June 25, 1946. E. H. AYERS 2,402,866

ELECTRIC SWITCH

Filed Aug. 20, 1942 2 Sheets-Sheet 1

Fig. 1.

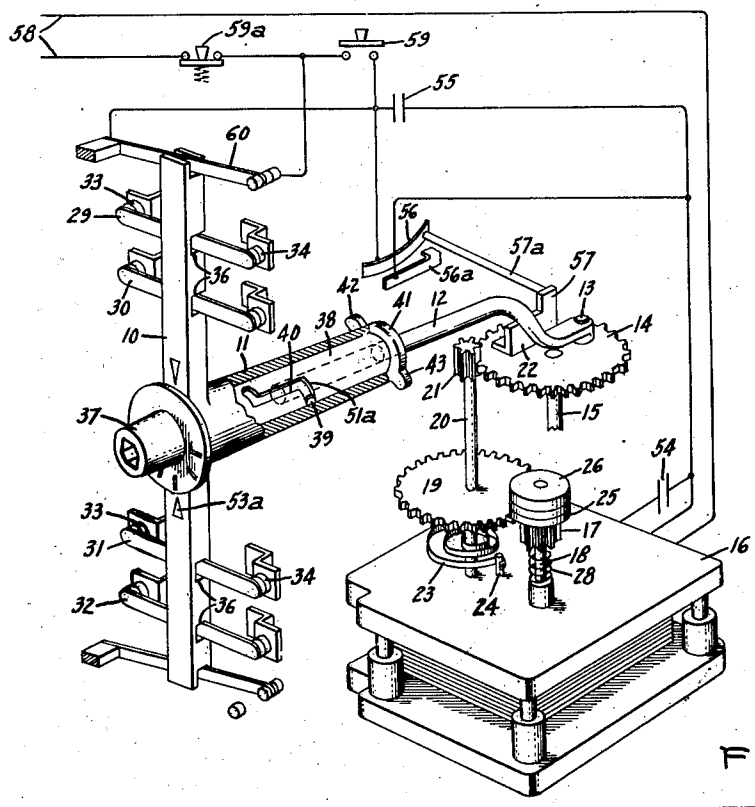


Fig. 2.

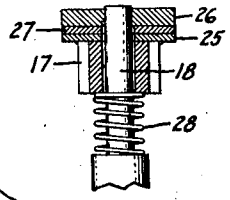


Fig. 3.

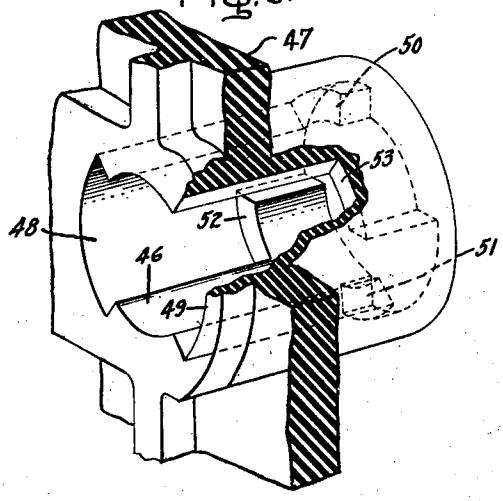
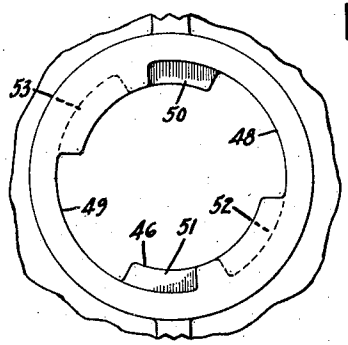


Fig. 4.



Inventor:
Edgar H. Ayers,
by Harry E. Dunham
His Attorney.

June 25, 1946. E. H. AYERS 2,402,866

ELECTRIC SWITCH

Filed Aug. 20, 1942 2 Sheets-Sheet 2

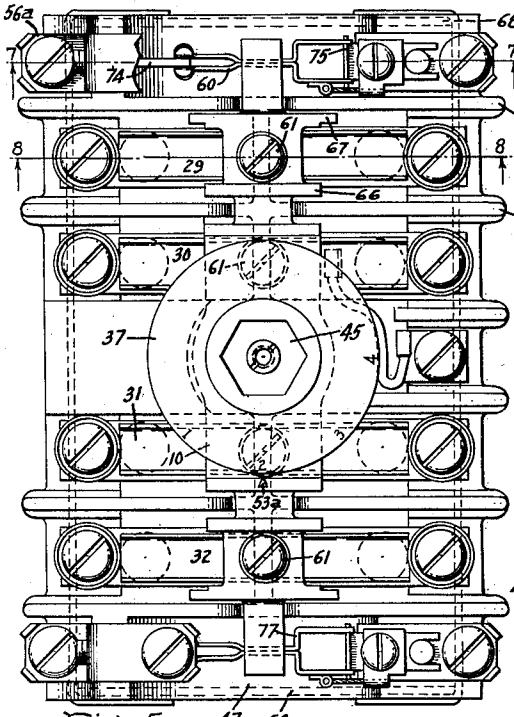


Fig. 5.

