United States Patent

Alinder

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[54] AUTOMATIC CURRENT-REVERSING SWITCH

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[73] Assignee: **Clinton Supply Co.,** Chicago, Ill.

[22] Filed: **May 26, 1970**

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[52] **U.S. Cl.** .....**200/1 V,** 200/163

[51] **Int. Cl.** **H01h 67/20**

[58] **Field of Search** .....200/1 V, 163, 83 J

[56] **References Cited**

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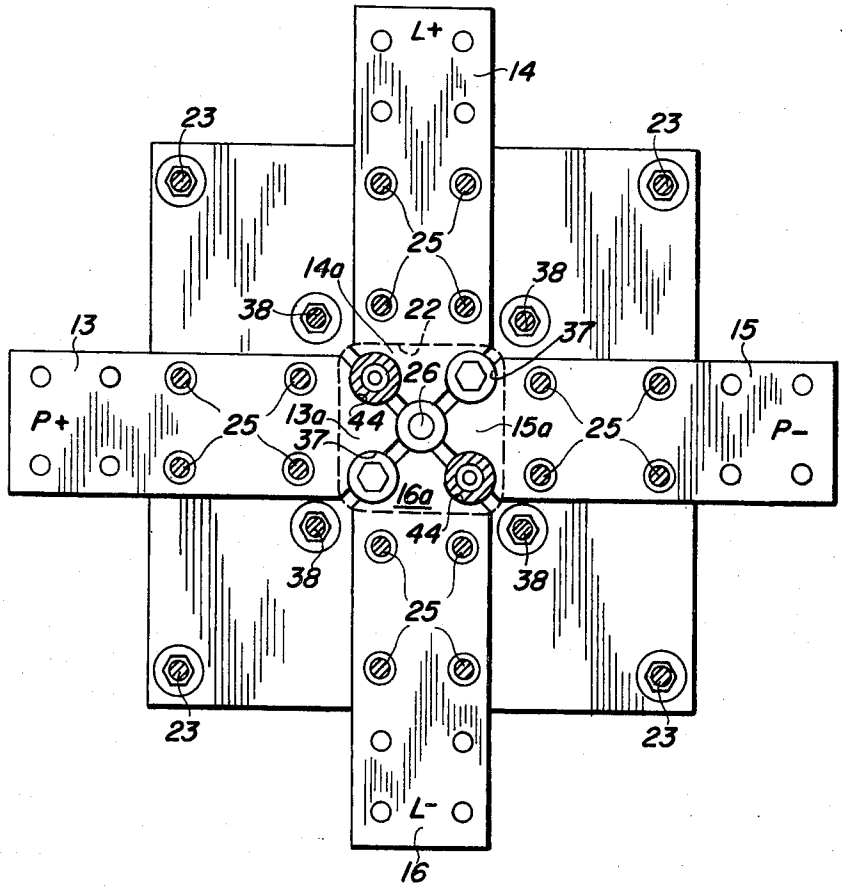
Primary Examiner—R. F. Staubly

Attorney—Rummler & Snow

[57] **ABSTRACT**

A current-reversing switch having four angularly disposed bus bars separated at the inner ends thereof. A power-actuated switch subassembly including a reciprocable shaft carrying switching contacts disposed on opposite sides of the bus bars. The switching contacts are disposed out of phase so that in one position of the reciprocable shaft the contacts on one side of the bus bars are operative to effect a current flow in one direction and in a second position on the opposite side the contacts are operative to reverse the current flow through the bus bars.

