March 18, 1924. 1,487,087

G. A. BURNHAM

ELECTRIC SWITCH

Filed June 17, 1918 4 Sheets-Sheet 1

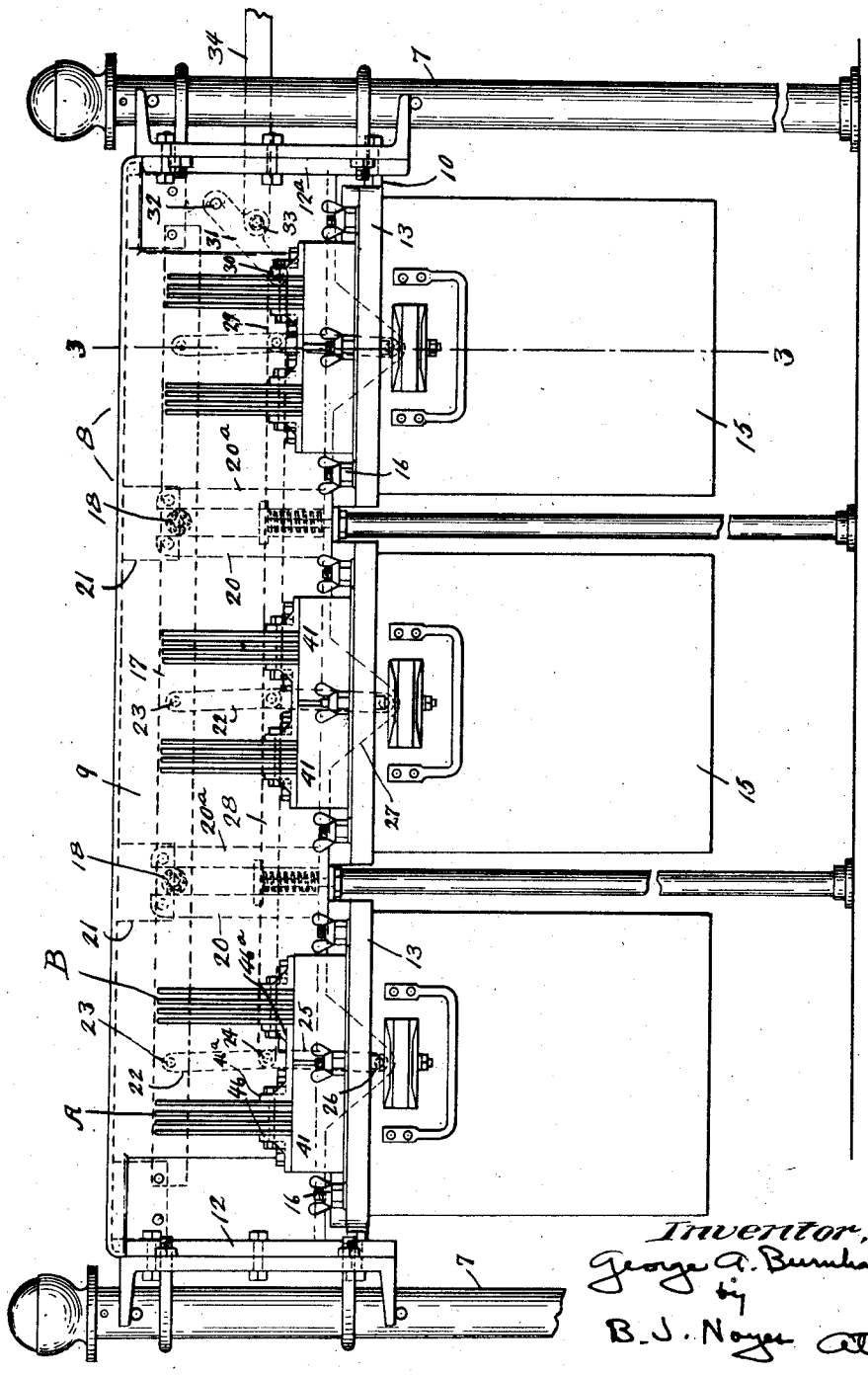


Fig. 1.

