May 29, 1951 E. E. CHEEK 2,555,025

BUS BAR REVERSING SWITCH

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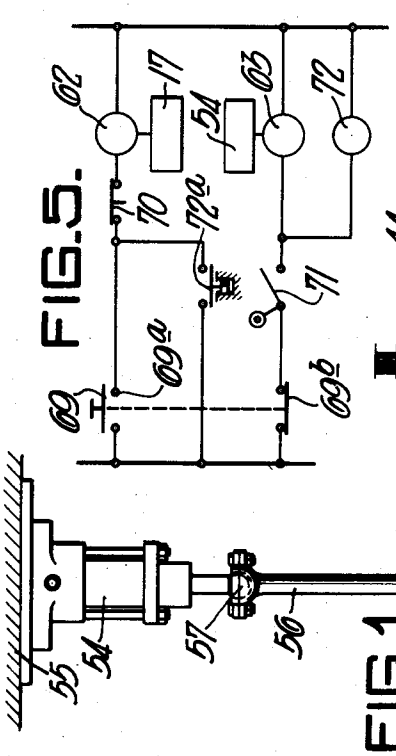


FIG. 5.

FIG. 1.

FIG. 6.

INVENTOR:
EDWARD E. CHEEK,
BY:
Donald G. Dalton
his Attorney.

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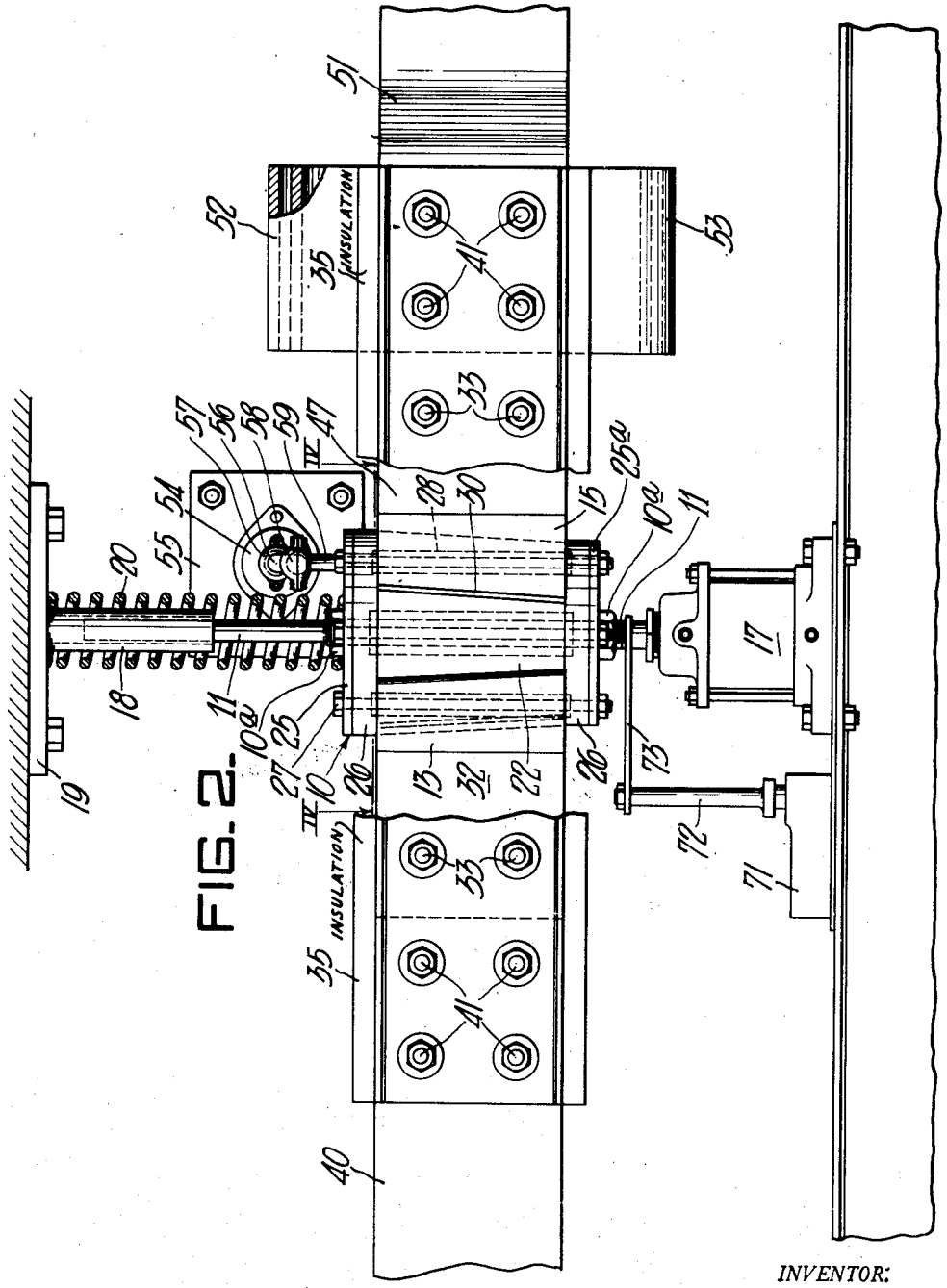