12 Claims, 9 Drawing Figures



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SHEET 1 OF 3

FIG - 1

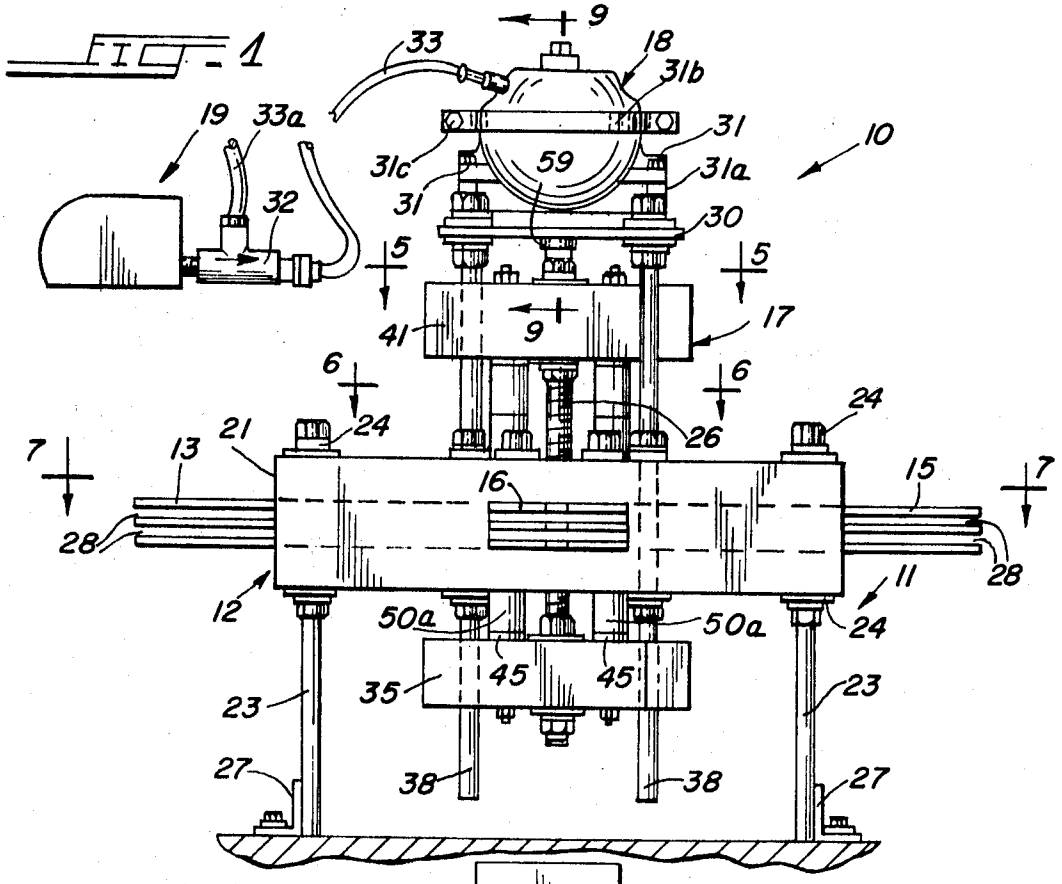
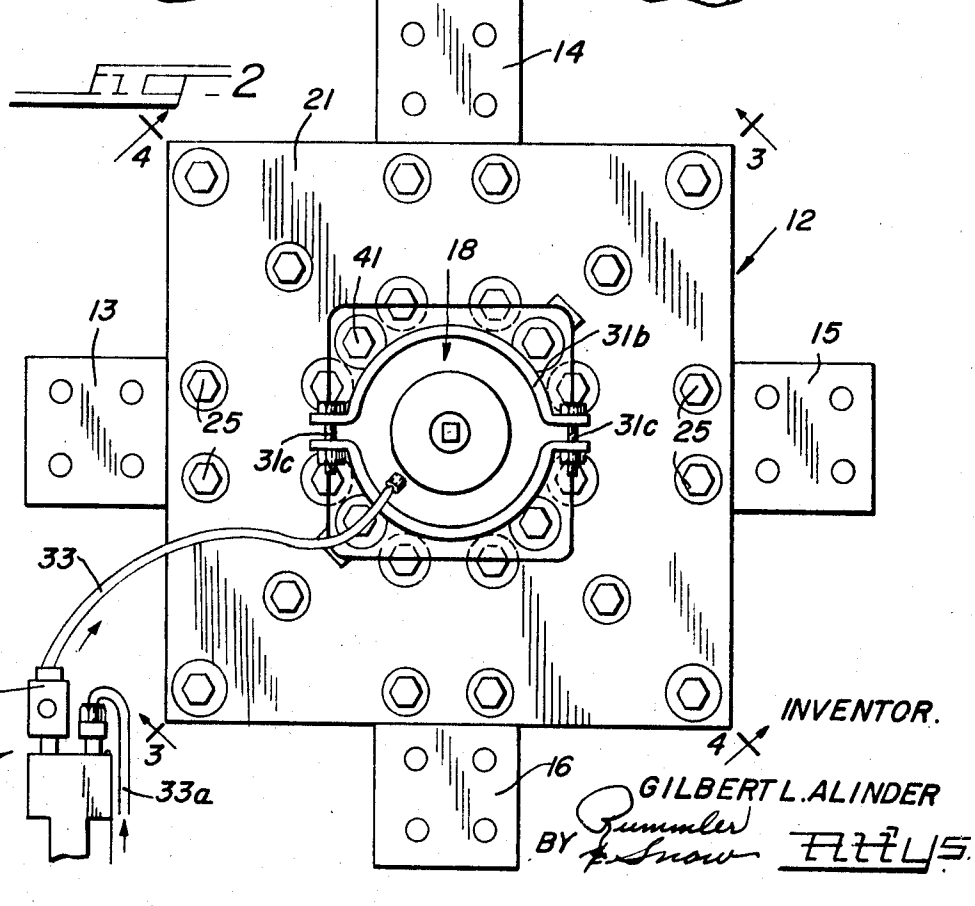


