baked in position, then, at the time of insertion of the succeeding upper row of contact studs 13, the contact stud positioning jig illustrated may be moved in the direction of its longitudinal dimension so as to place the respective positioned contact studs 13 in vertical alignment with passageway 25, then moved vertically upward to free the jig from the positioned row of contact studs 13, then moved in a reverse longitudinal direction to place the respective resting surfaces 24 in contact with certain of the previously positioned row of contact studs, thereby placing the respective guide means 22 and 23 for the contact studs 13 to be inserted in proper relative horizontal and vertical position to guide and retain in position the newly inserted contact studs 13 until they become baked in such position.

The light weight contact stud positioning jig may be provided with suitable flange means as shown at 26 for strengthening, if desired.

Horizontal stud channel-less type continuous electrodes may be constructed with downwardly depending portions 12 of the mold casing 11 omitted, to provide a large cut-out portion along the side of the electrode, in a manner known to the art and exemplified in Sem et al. Patent No. 2,337,279, Figure 6. With the channel-less construction so modified, the tendency for contact studs embedded in the unbaked portion of the electrode mass 10 to deviate from desired relative position, particularly horizontally, is aggravated. As previously stated, however, the tendency for contact studs embedded in the unbaked portion to deviate in a vertical direction is most pronounced and most disadvantageous, since weight suspension and current conduction through the contact studs both occur in a generally vertical direction.

It will be apparent from the foregoing description that the use of a contact stud positioning jig of the type disclosed herein will allow the advantages of channel-less furnace electrode operation to be realized without the poor contact stud grouping heretofore encountered in the channel-less type electrode, thus through proper positional arrangement, allowing better and more equal suspension of the continuous electrode, thus minimizing breakage, allowing easy removal of the contact studs, and making possible improved electrode current distribution throughout the lower surface of the electrode mass with consequent more efficient operation.

It will be apparent that the number of supporting surfaces 24 utilized to properly position the jig may be varied as desired.

It will be further apparent that various changes, modifications, and alterations may be made to the specific contact stud positioning jig disclosed herein as, for example, it will be seen that longitudinal portion 21 does not necessarily have to be of unitary construction in realizing the desired results of the instant invention. It is further obvious to those skilled in the art that, although 5 horizontal rows of contact studs are illustrated, a different number of horizontal rows may be utilized, the construction and manipulation of the positioning jig and the operation of the continuous electrode not being materially altered thereby. It is further considered that the contact stud guiding surfaces could be of a configuration other than the angular configuratifion illustrated.

As previously disclosed and illustrated, the contact stud positioning jig may be supported by the next lower row of contact studs. It will be further apparent that the contact stud positioning jig may be supported by other suitable means so long as the guiding and position retention functions of the jig are accomplished.

The contact stud positioning jig construction and manipulation as disclosed herein may be applied to horizontal stud channel-less type electrodes in electric furnaces used in general smelting operations, the making of steel, the production of calcium carbide and other similar applications as well as the reduction of alumina, wherein the tendency for contact studs to become misaligned in the unbaked portion of the electrode mass is encountered.

What is claimed is:

1. A continuous self-baking electrode of the channel-less horizontal stud type having a lower baked portion and an upper unbaked portion and provided with contact studs partially embedded in the electrode and arranged in substantial horizontal and vertical alignment along the side surfaces of the electrode, in combination with a contact stud positioning jig provided with guiding surfaces positioned to retain each respective contact stud partially embedded in the unbaked portion of the electrode in a relative position of substantially fixed vertical spacing and alignment with a contact stud partially embedded in the baked portion of the electrode.

2. Apparatus according to claim 1 wherein the fixed vertical spacing of the guiding surfaces of the contact stud positioning jig is provided by a plurality of surfaces which contact and are supported by a plurality of previously positioned contact studs.

3. A continuous self-baking electrode of the channel-less horizontal stud type having a lower baked portion and an upper unbaked portion and provided with contact studs partially embedded in the electrode and arranged in substantial horizontal and vertical alignment along

the side surfaces of the electrode, in combination with a contact stud positioning jig provided with guiding surfaces positioned to retain each respective contact stud partially embedded in the unbaked portion of the electrode in a relative position of substantially fixed vertical spacing and alignment with a contact stud partially embedded in the baked portion of the electrode, the fixed vertical spacing of the guiding surfaces of said jig being provided by a plurality of surfaces which contact and are supported by a plurality of previously positioned contact studs, and wherein the guiding surfaces of the contact stud positioning jig are each dimensioned to provide a passageway to allow removal of the guiding surfaces from guiding position by relative movement of the jig and the positioned contact studs in the general plane of the jig.

4. In combination with a continuous electrode of the channel-less horizontal stud type having contact studs partially embedded therein in relative horizontal and vertical alignment, a contact stud positioning jig comprising guide means to allow insertion of contact studs in proper relative horizontal and vertical position in substantial vertical alignment with previously positioned studs, said contact positioning jig further comprising a plurality of resting surfaces dimensioned to abut a plurality of said previously positioned studs when said guide means are in guiding position for the newly inserted row.

5. Apparatus according to claim 4 wherein said contact studs are provided with upper and lower raised portions thereon positioned and dimensioned to abut the surface of the jig when the contact studs have been partially embedded in the electrode at the desired angle and depth, the surface of said portions adapted to abut the jig lying in a plane that is at an oblique angle to the longitudinal axis of the stud.