FIG. 2.

INVENTOR:
EDWARD E. CHEEK,
BY:
Donald G. Dalton
his Attorney.

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FIG. 3.

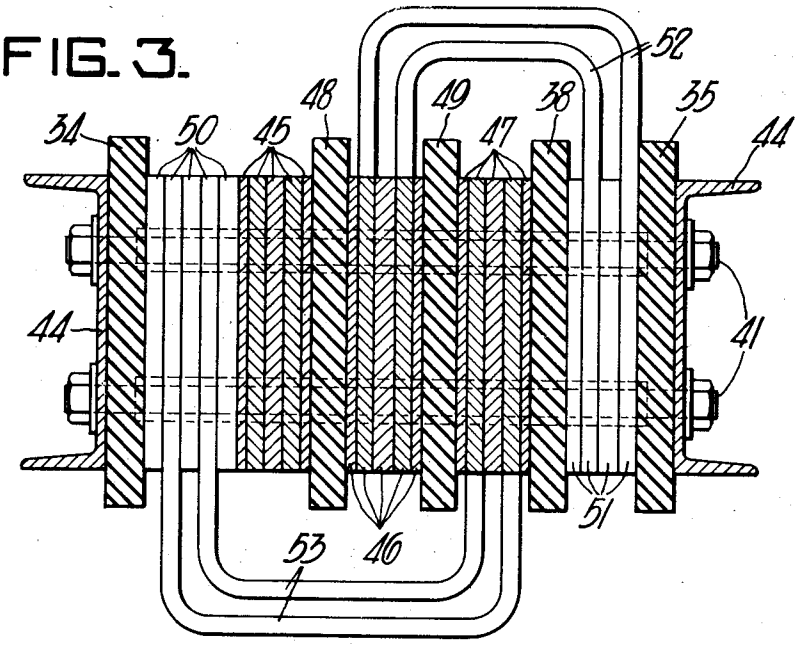
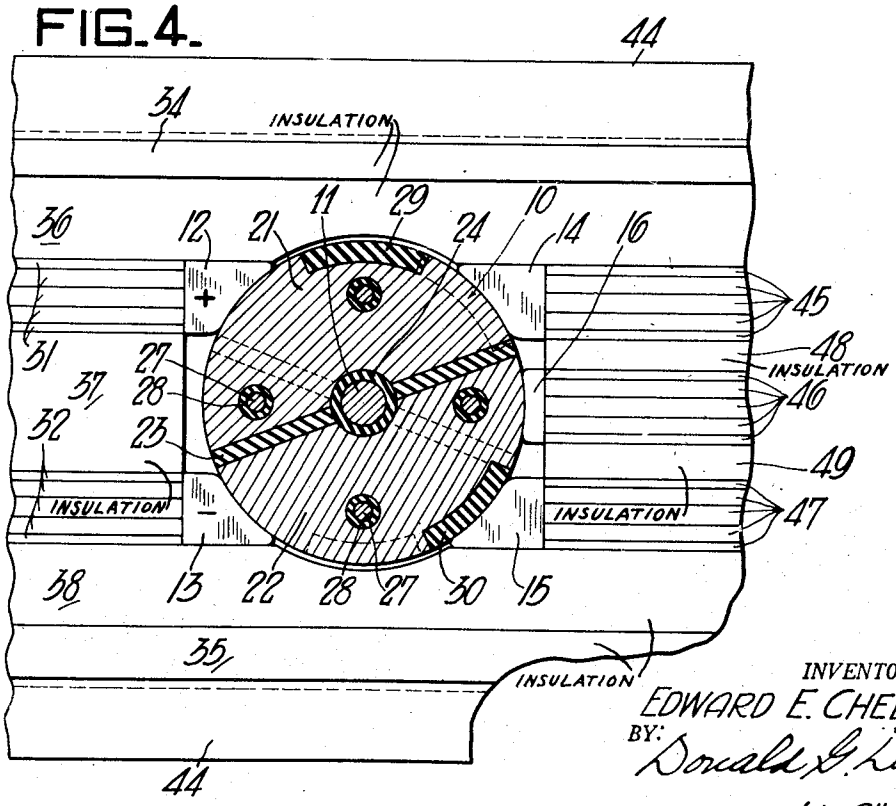


FIG. 4.