FIG - 2



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FIG. 3

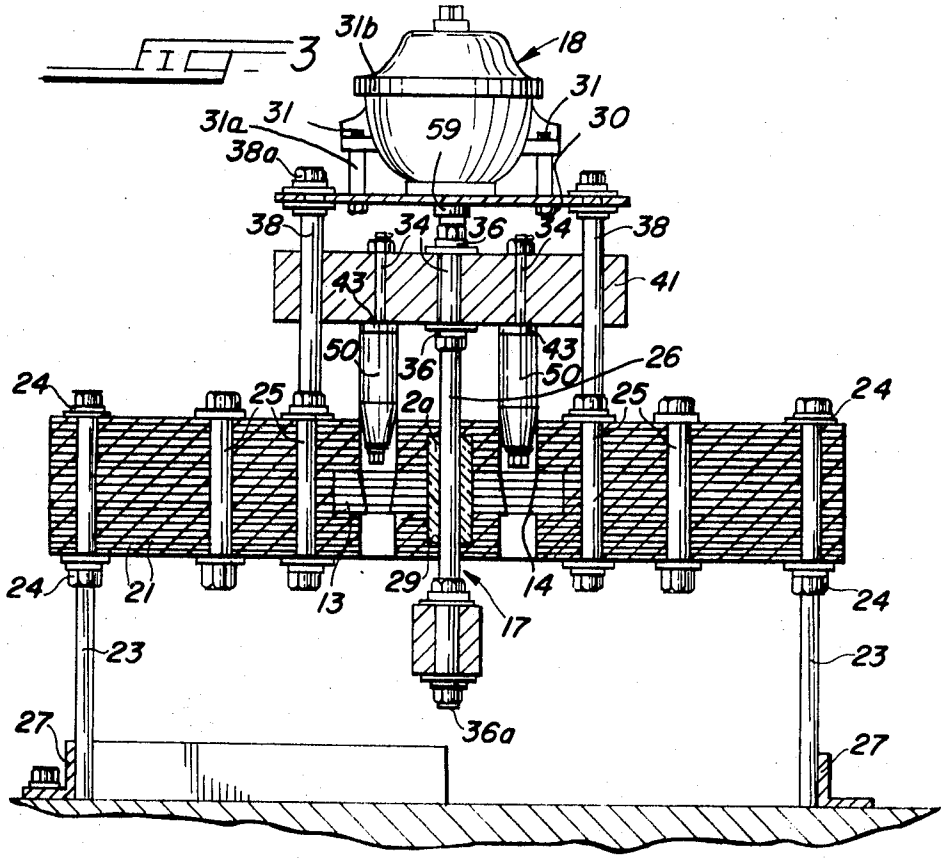
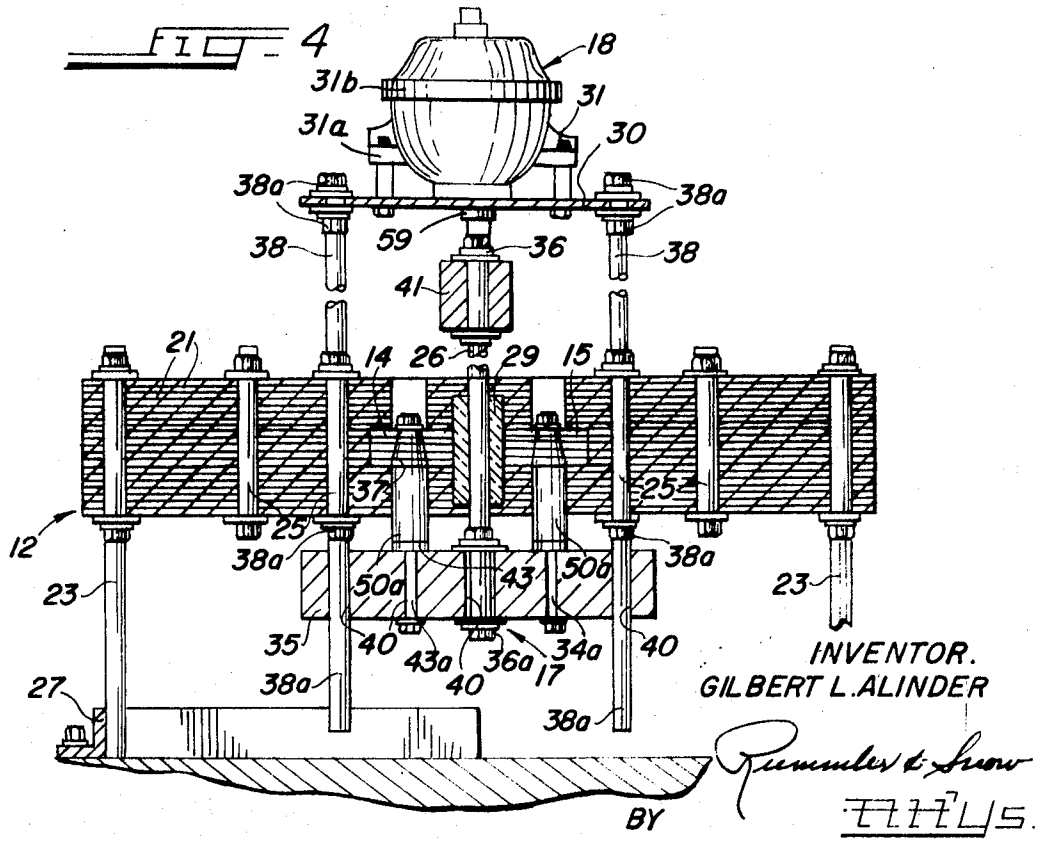