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Filed June 17, 1918 4 Sheets-Sheet 2

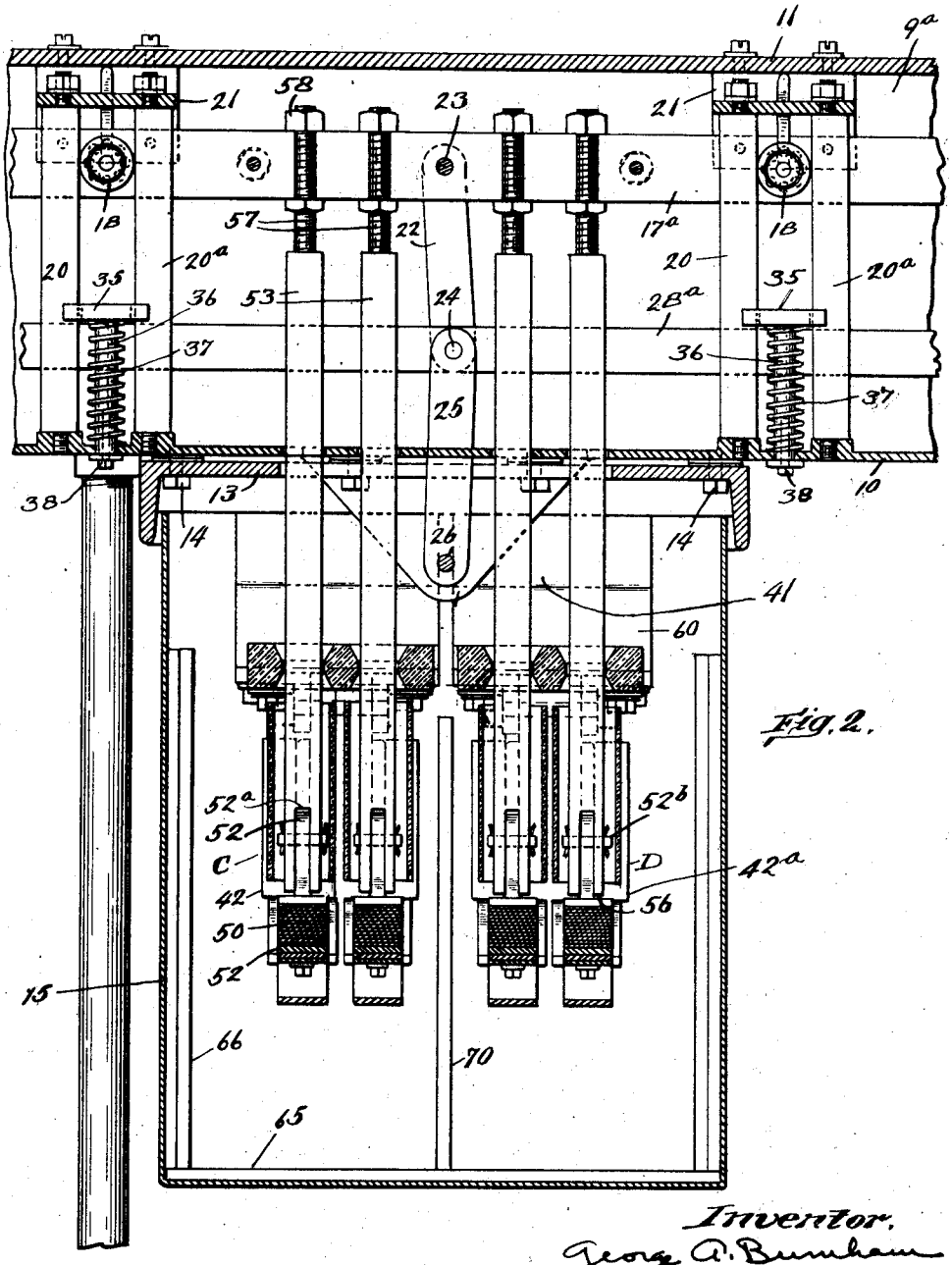


Fig. 2.