INVENTOR:
EDWARD E. CHEEK,
BY: Donald G. Dalton
his Attorney.

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UNITED STATES PATENT OFFICE

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BUS BAR REVERSING SWITCH

Edward E. Cheek, Pittsburgh, Pa., assignor to United States Steel Company, a corporation of New Jersey

Application February 20, 1948, Serial No. 9,793

7 Claims. (Cl. 175—375)

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This invention relates to a reversing switch and, in particular, to a reversing switch adapted to be connected in a busbar circuit carrying a heavy direct current such as employed in electrolytic processing.

In certain electrolytic processes, it is desirable occasionally to reverse the polarity of the direct-current supply. One example is the continuous electrolytic cleaning of ferrous strip. Numerous types of reversing switches are known, of course, but none of those available commercially is particularly suited for installations where the current load is great, e. g., 10,000 amps., and requires a plurality of large, heavy busbars in each side of the circuit. A reversing switch for such circuits must have a current-carrying capacity at least as great as the circuit conductors in order to prevent over-heating, and preferably a capacity even greater because of the unavoidable contact resistance between fixed and movable switch members and the fact that switch parts are necessarily less susceptible to cooling by atmospheric convection than the busbars themselves which are installed bare and in spaced relation. The lack of such a switch has made it necessary heretofore to unbolt the bus structure at some point, disassemble it and reassemble it with reversed polarity. Even though it is desirable to reverse polarity only infrequently, considerable time and labor are consumed by this procedure.

I have invented a reversing switch particularly suited for connection in busbar circuits carrying heavy currents, which makes it possible to change the polarity of the direct-current supply quickly and easily, as often as desired, without deenergizing the circuit for more than a few seconds. In a preferred embodiment, the switch comprises a generally cylindrical but slightly tapered drum composed of two similar segments having a circumferential extent of substantially 180°, disposed with their axial diametral planes adjacent but separated by insulating board. The drum is mounted on a shaft for rotation and the segments thereof have wiping contact with conducting blocks or shoes to which the circuit busbars are secured. The lateral or peripheral surface of each segment is recessed longitudinally to accommodate an insulating segment subtending an angle of about 45°. The insulating segments selectively engage the shoes on which the busbars from the load terminate. Each shoe on which a busbar from the current source terminates always has contact with the same one of the conducting segments, respectively. The drum is spring-pressed longitudinally to seat it firmly

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against the shoes which have their faces tapered to conform thereto and thus afford a seat therefor. A suitable motor disengages the drum from the shoes when it is desired to effect a reversal and another motor causes a limited angular movement of the drum after which the first motor reverses and with the spring reseats the drum against the shoes. The switch may be adapted for manual operation, but I prefer to employ fluid-pressure motors and I provide an automatic system of control initiated by actuation of a push-button or like starting switch, for causing operation thereof to effect the slight movements of the drum necessary to reverse the polarity.

A complete understanding of the invention may be obtained from the following detailed description and explanation which refer to the accompanying drawings illustrating the present preferred embodiment. In the drawings:

Figure 1 is a plan view with parts in horizontal section;

Figure 2 is a side elevation partly broken away;

Figure 3 is a transverse section taken along the plane of line III—III of Figure 1;

Figure 4 is a horizontal section taken along the plane of line IV—IV of Figure 2;

Figure 5 is a schematic diagram of the electrical control system; and

Figure 6 is a diagram showing the control means for switch-operating motors.

Referring in detail to the drawings, the reversing switch of my invention comprises a drum 10 mounted on a vertical shaft 11 and adapted to engage fixed contact shoes 12, 13, 14, 15 and 16 of copper or other suitable electrically conducting metal. The drum and shoes are generally cylindrical but are slightly tapered downwardly, the shoes forming a seat on which the drum normally rests with the lateral surface thereof engaging the shoes. The lower end of the shaft 11 is threaded into the piston rod of a fluid-pressure motor 17. The cylinder of motor 17 thus serves as a bearing for shaft 11, permitting longitudinal sliding movement with the piston in the cylinder, as well as rotation thereof. The upper end of the shaft is slidably and rotatably received in a guide tube or bearing 18 extending downwardly from a fixed support 19. A compression spring 20 surrounding the tube 18 and shaft 11 and bearing on the support 19 and drum 10, normally urges the drum against its seat. The admission of operating fluid to the motor 17, however, serves to raise the drum against the force of the spring preparatory to limited rotary movement. The

switch is adapted for ceiling mounting by suitable hangers, not shown, in case the busbar circuits described later are suspended therefrom so as to be out of the way.