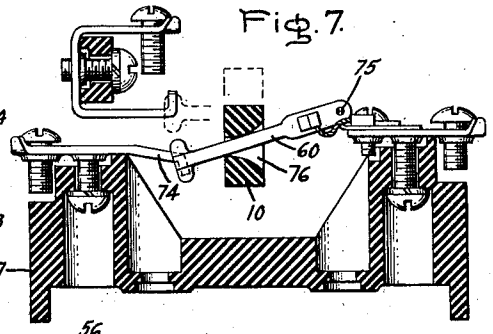


Fig. 7.

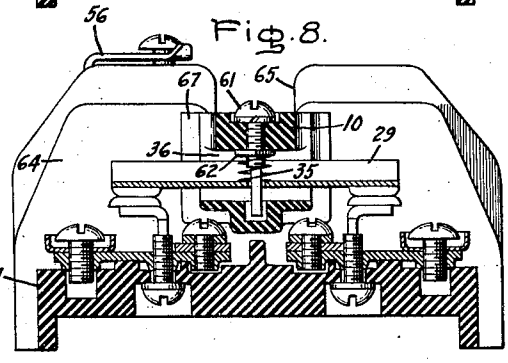


Fig. 8.

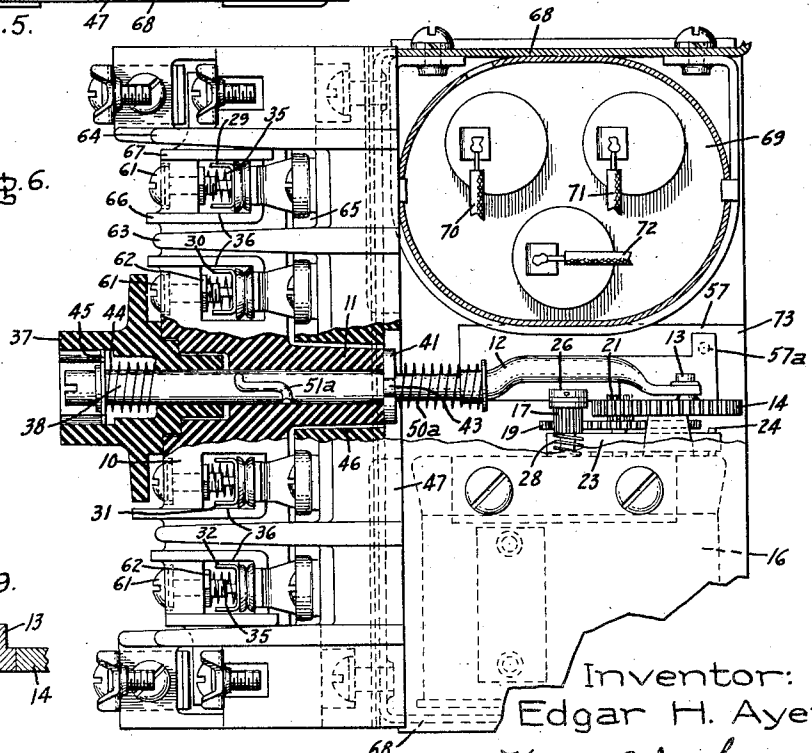


Fig. 6.

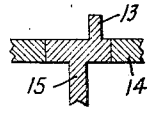


Fig. 9.

Inventor:
Edgar H. Ayers,
by Harry E. Dinham
His Attorney.

Patented June 25, 1946 2,402,866

UNITED STATES PATENT OFFICE

2,402,866

ELECTRIC SWITCH

Edgar H. Ayers, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

Application August 20, 1942, Serial No. 455,458

9 Claims. (Cl. 200—92)

1

My invention relates to electric switches, more particularly to electrically operated switches of the type known as contactors, and has for its object a simple and reliable electric switch of this type which is capable of withstanding severe mechanical shocks.

More particularly my invention relates to motor driven electric switches of the type described and claimed in a copending application, Serial No. 452,262, filed on July 25, 1942, by Chester I. Hall and Alexander W. Bedford, and assigned to the same assignee as my application. My invention is an improvement over the invention claimed in said Hall and Bedford application.