FIG. 4



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FIG — 5

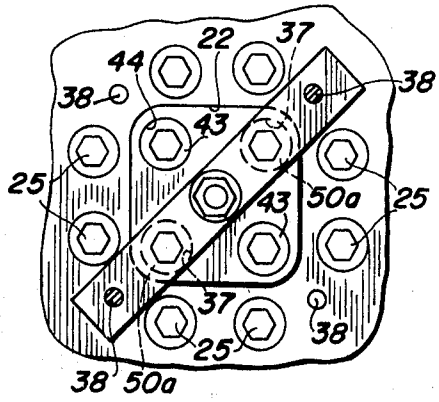


FIG — 6

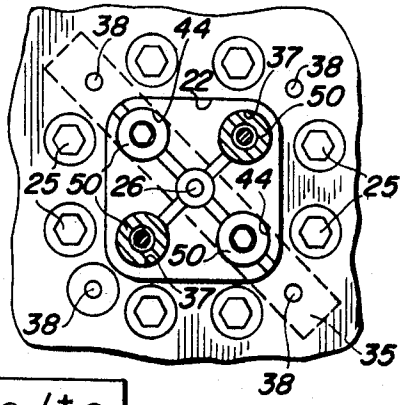


FIG — 7

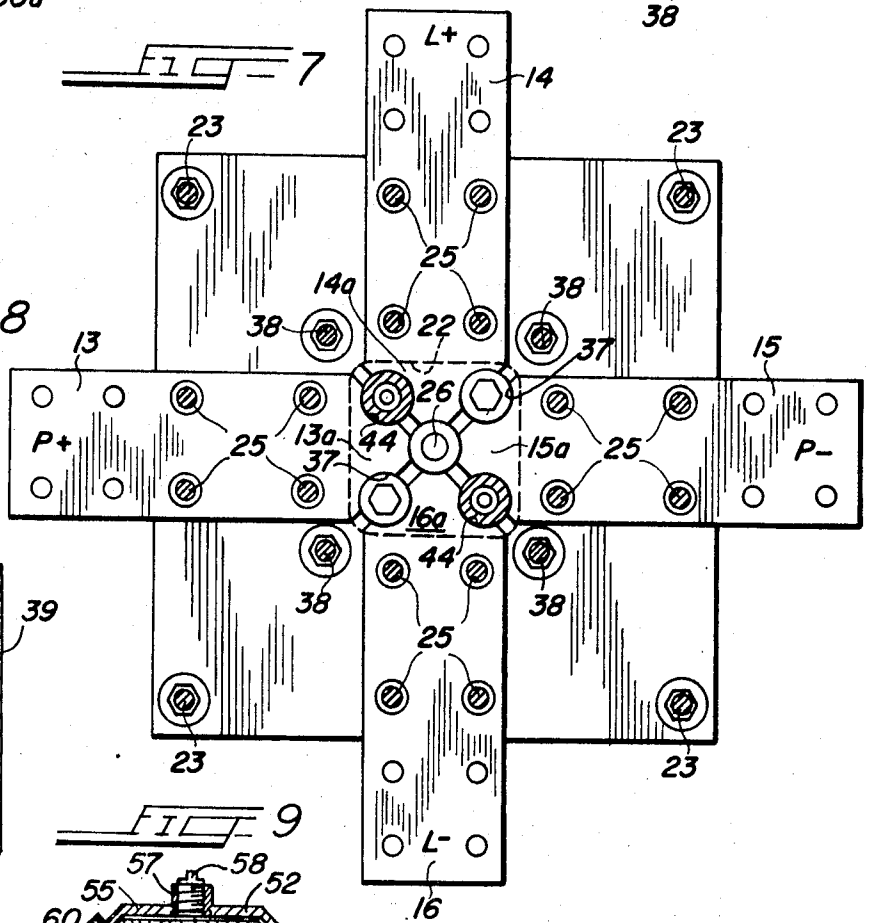


FIG — 8

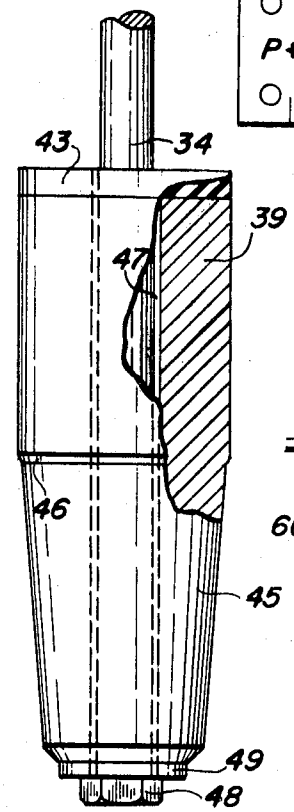
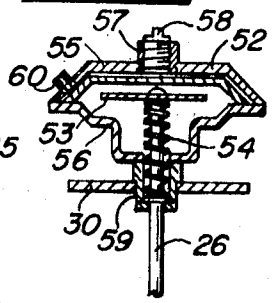


FIG — 9



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AUTOMATIC CURRENT-REVERSING SWITCH

The present invention relates to switches and more particularly to a new and improved automatic current reversing switch.

Current-reversing switches of the general type to which the present invention relates are used in electroplating for changing the polarity of the current flow to the equipment for effecting either plating or deplating. These plating and deplating operations are frequently performed in an electroplating installation such that current-reversing switches are subject to considerable wear.

BACKGROUND OF THE INVENTION

Heretofore, in the main current-reversing switches have been manually operated. The Geltner U.S. Pat. No. 3,315,057 is typical of this prior structure. Generally the prior art current-reversing switches have been constructed so as to require both a reciprocating and rotary movement to achieve the desired current flow. This has necessitated a complex and cumbersome structure. Moreover, the compound movement has resulted in considerable wear in the components which tends to shorten the useful life of the switch. A further disadvantage in the typical prior art switches has been the requirement that the current flow be deactivated by a separate circuit breaking switch prior to changing the polarity. These circuit breaking switches, of course, not only increase the cost of the unit but may also result in increasing the operating difficulties.

Furthermore, the prior current-reversing switches required a manual setting from one position to another to change the polarity.

SUMMARY OF THE INVENTION

By the present invention it is proposed to provide a current-reversing switch which overcomes the difficulties encountered heretofore.