The drum 10 comprises a pair of generally semi-cylindrical conducting segments 21 and 22 of copper or the like separated from each other by insulating board 23 and from the shaft 11 by an insulating sleeve 24. The segments are assembled about the shaft between metal end plates 25 and 25a which are spaced therefrom by insulating discs 26. The parts of the drum are held assembled by bolts 27 extending longitudinally through holes drilled in the segments, the end plates and the insulating discs. The bolts are surrounded by insulating sleeves 28. The drum is adjustable axially of the shaft 11 by means of nuts 10a threaded thereon.

The segments 21 and 22 are recessed longitudinally to accommodate insulating segments 29 and 30, respectively, spaced from the longitudinal edges of the conducting segments. As shown in Figure 4, radii through the centers of segments 29 and 30 make an angle of about 65° with the plane of insulating board 23 separating the segments 21 and 22. As a result, when the drum is in the position illustrated in solid lines in Figure 4, the shoe 14 engages the segment 21, the shoe 16 engages the segment 22 and the shoe 15, the insulating segment 30 carried thereby. When the drum is turned to an angle of about 45° to its other position, indicated in chain lines in Figure 4, shoe 15 engages segment 22, shoe 16 engages segment 21 and shoe 14, the insulating segment 29 carried thereby. The shoe 12 engages the segment 21 and the shoe 13, the segment 22 in either position of the drum.

The shoes 12 and 13 have terminals 31 and 32 composed of a plurality of conducting bars extending outwardly therefrom. The terminals are held in assembled relation by bolts 33 extending through the terminals and through insulating boards 34 and 35 on opposite sides of the switch and intermediate insulating spacer blocks 36, 37 and 38. The two sides of a busbar circuit from a generator or converter, indicated at 39 and 40, each including a pair of spaced bars, are secured to the terminals 31 and 32, respectively, by bolts 41. Conducting filler blocks 42 are disposed between the spaced busbars and between the latter and the terminals. The bolts 33 and 41 have insulating sleeves 43 therearound. These bolts extend through longitudinal channels 44 which constitute side frames for the switch.

The shoes 14, 15 and 16 also have terminals 45, 46 and 47 extending outwardly therefrom between the insulating blocks 36 and 38, being separated from each other by insulating boards 48 and 49. The end of one side of the load busbar circuit 50 makes contact with the terminal 45. The right-hand ends of the insulating board 35 and block 38 are recessed to receive the end of the other side of the circuit, designated 51, but it will be observed that the latter is insulated from the terminal 47. Jumper busbars 52 engage the ends of the busbars 51 and the terminal 46. Similar jumper busbars 53 connect the ends of the busbars 50 to the terminals 45, 46 and 47, the busbars 50, 51, 52 and 53 and the insulating boards 48 and 49 are secured together between the outside boards 34 and 35 by bolts 33 and 41 in the same manner as the terminals 31 and 32 and busbars 39 and 40.

By virtue of the construction described and particularly the jumper busbars 52, the side 51 of the load circuit is always connected to the shoe 16. The other side of the load circuit 50 is connected directly to the terminal 45 and by the jumper busbars 53 to the terminal 47. Thus, when the drum 10 is in the position illustrated in solid lines in Figure 4, the side 50 of the load circuit is connected to the side 39 of the supply circuit and the side 51 of the load circuit is connected to the side 40 of the supply circuit through terminal 46 and shoe 16. When the switch drum is in the position indicated in chain lines, side 50 of the load circuit is connected to side 40 of the supply circuit through jumper busbars 53 and shoe 15. At the same time, side 51 of the load circuit is connected to side 39 of the supply circuit through jumper busbars 52 and shoe 16. Shifting of the drum 10 thus effects the reversal of the polarity of the load.

For shifting the drum 10 through the angle necessary to effect reversal, I employ a fluid-pressure motor 54 mounted on any suitable support 55. A link 56 has a ball and socket connection 57 to the piston rod of the motor 54 and a similar connection 58 to a stud 59 extending upwardly from the end plate 25 of the drum.