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ELECTRIC SWITCH

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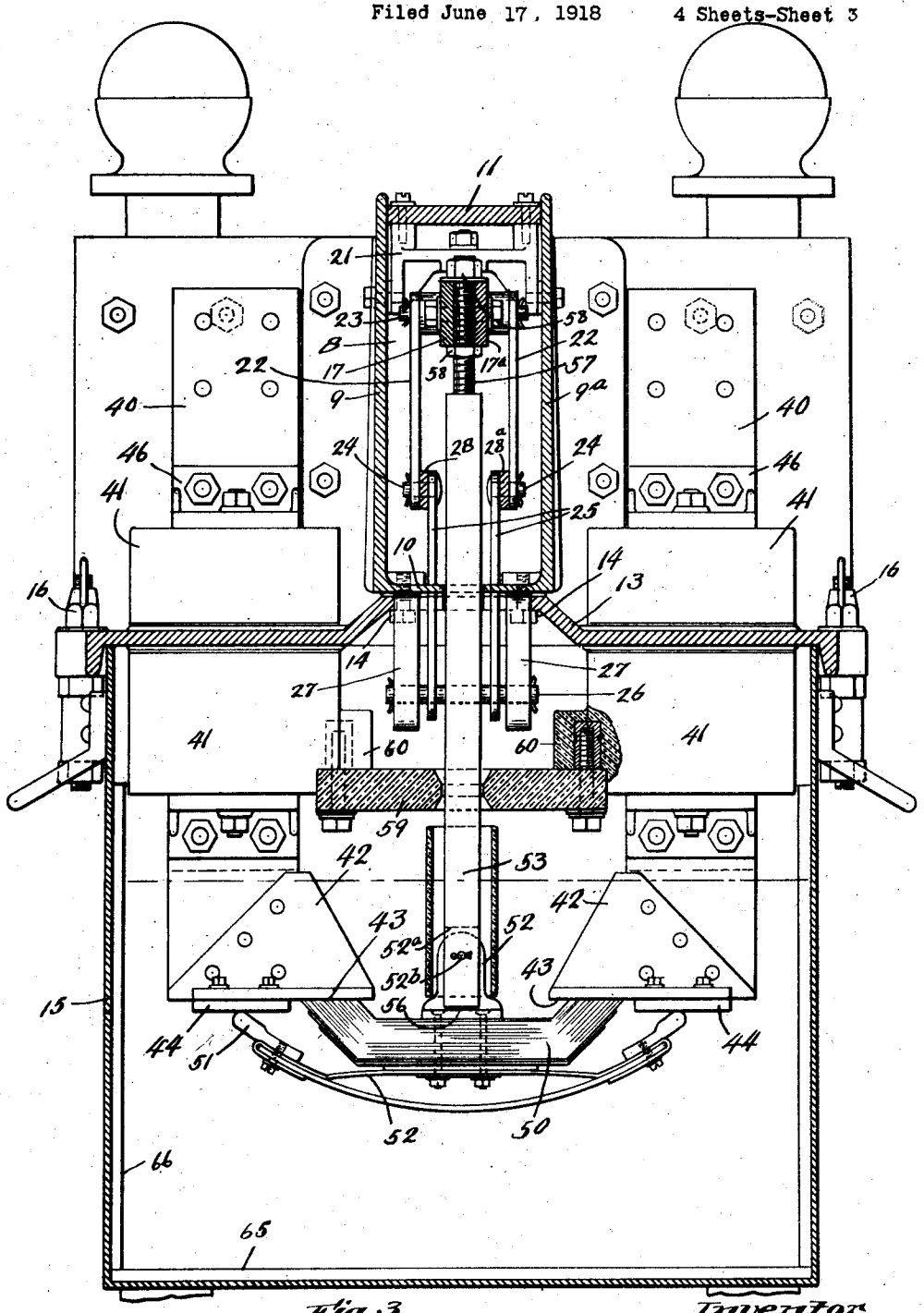


Fig. 3.

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ELECTRIC SWITCH

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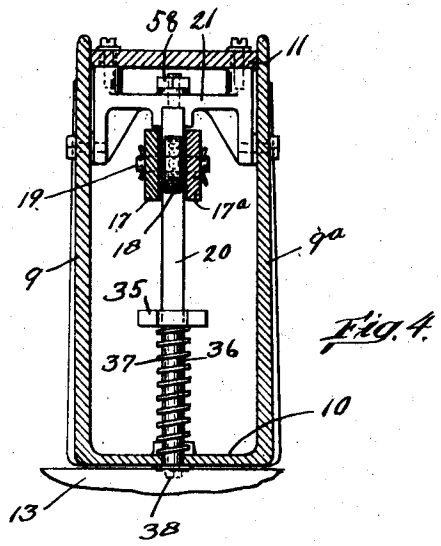


Fig. 4.