It is a further object of the present invention to provide a current-reversing switch which is power operated and includes means reciprocably movable to selectively change the polarity.

It is still a further object to provide a current-reversing switch which is constructed and arranged so that the current is reversed by a contact arrangement which is linearly movable only.

It is another object to provide a current-reversing switch having an improved bus bar arrangement which is radially disposed on a support and a reciprocably movable contact means for selectively connecting the bus bars to change the current flow path therethrough.

It is still another object taken in conjunction with the immediately foregoing object wherein the contact means are in closed circuit engagement only at the termination of the reciprocable movement whereby the circuit is open during the interval between which the polarity is being reversed.

It is still another object to provide a current-reversing switch which is of simple construction and economical to manufacture.

The foregoing objects and others which will be readily apparent from the following specification are accomplished generally by a current-reversing switch including a plurality of radially extending bus bars which are angularly arranged on a support and separated at the inner ends thereof. Contact pins for selectively changing the flow of the current through the bus bars are disposed on opposite sides of the bus bar support. The contact pins are mounted on a common support which is mounted for reciprocable movement normal to the plane in which the bus bars are supported so that in one position the contact pins on one side of the bus bars are effective to achieve current flow in one direction and when moved to a second position the contacts on the opposite sides are effective to reverse the current flow.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevational view of the current-reversing apparatus embodying the structure of the present invention.

FIG. 2 is a top plan view of the current-reversing apparatus shown in FIG. 1.