The motors 17 and 54, as shown in Figure 6, are controlled by valves 60 and 61. These are four-way valves having no neutral position and are operated by solenoids 62 and 63, respectively. The valves may be of any suitable construction, a rotary type being illustrated comprising a body 65 and a rotor 66 therein operated by a ratchet wheel 67. A pawl 68 pivoted to the armature of the operating solenoid causes partial rotation of the rotor on energization of the latter. Specifically, each energization of the solenoid effects a quarter-turn of the valve rotor, thus reversing the connections to the ends of the cylinders of the motors. A supply of motive fluid is maintained under pressure at a suitable reservoir at 64 connected to the pressure ports of the valves.

The control circuit for the solenoids 62 and 63, as shown in Figure 5, includes a push-button or other manual switch 69. To effect a reversal of the position of the drum 10, the push button is actuated. The upper contact 69a of the switch closes a circuit for solenoid 62. This circuit includes an interlock 70 which is closed only when the supply circuit 39, 40 is de-energized. This prevents operation of the reversing switch under load. Energization of solenoid 62 operates the valve 61 to admit motive fluid to the lower end of motor 17, thereby raising drum 10 against the pressure spring 20. This permits closing of a limit switch 71 normally held open by push rod 72 mounted on an arm 73 extending laterally from the shaft 11 below drum 10 (see Figure 2). When the push-button switch is released, its lower contact 69b completes a circuit including limit switch 71, for solenoid 63. Energization thereof operates valve 60 causing the motor 54 to turn drum 10 to its chain-line position.

A time-delay relay 72 is energized simultaneously with the solenoid 63. After a few seconds delay, the relay closes its contact 72a, thereby effecting a second energization of solenoid 62. This reverses the connections to the motor 17 and it, together with the spring 20, causes the drum 10 to be reseated on the segments 12 through 15. This opens limit switch 71, de-energizing solenoid 63 and relay 72, which there-

upon opens its contact 72a. On the next operation, solenoid 63 will operate valve 60 to cause the motor 54 to restore drum 10 to the position shown in solid lines. The operation of the reversing switch is thus entirely automatic after it has been manually initiated by operation of push-button 69.

It will be evident that the invention provides a reversing switch particularly adapted for heavy-current loads such as electrolytic plants requiring multiple busbar circuits for supplying current to the load. The structure of the switch is simple so it can be manufactured at relatively low cost. At the same time, it may be operated quickly and easily to effect reversal of polarities as often as desired. The switch requires little or no maintenance. The seating spring 20 and motor 17 serve to hold the drum firmly against the fixed contact shoes, except when a reversing operation is in progress. There is, however, sufficient wiping of the drum segments on the shoes as the drum seats thereon to insure good contact therebetween.

Although I have illustrated and described but a preferred embodiment of the invention, it will be recognized that changes in the details and arrangement disclosed may be made without departing from the spirit of the invention of the scope of the appended claims.

I claim:

1. A reversing switch comprising a drum mounted for rotation on its axis and composed of a pair of generally semi-cylindrical conducting segments insulated from each other, a pair of spaced contact shoes, each shoe normally engaging one of said segments, an insulating segment set in the peripheral surface of each conducting segment spaced from the longitudinal edges thereof, a second pair of spaced contact shoes, one of which normally engages one of said conducting segments and the other the insulating segment in the other conducting segment, and a fifth contact shoe intermediate said second pair of shoes adapted to engage one or the other of said conducting segments depending on the angular position of the drum relative thereto, said fifth shoe normally engaging the conducting segment in which the insulating segment is engaged by one of said second pair of shoes.

2. The apparatus defined by claim 1 characterized by said segments being tapered and said shoes being tapered to conform to the segments.

3. The apparatus defined by claim 2 characterized by yielding means exerting pressure on the drum in the direction of its taper.

4. The apparatus defined by claim 1 characterized by terminals extending from said shoes adapted to have busbars connected thereto.

5. The apparatus defined by claim 4 characterized by a jumper busbar connecting the terminals of said second pair of shoes.

6. The apparatus defined by claim 1 characterized by said first-mentioned pair of shoes being disposed on one side of said drum and the other shoes on the opposite side of the drum.

7. A switch comprising a drum and fixed contacts engageable thereby, means mounting the drum for rotation and axial movement relative to said contacts, independent motors connected to said drum for effecting axial and rotary movement thereof, respectively, means controlling said motors and solenoids for actuating said control means, a manual switch for energizing the solenoid of the axial-movement motor and a limit switch held open by the drum in its normal position for energizing the solenoid of the rotary-movement motor.

EDWARD E. CHEEK.

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