6. A contact stud positioning jig for use in combination with a self-baking electrode of the horizontal contact stud channel-less type comprising guiding surfaces positioned to retain contact studs partially embedded in the unbaked portion of the electrode in substantial vertical alignment with respect to previously positioned contact studs, said jig further comprising surfaces dimensioned to contact a plurality of previously positioned contact studs to maintain said guiding surfaces in proper position to retain said contact studs partially embedded in the unbaked portion of the electrode in the desired vertical spacing from the row of said previously positioned contact studs.

7. Apparatus according to claim 6 wherein said guiding surfaces are each provided with a passageway to allow removal of the guiding surfaces from guiding position by relative movement of the jig and the contact studs in the general plane of the jig.

8. A contact stud positioning jig for use in combination with a continuous electrode of the channel-less horizontal stud type, comprising an elongated element, downwardly depending portions depending from said element dimensioned to provide a vertical guiding surface for a contact stud, a laterally depending portion depending from each of said downwardly depending portions dimentioned to provide a horizontal guiding surface for a contact stud, a plurality of said downwardly depending portions being dimensioned to provide surfaces adapted to rest on the next lower row of contact studs.

9. The method of positioning contact studs in a continuous electrode of the channel-less horizontal stud type comprising positioning guiding surfaces at predetermined relative positions on the sides of the unbaked portion of the electrode, partially embedding contact studs in said unbaked portion at the positions defined by said guiding surfaces, and maintaining said guiding surfaces in such position until the contact studs become baked in the electrode mass.

10. The method according to claim 9 which further comprises removing said guiding surfaces from guiding position after said contact studs become baked in the electrode and repositioning said guiding surfaces adjacent the unbaked portion of the electrode in proper position for insertion and retention in position of additional contact studs therein.

11. The method according to claim 10, comprising removing said guiding surfaces from guiding position after the contact studs become baked in the electrode by relative movement of the contact studs and the guiding surfaces through passageways provided in said surfaces.

12. A continuous self-baking electrode of the channel-less horizontal stud type having a lower baked portion and an upper unbaked portion and provided with contact studs partially embedded in the electrode and arranged in substantial horizontal and vertical alignment along the side surfaces of the electrode, in combination with a contact stud positioning jig provided with guiding surfaces positioned to retain each respective contact stud partially embedded in the unbaked portion of the electrode in a relative position of substantially fixed vertical spacing and alignment with a contact stud partially embedded in the baked portion of the electrode, said jig further being provided with a plurality of surfaces which contact and are supported by a plurality of previously positioned contact studs, said guiding surfaces being dimensioned to provide a passageway to allow removal of the guiding surfaces from guiding position by relative movement of said jig and the positioned contact studs in the general direction of the longitudinal dimension of the jig and then allow relative movement of the jig in a general vertical direction and relative movement in a reverse longitudinal direction to place the jig in new guiding position.

13. A continuous self-baking electrode of the channel-less horizontal stud type having a lower baked portion and an upper unbaked portion and provided with contact studs partially embedded in the electrode and aranged in substantial horizontal and vertical alignment along the side surfaces of the electrode, in combination with a contact stud positioning jig provided with guiding surfaces positioned to retain each respective contact stud partially embedded in the unbaked portion of the electrode in a relative position of substantially fixed vertical spacing and alignment with a contact stud partially embedded in the baked portion of the electrode, said guiding surfaces being dimensioned to provide a passageway to allow removal of the guiding surfaces from guiding position by relative movement of said jig and the positioned contact studs in the general direction of the longitudinal dimension of the jig and then allow relative movement of the jig in a general vertical direction and relative movement in a reverse longtitudinal direction to place the jig in new guiding position.

14. A contact stud positioning jig for use in combination with a continuous electrode of the channel-less horizontal stud type, comprising an elongated element, downwardly depending portions depending from said element dimensioned to provide a vertical guiding surface for a contact stud, a laterally depending portion depending from each of said downwardly depending portions dimensioned to provide a horizontal guiding surface for a contact stud, said guiding surfaces being dimensioned to provide a passageway to allow removal of the guiding surfaces from guiding position by relative movement of said jig and the positioned contact studs in the general direction of the longitudinal dimension of the jig and then allow relative movement of the jig in a general vertical direction and relative movement in a reverse longitudinal direction to place the jig in new guiding position.

15. A contact stud positioning jig according to claim 14 wherein a plurality of said downwardly depending portions are dimensioned to provide surfaces adapted to rest on the next lower row of contact studs.

16. A contact stud positioning jig for use in combination with a continuous electrode of the channel-less horizontal stud type, comprising an elongated element, downwardly depending portions depending from said element dimensioned to provide a vertical guiding surface for a contact stud, a laterally depending portion depending from each of said downwardly depending portions dimensioned to provide a horizontal guiding surface for a contact stud, the lateral extent of each of said laterally depending portions being such that a space is defined with the adjacent downwardly depending portion for passage of a contact stud.

17. A contact stud positioning jig according to claim 16 wherein a plurality of said downwardly depending portions are dimensioned to provide surfaces adapted to rest on the next lower row of contact studs.

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