A further object of my invention is the provision of manual operating means for the switch whereby the movable contacts can be released from the operating motor, moved to the open circuit position, and latched in that position and also latched in the closed circuit position.

My invention also comprehends improved means for operating the switch controlling the capacitor or other current limiting device in the driving motor circuit in such manner that operation of the switch to its closed position is assured before the switch is operated to insert the capacitor in the motor circuit. In accordance with my invention I operate this switch directly from the gear train connecting the driving motor with the switch.

I also provide a simple and rugged mechanical construction for the crank pin and driving shaft on the gear carrying the crank pin consisting in constructing the shaft and crank pin as a unitary member so that shocks applied to the shaft are transmitted directly to the pin and not to the gear itself. Likewise I have provided a shockproof mechanical converter between the contacts and their supports.

For a more complete understanding of my invention, reference should be had to the accompanying drawings, Fig. 1 of which is an exploded view in perspective of a motor driven switch embodying my invention; Figs. 2 and 3 are fragmentary views showing details of construction; Fig. 4 is a bottom view of Fig. 3; Fig. 5 is a plane view of a complete switch embodying the features of Figs. 1 to 4 inclusive; Fig. 6 is a side elevation view partly in section of Fig. 5; Fig. 7 is a sectional view along the line 7—7 of Fig. 5 looking in the direction of the arrows; Fig. 8 is a sectional view along the line 8—8 of Fig. 5 looking in the direction of the arrows; while Fig. 9 is a sectional view showing details of construction.

Referring to Fig. 1 of the drawings, in one form of my invention the movable contacts of the switch are mounted on an operating or cross bar 10 made of electrically insulating material such as a molded compound provided with a central cylindrical portion 11 to which is connected one

2

end of an operating link 12. This link or operating rod 12 is pivotally connected at its other end to a crank constituted by a pin 13 secured to a gear 14 a suitable distance from the pivot axis of the shaft 15 to which the gear 14 is secured. Thus rotation of the gear 14 moves the cylindrical portion 11 longitudinally and thereby moves the bar 10 between its closed and open circuit positions. An electric motor 16 is connected to drive the gear 14 through a gear train comprising a gear 17 mounted on the shaft 18 of the motor, a large gear 19 meshing with the gear 17, a shaft 20 to which the gear 19 is secured, and a small gear 21 secured on the shaft 20 and meshing with the gear 14.

As shown, the motor 16 is operated electrically in one direction only, this rotation of the motor moving the bar 10 to its closed circuit position. When energized the motor turns the gear 14 through its gear train connection therewith to the position shown in the drawing in which the link 12 comes to rest against a flange 22 secured to the gear 14 whereby the gear 14 is stopped forcibly with the pin 13 in a dead center position with respect to the link 12. As long as the switch is held closed the motor remains energized and holds the gear 14 in this position.

For effecting opening movement of the switch bar 10 a spiral spring 23 is provided, the outside end of which is connected to a fixed post 24 and the inside end of which is connected to the shaft 20. This spiral spring is wound up by the clockwise rotation of the gear 19, looking down on Fig. 1, during the switch closing movement. Upon deenergization of the motor, the spring turns the gear 19 in a counterclockwise direction and thereby moves the gear train, the switch and the rotor of the motor to their open circuit positions. This open circuit position is again defined by the flange 22 which moves again into engagement with the link 12 although on the side of the link opposite that shown in Fig. 1 whereby the pin 13 is stopped in its opposite dead center position.

The opening of the contacts is effected at a predetermined desired slow speed giving a minimum of arcing, this speed of the moving contact being between .25 and 4 inches a second and preferably between .5'' and 1.5'' a second. The spring 23 is constructed to apply an opening force sufficient to give this desired rate of contact opening movement. It will be observed that, by reason of the fact that the pin 13 is in its dead center position when the switch is closed, the contact holding force applied through the link 12 does not assist the spring at the beginning of the opening movement. As the pin 13 moves away from the dead center position, a component of the contact holding force tends to rotate the gear 14 toward the open position and therefore assists the spring 23. Preferably, separation of the contacts

begins after about 70° movement of the gear **14** in a clockwise direction looking down on Fig. 1. At that time the spring has accelerated the gear and other driven parts to their maximum speeds. After 180° rotation of the gear, it is brought to rest, as previously stated, by engagement of the flange **22** with the link **12**.