FIG. 3 is a vertical cross-sectional view taken generally along the lines 3—3 of FIG. 2 and showing the upper contact pins in an open circuit position.

FIG. 4 is a vertical cross-sectional view taken generally along the lines 4—4 of FIG. 2 and showing the lower contact pins in a closed circuit position in the bus bars for achieving a current flow for effecting plating in an electroplating apparatus.

FIG. 5 is a cross-sectional view taken generally along the lines 5—5 of FIG. 1.

FIG. 6 is a cross-sectional view taken generally along the lines 6—6 of FIG. 1.

FIG. 7 is a cross-sectional view taken generally along the lines 7—7 of FIG. 1 and showing the bus bar arrangement on the support plate with the contact pins positioned to effect the current flow for achieving plating.

FIG. 8 is a fragmentary enlarged view of one of the contact pins with a portion thereof being broken away to show underlying details of structure.

FIG. 9 is a cross-sectional view taken on the lines 9—9 of FIG. 1.

DETAILED DESCRIPTION

Referring now to the drawings, there is shown a current-reversing apparatus or switch **10** embodying the structure of the present invention. The operation of the switch **10** will be hereinafter described as it is used with electroplating equipment. It is to be understood, however, that the switch **10** is not limited to such use.

The current-reversing switch **10** comprises generally a frame **11** including a bus bar support **12** on which there is mounted a plurality of bus bars **13**, **14**, **15** and **16**. Reciprocably mounted on the frame **11** is a switching or contact subassembly **17** which is movable between a first or raised and second or lower position for effecting a current reversal, as more fully to be explained hereinafter. The switching subassembly **17** is operated by a manual air valve **19** operable through the airbrake cylinder **18** against a preloaded spring **54**.

The frame **11** includes a plurality of laminate plates **21** between which the bus bars **13**, **14**, **15** and **16** are disposed and held in position. Each of the laminate plates **21** are formed with a centrally located opening **22** which may be substantially rectangular contour. The laminate plates **21** are assembled at the four corners by posts **23** which are threaded at the upper ends and hold the plates clamped between nut and washer assemblies **24**. Nut and bolt assemblies **25** clamp and hold the bus bars **13**, **14**, **15** and **16** assembled to the laminate plates **21**. Preferably the plates **21** are made from a relatively low electrically conductive material, as for example a plastic such as phenolic resin. The posts or legs **23** at the lower ends may be suitably braced by angle irons **27**.

The four bus bars **13**, **14**, **15** and **16**, as shown in FIG. **1**, each include three vertically spaced plates which are suitably maintained in spaced relationship at the outer ends to provide in the nature of two grooves **28** adapted to receive the tongues (not shown) of bus bars adapted to be connected to the electroplating equipment. The bus bars **13**, **14**, **15** and **16** may be made from a single block of electrically conductive material having grooves formed along the outer ends thereof rather than being constructed from separate bars, as shown. The diametrically aligned bus bars **13** and **15** are adapted to be connected to a suitable power source, while the bus bars **14** and **16** are adapted to be connected across an electroplating load.

The inner ends of each of the bus bars **13**, **14**, **15** and **16** are in the form of substantially isosceles triangles **13***a*, **14***a*, **15***a* and **16***a* (see FIG. **7**) which project into the center opening **22**. The inner ends are maintained in spaced relationship from each other by the nut and bolt assemblies **25**.

Slidably extending through the center opening 22 and through complementary recesses formed in the apices of the bus bar ends 13*a*, 14*a*, 15*a* and 16*a* is a slide shaft 26 of the contact subassembly 17. As shown in FIGS. 3 and 4, the shaft 26 is insulated from the bus bars 13, 14, 15 and 16 by means of an insulating bushing 29 seated in the apices of the ends 13*a*, 14*a*, 15*a* and 16*a*. The upper end of the shaft 26 is attached to the plate 53 in the cylinder 18.

The airbrake cylinder 18 is mounted on a plate 30 which is supported at the four corners by guiding posts 38 extending above and below the laminated plates 21 and being fixed thereto by nuts and washer assemblies 38*a*. The air cylinder 18 is restrained against rocking by a pair of upright anchor bolts 31 extending through bosses 31*a*. Bolts 31*c* connect the ends of split straps 31*b* clamped about the two-piece cylinder housing.