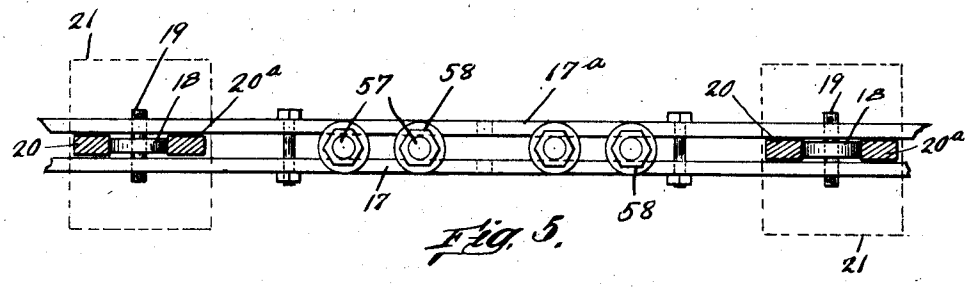


Fig. 5.

Inventor,
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by
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Patented Mar. 18, 1924. 1,487,087

UNITED STATES PATENT OFFICE.

GEORGE A. BURNHAM, OF SAUGUS, MASSACHUSETTS, ASSIGNOR TO SEARS B. CONDIT, JR., OF BROOKLINE, MASSACHUSETTS.

ELECTRIC SWITCH.

Application filed June 17, 1918. Serial No. 240,317.

To all whom it may concern:

Be it known that I, GEORGE A. BURNHAM, a citizen of the United States, residing at Saugus, in the county of Essex and State of Massachusetts, have invented an Improvement in Electric Switches, of which the following is a specification.

My invention relates to oil switches of large ampere carrying capacity.

In such switches, it is common to provide two separate brush members connected to one operating rod and which are adapted to be moved simultaneously into contact with the two poles of the switch to conjointly conduct current therebetween.

The current carried by a brush member making contact with a pole of a switch depends to some extent upon the pressure with which the brush is forced against the pole. With a plurality of independent brush members all making contact with a pole of a switch, it is necessary that they all be pressed against the pole with equal pressure in order that they may, so far as possible, carry equal currents.

This result is usually obtained by placing shims beneath the independent brush members and independently adjusting each brush member by the insertion or removal of shims until the proper contact pressure is obtained.

With continued operation of the switch, it becomes necessary to more or less frequently adjust the brush members on the operating rod to maintain substantially equal contact pressure at all times and thus maintain a uniform current distribution between the independent brush members.

The brush members are necessarily continually submerged in the oil of the switch and are accessible only by the removal of the oil receptacle. The proper adjustment of the brushes is difficult to obtain, requires a considerable time and moreover is a very disagreeable operation since the contacts and much of the switch structure is coated with oil; furthermore it is exceedingly dangerous inasmuch as the adjustment may have to be made in close proximity to live switch members.

Consequently an object of my invention is in the provision of means whereby many degrees of adjustments may be readily made to the individual brush members from without the casing, thereby avoiding the difficulties which are inherent with brush members which must be adjusted by the use of shims and the like.

The means whereby I accomplish this object of my invention is in the provision, in a switch having a plurality of brush members acting to conjointly conduct current between two opposite poles of the switch, of an independent operating-rod for every brush member, each of the movable switch members formed of the separate operating rods and connected brush members being independently adjustably connected to the switch operating mechanism disposed above the switch.

Inasmuch as each brush member and operating rod is independently adjustably connected to the switch mechanism it follows that each brush member may be adjusted independently of any other brush member and as the connection with the operating mechanism is above the switch, it is not necessary to remove the oil receptacle to adjust the brush members.

Furthermore it may be seen that the multiplicity of parts which must be manufactured and kept in stock for a line of oil switches of varying capacities may be materially reduced. If the manufacturer makes a switch, for instance, having a current carrying capacity of 1,000 amperes and using one brush member and operating rod, then to construct a switch of say 2,000 amperes, it is merely necessary to take two 1,000 ampere movable switch members, each comprising a brush-member and operating rod, and arrange them to operate in parallel with a common pole of the 2,000 ampere switch. In the same manner, if a 4,000 ampere switch is desired, it is simply necessary to take four 1,000 ampere movable switch members and independently connect them to the switch operating mechanism to operate in parallel with a common pole of the switch.