For the purpose of absorbing the kinetic energy of the motor rotor and other moving parts in both the closed and open positions after the driving parts have been brought to rest by engagement of the flange **22** with the link **12**, a friction clutch connection is provided between the shaft of the motor and the gear **17**. This clutch consists of a disk **25** (Fig. 2) secured to the gear **17**, a disk **26** secured to the motor shaft **18** and a suitable loose friction disk **27** between them. The gear **17** is loose on the shaft **18** and is pressed by a spring **28** against the disk **25** whereby the gear is rotationally secured to the shaft by the friction between the disks. This friction is great enough to stop the rotor of the motor in one or two revolutions after the driving mechanism has come to rest. The friction should be as great as consistent with the strength of the parts driven by the motor in order to make available, in the event of welded contacts, as much as possible of the stored energy of the motor rotor.

As shown, the cross bar **10** carries four bridging contact members **29**, **30**, **31** and **32**, although in the control of a 3-phase motor, for example, only three of these will be used. These bridging members are secured at approximately their centers to the arm **10**. Each carries a movable contact at each end cooperating with suitable stationary contacts **33** and **34** which are connected to suitable terminals for connection in the circuit of the electric motor or other device to be controlled.

In order to prevent arcing in the event of a weld between the contacts, the bridging members **29** to **32** and the other operating parts for the bridging members are made stiff and unyielding so as to break the weld without appreciable bending or flexing. In other words, the parts are sufficiently stiff and unyielding to separate the welded contacts at the predetermined low speed. It will be obvious, on the other hand, that if the bridging members and other driving parts were resilient in the breaking of a weld, the movable contact, immediately upon the breaking of the weld would snap away and move at a very high speed until the operating parts recovered their normal shapes. Such rapid opening movement by reason of the spring recovery action of the parts would result in destructive arcing between the contacts. Preferably, the bridging members are channel members for the purpose of increasing their rigidity.

The contact pressure is determined by the strength of a helical spring **35** (Fig. 6) mounted between each bridging member and the cross bar on the side of the bridging member opposite the movable contacts so as to be compressed during the final movement of the cross bar after engagement of the contacts. Each bridging member, as shown, extends through an aperture **36** provided for it in the cross bar. When the contacts are disengaged, the bridging member is held by the spring **35** on the seat for it formed by the lower or opposite wall of the aperture **36**. During the opening movement of each bridging member, it is held in its closed circuit position by the spring **35** as the cross bar **10** moves away until the cross bar **10** is rigidly engaged by the bridging member. Then the bridging member is forcibly moved away from the stationary contacts.

In accordance with my invention I provide a knob **37** by means of which the cross bar **10**, when in its open circuit position, can be latched in that position so that it cannot be closed by the driving motor **16** or by shocks. Furthermore, when the cross bar is in its open circuit position, the knob **37** can be turned to release the cross bar from the link **12** and then the cross bar can be operated manually between its open and closed circuit positions and latched in its closed position as well as in its open position, as stated above, so that it cannot be opened by the spring **23** or by shocks.

This knob **37** is slidably mounted on a sleeve **38** which is rotatably mounted in a longitudinal bore provided for it in the cylindrical member **11**, the center line of the sleeve **38** being coincident with the center line of the link **12**. The link **12** extends into the sleeve **38** and is provided with a pin **39** which extends into a slot **40** in the sleeve. At each end as shown the slot **40** has a short transverse portion extending circumferentially of the sleeve while the main portion of the slot extends lengthwise of the sleeve. Normally, the pin **39** lies in the right-hand transverse portion, Fig. 1, as shown, whereby by means of this bayonet joint the driving rod **12** is releasably connected to the cross bar **10**.

On the end of the sleeve **38** opposite the knob **37** is a transversely extending flange member **41** having two diametrically opposite projections **42** and **43** extending outward beyond the periphery of the supporting portion **11**. A spring **44** (Fig. 6) is provided in the knob which engages a hexagonal disk **45** secured to the end of the sleeve **38** thereby to bias the sleeve slidably toward the left hand with respect to the knob, the disk **45** moving in a hexagonal seat in the knob, and hold the flange **41** and the knob against opposite sides of the cylindrical portion **11**. Furthermore, the cylindrical portion **11** extends loosely into a bore **46** (Fig. 6) provided for it in the stationary support **47** made of electrically insulating material on which the stationary contacts are secured.