The airbrake cylinder 18 is actuated by a manual air valve 19 which is connected to a flow control valve 32 to restrict the air flow and control the speed of switching (or this switch may be cyclically operated through timed means), which serves to connect air cylinder 18 to a suitable source of air under pressure by way of a conduit 33*a*. Also connected to the valve 32 is a conduit 33 which is connected to the upper side of the airbrake cylinder 18. Upon actuation of the switch 19, the compressed air enters the chamber 51 above the diaphragm 52 to exert pressure on the circular plate 53 to move the shaft 26 from its normally upwardly disposed plate 53 to move the shaft 26 from its normally upwardly disposed position, as shown in FIG. 3, to a depressed position as shown in FIG. 4, against the action of the spring 54 surrounding the shaft 26.

In this connection, it is to be noted that in the upper position shown (see FIG. 3), a pair of switch contacts or terminal connectors 50–50 are positioned to connect the power bus bars 13 and 15 to load bus bars 14 and 16 for effecting a current polarity resulting in a plating operation at the electroplating equipment.

As shown in particular in FIG. 4, the terminal connectors 50*a*–50 are anchored to a mounting bar 35 by the rods 34*a*. The shaft 26 is likewise mounted at its lower end to the bar 35. The mounting bar 35 is fixed to the shaft 26 but nut and washer assemblies 36*a* and is guided for vertical movement so that the terminals 50*a*–50*a* are seatable within complementary grooves on oppositely facing surfaces and defined pockets 37 on the bus bar ends 13*a*, 14*a*, 15*a* and 16*a*.

The posts 38 guide the mounting bar 35 for vertical movement. At the other end, the posts 38 are received within openings 40 in the bar 35.

A second or upper terminal or contact mounting bar 41 is fixed to the upper position of the slide shaft 26 by means of a pair of nut and washer assemblies 36. The mounting bar 41 is disposed 90° out of phase with the mounting bar 35 and is guided during vertical movement by posts 38. Mounted on the bar 41 is a pair of terminals or contacts 50–50 which are spaced above and in alignment with a pair of terminal sockets 44–44 formed between the adjacent faces of the bus bar ends 13*a*, 14*a*, 15*a* and 16*a*.

As shown in FIG. 8, the terminals 50–50 and 50*a*–50*a* are of substantially the same structure, each including a hollow cylindrical contact sleeve 39, the lower end 45 being slightly tapered and extending from a shoulder 46. Accommodated within a bore 47 of the sleeve 39 is the mounting shaft 34 or 34*a* of which one end is fixed to the respective terminal mounting bars 35 or 41 as aforesaid. Threaded on the other end of the shaft 34 is a nut 48 which engages a collar 49 on the tapered end 45 to retain the other end of the sleeve 39 in engagement with the respective mounting bars. It is to be noted the shaft 34 is smaller than the bore 47 to provide a loose rocking fit and thereby assure that the terminal sleeve may easily be aligned with their respective sockets as the tapered end 44 seats therein. A rubber washer 43 is positioned on the shaft 34*a* or 34*c* and snugly abuts the bar 35 or 41 respectively and the upper end of sleeve 39. The contact sleeves 39 are each preferably made from copper having a plated silver cadmium surface.

Referring now again to FIG. 4, the terminals 50*a*–50*a* on the lower terminal bar 35 are shown in engagement or seated within the sockets 37. In this position of the switch subassembly 17, the power associated bus bars 13 and 15 are connected to the load-associated bus bars 14 and 16 to effect a plating operation.

Upon actuation of the switch 19, the airbrake cylinder 18 is energized so that the slide shaft 26 is moved downwardly. This causes the terminals 50*a*–50*a* carried by the terminal bar 35 to be moved out of seating engagement with the sockets 37. At the same time, the upper bar 41 moves downwardly so that the upper terminals 50–50 enter or seat within the sockets 44–44. This causes the current flow from the power bus bars 13 and 15 to the load bus bars 14 and 16 to be reversed and thereby effect a deplating operation at the electroplating equipment.

Return of the current flow to effect plating is achieved by actuation of the switch 19 to exhaust and to close off the compressed air supply to relive the pressure in chamber 51 and allow the spring 54 to shift the plate 53 (and the shaft 26 anchored thereto) upwardly to the upper position shown in FIG. 3 whereupon the contacts 50–50 disengage from the seats 44–44 and the contacts 50*a*–50*a* reseat within the sockets 37–37 to effect a current flow resulting in plating.

Referring again to the airbrake cylinder 18, the housing is of two-piece construction, an upper shell 55 and a lower shell 56, held together by strap 31*b*. The medial portion of the upper shell 55 is provided with nipple 57 and plug 58. The diaphragm 52 generally conforms to the shape of the upper shell 55 and is spaced away from the inner surfaces to form the chamber 51. The shaft 26 is secured to the plate in any suitable way such as by welding.