In this manner a switch of any desired large capacity may be easily and cheaply constructed from the movable switch members of switches of a smaller capacity.

In conjunction with two brush members connected to a single operating rod, it is common to employ a single contact block to be engaged by the double brush members.

The contact blocks are made exceedingly massive in construction to provide sufficient

radiating surface to permit the conduction of the current without an excessive temperature rise.

It is well known that the current carrying capacity of a given conductor for a given temperature rise is dependent upon its effective radiating surface.

If a conductor of a certain cross-sectional area operates successfully to carry a certain value of current and it is desired to provide a conductor to carry say double the current, it will not suffice to merely double the cross-sectional area of the conductor while preserving the same general shape or form of the conductor, for the doubling of the area of copper does not, by far, double the heat radiating area of the conductor and it becomes necessary to additionally increase the area of the conductor until sufficient metal has been added to double the effective radiating surface.

In electric switches it has been common to increase the size of the contact blocks by adding copper while still preserving the general form and design of the blocks, until the block has sufficient effective radiating area to successfully carry the current. This results in a block that is exceedingly massive in construction and exceedingly expensive and highly inefficient because of eddy current losses in the mass.

If, however, instead of increasing the mass of copper in a single contact block to carry the increased current, the number of the contact blocks are increased in proportion to the increase in current, then the increase in mass of copper bears a more equable ratio to the increase in current.

Consequently, a further object of my invention is the provision of a switch having a plurality of independent contact blocks per pole with which the brush members are adapted to make contact.

I may prefer to employ a single contact block for two or more independent movable switch members, but with a given number of movable switch members operating in parallel with a common pole of the switch, I prefer to use a plurality of contact blocks, which are arranged to be connected in parallel, to form a common switch pole or stationary switch member.

A yet further object of my invention is in the provision of a plurality of independent switch studs per pole of the switch.

I prefer to so arrange said studs that they are electrically independent within the switch but may be electrically connected above the switch whereby the current distribution therein tends to become equalized.

Fig. 1 is an assembly of three switch units embodying my invention and adapted for the control of a three phase circuit.

Fig. 2 is a sectional longitudinal elevation of a switch unit of Fig. 1.

Fig. 3 is a transverse sectional elevation of a switch along lines 3—3 of Figure 1.

Fig. 4 is a sectional detail of the operating mechanism.

Fig. 5 is a plan detail of the operating mechanism.

As here shown, three switches embodying my invention and adapted for the control of a three phase circuit are supported by the pipe frame structure 7 and are secured to and depend from a casing in which the switch operating mechanism is inclosed.

Said casing is substantially U shaped in section and comprises the two vertical spaced apart side walls 9 and 9ª and the connecting bottom wall 10. A cover plate 11 arranged between the tops of said side walls serves to completely inclose the operating mechanism arranged therein and prevent the entrance of water or other foreign substance.

The ends of said side walls are provided with flanges 12 and 12ª by means of which the casing may be secured to the pipe frame structure.

Each switch unit includes a cover plate 13 secured by means of bolts 14 to the bottom wall 10 of said casing and on which the component parts of the switch are arranged. An oil receptacle 15 is secured to said cover plate by means of wing-bolts 16 which permit the ready removal of the receptacle when desired.

The switch operating mechanism is inclosed in the mechanism casing 8 and includes the bars or rods 17 and 17ª which extend the length of said casing above the switch units and to which the movable switch members thereof are connected.

Said bars 17 and 17ª are spaced apart a suitable distance by means of spacing blocks and are bolted or otherwise secured together to form in effect a single switch operating member.

Said operating member is designed to move in a substantially straight line to thereby move the movable switch members connected thereto in a straight line into and away from contact with the stationary switch members.

For this purpose ball bearings 18 are arranged between the bars 17 and 17ª on pins 19. Vertical ways 20 and 20ª are arranged on each side of said bearings and are secured in cross-members 21 arranged in the upper part of the mechanism casing and bolted to the vertical side walls thereof.

The distance between the guide faces of said ways is arranged to be slightly greater than the outer diameter of the races of the ball bearings in order that the bearings may roll on the faces of either of the ways 20 or 20ª as the operating member is moved in a vertical plane. Toggle members are arranged at each switch and co-operate with the ball-bearings 18 and ways 20 and 20ª

in moving the bars 17 and 17ª in a straight line. Said toggle members include the links 22 which are pivoted to said bars by pins 23 extended through said bars and which are also connected by pins 24, to links 25 forming the other part of the toggles, which latter links are pivotally arranged on pins 26. Said pins are arranged between lugs 27 downwardly extended from the bottom wall 10 of the mechanism casing into the top part of the switch receptacle in order to permit a length of link sufficient to give an adequate movement of the movable switch members. Said toggles are connected together for simultaneous operation by the rods 28 and 28ª which extend between the toggles and are connected thereto by the pins 24.

A link 29 is connected to said rods 28 and 28ª at an end toggle and at 30 to a lever 31, pivotally arranged on a pin or shaft 32 extended between the side walls 9 and 9ª of the mechanism casing. Said lever 31 is formed with an extended lug or ear 33 which is adapted for pivotal connection with a rod 34 extending to the switch operating handle, not shown, which may be placed in any suitable position.

It is seen that if said lever 31 is moved to the right from the position shown in Fig. 1, the toggles will be moved from their straightened position and the operating members will be moved vertically downward, being guided in such movement by the ways 20ª, and the movable switch members connected to said operating members will be moved from contact with the stationary switch members.

A movement of said lever 31 in the opposite direction serves to straighten the toggles and to move said operating members upward and it is guided in such upward movement in substantially a straight line by the engagement of the ball bearings 18 with the ways 20, and the movable switch members are consequently moved into contact with the stationary switch members in substantially a straight line.

Shock absorbing means are provided to absorb the energy of the switch operating member and connected mechanism in movement to open position. Said means includes plates 35 having grooves therein by means of which the plates are slidably arranged between the vertical guide members 20 and 20ª. Rods 36 are secured to the under side of said plates and are slidably arranged in the bottom wall 10 of the mechanism casing. Springs 37 interposed between said bottom wall 10 and said plates 35, serve to normally maintain said plates in position and screws 38 secured to the lower end of said rods 36 serve to prevent said rods from being forced from the bottom wall 10 by said springs.

During the latter part of the movement of the operating mechanism in a movement of the switch into open position the bars 17 and 17ª of the operating mechanism fall into contact with the plates 35 of the shock absorbing mechanism and the momentum of the moving mechanism is absorbed into compressing the springs 37 and thereby preventing severe stresses that would be otherwise set up in the component parts of the mechanism.

The stationary switch studs are formed of a plurality of spaced apart bars 40 which are extended through openings in bushings 41 secured in the cover plate 13, into the interior of the switch housing and terminate in contact blocks 42 which are slotted to receive the individual bars 40. The contact blocks are provided with flat, broad, main contact surfaces 43 to which are secured auxiliary contact members 44.

As here shown, the switch is provided with two separate switch studs A and B each formed of a plurality of said bars 40 which are electrically and mechanically independent within the switch housing and are extended through separate insulating bushings 41 as shown and both of which conjointly form one pole of the switch.

Above the switch housing, the switch studs A and B are secured to the bushings by means of the clamps 46 and 46ª between which the bars comprising each stud are secured. Said clamps 46ª extend between both studs A and B and serve to electrically connect said studs and therefore tend to equalize the current flow in said studs.

A plurality of independent brush members 50 of more or less common form and construction are arranged to make independent contact between the stationary switch members and as here shown, four independent brush members are employed which serve collectively to carry the current from one pole of the switch to the opposite pole.

Auxiliary contact members 51 are arranged at the ends of a spring 52 secured to each brush member 50 and are adapted to make initial contact with the auxiliary contact plates 44 arranged on the contact blocks 42 and 42ª as is common practice.

Each of said independent brush members 50 is provided with an independent operating rod 53 of an insulating material to thereby form independent movable switch members.

Each brush member is secured to a plate having an extended ear or lug 52 which is pivotally secured in a slot 52ª in said operating rod by a pin 52ᵇ. The end face 56 of said rod 53 is substantially square and terminates slightly above said plate so that a slight amount of rocking motion is permitted said brush member in order that the brush may firmly seat itself upon the contact blocks when moved into engagement

therewith, and undue rocking movement of said brush 50 is prevented by the engagement of said member with an edge of said rod 53.