The spring 54 is preferably preloaded at about 150 pounds and is preferably a 1½-inch by 5-inch medium chrome vanadium die spring. A cupped extension 59 forms the lower bearing surface of the spring with the upper end of the spring bearing against the lower side of plate 53.

The upper shell 55 also contains a short nipple 60 for communication with chamber 51 and to which the conduit 33 and its fitting 62 is attached.

It should be obvious that the switch 19 could be operated by a double-acting air cylinder or any other device that would give two direct linear motions. It could also be a solenoid-operated air valve.

Although but one specific embodiment is herein shown and described, it is to be understood that numerous details may be changed or omitted without departing from the spirit of this invention as defined by the following claims.

1. A current-reversing switch comprising a first pair of bus bars associated with power terminals and a second pair of bus bars associated with load terminals, said pairs of bus bars each being radially disposed and said inner ends of each of said pairs arranged in end-to-end spaced relationship at a substantially common level, switch means including a first contact means and a second contact means disposed on opposite sides of the plane in which said bus bars are mounted, said switch means being reciprocably mounted for linear movement along an axis approaching perpendicularly to the plane of said bus bars toward and away from said bus bars between a first position wherein said first contact means connect selected ones of said bus bars across said spaced inner ends to achieve current flow in one direction and a second position wherein said second contact means connects other ones of said pairs of bus bars across said spaced inner ends to achieve current flow in the opposite direction.

2. The current-reversing switch as defined in claim 1 wherein said first and second contact means are fastened to a common support means which is mounted for linear reciprocable movement.

3. The current-reversing switch as defined in claim 2 wherein said common support means is connected at one end to a fluid drive means.

4. The current-reversing switch as defined in claim 3 wherein said fluid drive means comprises an airbrake cylinder comprising a housing, a plate anchored medially to a rod for

shifting the contacts into and out of position, and a diaphragm between the inner surface of the housing and the plate.

5. The current-reversing switch as defined in claim 2 wherein said bus bars are angularly spaced 90° and wherein said inner ends are each a substantially isosceles triangle.

6. The invention as defined in claim 5 wherein said common support extends through the apices of said triangular ends and wherein said first contacts are disposed 90° out of phase with said second contacts whereby said first contacts in the first position of said switching means are operative to connect opposite polarity terminal associated bus bars and in the second position are operative to connect like polarity terminal associated bus bars.

7. The device according to claim 6 wherein each of said first and second pairs of contact means are pairs of spaced tapered cylindrical members anchored on terminals bars, and the cylindrical member are positioned for vertical movement in and out of respective bus bars.

8. A current-reversing switch comprising a first pair of end-to-end spaced bus bars each being adapted to be connected to opposite charged terminals of a power source, a second pair of end-to-end spaced bus bars angularly spaced about and at a substantially common level as said first pair of bus bars and adapted to be connected to a load, said ends of said first and second pairs of bus bars being arranged about a common center, switch means including shaft means reciprocable at said common center along an axis approaching perpendicularity to the plane of the bus bars, a first pair of switch contacts fixed to said shaft means on one side of said bus bars, a second pair of switch contacts fixed to said shaft means on the opposite side of said bus bars, and power means for reciprocating said shaft means between a first position wherein said first pair of switch contacts is operative to connect said first pair of bus bars to said second pair of bus bars to cause a current flow in one direction and to a second position wherein said second pair of switch contacts causes said current flow to be reversed through said first and second pairs of bus bars.

9. The current-reversing switch as defined in claim 8 wherein said power means comprises a fluid drive means.

10. The current-reversing switch as defined in claim 9 wherein said fluid drive means comprises a compressed air-brake cylinder, wherein an enlarged plate is secured to the upper end of said shaft and within the cylinder housing, a diaphragm positioned above said plate and the inner surface of said housing, and a spring positioned on the shaft in said housing tending to retain said plate in its upwardmost position against the compressed air pressure.

11. A current-reversing switch comprising a first pair of bus bars spaced in end-to-end relationship, a second pair of bus bars spaced in end-to-end relationship to each other and to said ends of said first pair of bus bars, said first pair of bus bars and said second pair of bus bars being mounted in substantially the same plane, reciprocable switch means including switch contact means located on opposite sides of said bus bars, and fluid power means for linearly reciprocating said switch means toward and away from said bus bars between a first position wherein the switch contact means on one side of said bus bars connect selective ones of said bus bars to achieve current flow in one direction and a second position wherein the switch contact means on the opposite side connects other ones of said pairs to effect a reverse current flow through said bus bars.

12. The device according to claim 13 wherein each of the contact means comprises a cylindrical member having a tapered end for contacting the bus bar.

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