Each rod 53 is extended upwardly through the cover plate 13 and is provided at its upper end with a threaded rod 57 pinned or otherwise secured therein. Said rods are arranged in the space between the parallel bars 17 and 17ª of the operating mechanism, and are clamped to said bars by means of the nuts 58.

Inasmuch as the bars 17 and 17ª are constrained to move in a straight line in a vertical plane it follows that the switch rods 53 and associated brush members are also moved in a straight line into and from contact over the stationary members.

Blocks 59 preferably of insulating material are disposed around said rods 53 and are secured to lugs 60 integrally formed with and extended from the bushings 41 and serve to guide the lower end of said rods 53 in a vertical plane and to prevent lateral motion of said rods.

By means of the provision of independent brush members which co-operate with a single pole of the switch to conjointly control the current controlled by the switch a large amount of radiating surface is provided and the current density in the individual brushes may be considerably increased over that which is permissible with the provision of but a single brush member to control the same amount of current and the cost of the switch is thereby considerably reduced.

By the provision of separate rods extended from the individual brush members to the bars 17 and 17ª of the operating mechanism, it is seen that any brush member may be adjusted independently of any other brush member by simply adjusting the nuts 58 on the ends 57 of said rods and this adjustment may be made without removing the oil receptacle 15 from the switch cover.

In conjunction with the four brush members employed to conjointly control the current controlled by the switch, two independent contact blocks 42 and 42ª are provided, each of which is independently secured to an independent switch stud. Two of said brush members are arranged to make contact with each contact block. With a large number of brush members it is obvious that a greater number of contact blocks may be employed.

By the provision of independent contact blocks which conjointly form one pole of the switch, and which are arranged to be engaged by a plurality of brush members, ample heat radiating surface is provided and a high current density may be employed, thereby resulting in a reduced weight of copper and consequently in reduced cost.

The interior of the oil receptacle 15 is provided with a lining of insulating material, such as wood for instance, which forms a receptacle having the bottom wall 65 and side walls 66.

An insulating wall or partition 70 is extended upward from the bottom of the receptacle between said contact blocks 42 and 42ª, to a point above said blocks and serves in effect to divide said switch into two separate enclosures both of which however form one pole of the switch and to prevent arcing between the individual contact blocks of the same pole of the switch.

I claim:—

1. In an electric switch, stationary switch members immersed in a bath of oil, a plurality of independent movable switch members arranged to conjointly conduct current between said switch members, and means which admits of the independent adjustment of said movable members from without said bath of oil.

2. In an electric switch, two stationary switch members each having a plurality of independent and spaced apart contact blocks, a plurality of independent brush members arranged to make contact with said spaced apart blocks and an insulating partition extended between and spaced from the contact blocks of both switch members.

3. In an electric switch, two stationary switch members, switch operating mechanism, a plurality of separate movable switch members each having an independent brush member, said brush members conjointly arranged to engage said stationary switch members, and means connecting said separate movable switch members with said operating mechanism permitting independent adjustment thereof with respect to said operating mechanism.

4. In an electric switch, stationary switch members forming opposite poles of the switch, switch operating mechanism, a plurality of independent brush members adapted to engage said stationary switch members to conjointly conduct current between the poles of the switch, and a plurality of operating rods independently connecting said brush members with the operating mechanism.

5. In an electric switch, stationary switch members forming opposite poles of the switch, switch operating mechanism, a plurality of independent brush members adapted to engage said stationary switch members to conjointly conduct current between the poles of the switch, a plurality of operating rods independently connecting said brush members with the operating mechanism, and means permitting the adjustment of one of said members relative to said stationary switch members and independent of any other brush member.

6. An electric switch including a station-

ary switch member comprising a plurality of independent and spaced apart studs, each stud formed of a plurality of spaced-apart, electrically connected conducting bars.

7. An electric switch including a cover plate and a stationary switch member comprising a plurality of independent and separated studs electrically independent below said cover plate, and means electrically connecting said studs above said cover plate.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

GEORGE A. BURNHAM.

Witnesses:
T. T. GREENWOOD,
H. B. DAVIS.