Ordinarily, the projections **42** and **43** are free to move axially during movement of the cross bar **10** in slots **48** and **49** (Fig. 3) provided for them in opposite sides of the bore **46**. If it is desired manually to close the switch, the switch at the time being open, the knob **37** is turned in a clockwise direction, as seen in Fig. 1, so as to bring the axial slot **40** into register with the pin **39** and then the knob is pushed inward on the rod **12** carrying with it the contact bar **10** to the closed position which brings the pin **39** to the left-hand end of the slot **40**, as seen in Fig. 1, or rather the sleeve **38** is pushed inward until the end wall of the slot engages the projection **39**. If it is desired to lock the switch in this closed position, the knob **37** is now turned still farther in a clockwise direction which is permitted by the outer lateral end portion of the slot **40** whereby the projections **42** and **43** move into the recesses **50** and **51** (Fig. 4) under the lower end of the wall of the bore **46** and latch the contact bar **10** in its closed circuit position. This manual closing operation comprises the helical spring **50***a* surrounding the link **12** and having one end bearing on the flange **41**. After thus being closed manually the switch can be opened manually by the reverse operation of the knob, the spring **50***a* pushing the knobs and cross bar **10** to their open positions.

The contact bar 10 may be latched in the open position after it has been moved by the motor 16 to the open position, by turning the knob to its extreme counterclockwise position as permitted by the much longer circumferential transverse end portion 51*a* of the slot at the right-hand end of the slot 49, as seen in Fig. 1. This transverse portion of the slot 51*a*, together with the other transverse portion, provides for about 90 degrees total rotation of the sleeve 38 and knob 37. It will be seen that when the bar 10 has been moved to its open circuit position by the motor the lugs 42 and 43 are in position to be moved over the shoulders 52 and 53 simply by turning the knob 37 counterclockwise, whereby the contact bar is latched in its open position.

To facilitate the operation of the switch by the knob 37, the knob is provided with a peripheral dial flange on which suitable position marks numbered 1, 2, 3 and 4 are provided, these marks registering with a mark 53*a* on the cross bar. With the dial in position as shown in Figs. 1 and 5, i. e., the No. 2 mark registering with the stationary mark 53*a*, the cross bar is operated normally by the motor 16. To move the cross bar to its closed circuit position and lock it as just described, the dial is turned to the position No. 3, pushed in and then turned still farther clockwise to the position No. 4. Counterclockwise rotation of the knob from position #2 of Fig. 5 to the position No. 1 latches the cross bar in its open circuit position as just described. Moreover, the knob may be latched in any of these positions by providing a projection (not shown) on the inner side of the knob at each position and corresponding depression for the projection in the cross bar 10.

As shown, the motor 16 is preferably a split phase motor having a capacitor or condenser 54 connected permanently in parallel with one of the motor windings.

A current limiting device shown as a second capacitor 55 is connected in the circuit of the motor for the purpose of reducing the voltage applied to the motor after the motor has closed the switch so that the motor can remain energized on the supply circuit without overheating for indefinite periods of time. This capacitor 55 is short-circuited when the switch is in its open circuit position by means of an interlock switch operated by the gear 14. As shown in Fig. 1, the spring contact arm 55 of this interlock switch normally engages a stationary spring contact 56*a* thereby to short-circuit the capacitor 55. When the gear 14 is turned to the closed switch position, as shown in Fig. 1, a projection 57 on the flange 22 engages a pin 57*a* made of electrically insulating material, the other end of which engages the end of the spring contact arm 56. As the gear 14 completes its final movement to the open position, the pin 57*a* is moved to push the spring contact arm 56 away from the stationary contact and thereby open the short circuit around the capacitor 55. The motor 16 may be constructed, for example, for 80-volt alternating current continuously applied, but it may be operated on a much higher voltage from the alternating current supply source 58, such as 440 volts, in the actual closing of the switch. This higher voltage gives the motor a high rate of acceleration. The closing period of operation is so short that the motor is not overheated and damaged.

The operation of the switch arm 56 by the gear 14 in accordance with my invention assures that that short circuit around the capacitor 55 is opened only after the switch is closed and the motor 14 is nearly in its final closed position. At that time the pin 13 is closely approaching its dead center position shown in Fig. 1, and consequently the force applied to the gear by the operating rod 12 has only a very small component in opposition to the rotation of the gear by the motor. Thus the motor has enough torque under these conditions after the short circuit around the capacitor 55 is opened to complete the final opening movement of the gear 14. This arrangement avoids the possibility of the opening of the short circuit around the condenser under conditions such that the motor can not complete the closing movement. Such conditions might occur if the short-circuit switch were operated by the cross bar 10 and a permanent electric connection were used in place of the push button 59, and a condition were encountered of slowly rising voltage on the supply circuit. In such case, the motor might operate back and forth to open and close the short-circuit switch repeatedly with opening and closing of the main switch contacts carried by the bar 10.

When the capacitor 55 has been inserted in the motor circuit and the voltage of the motor thereby reduced, in the example shown to about 80 volts, the torque of the motor is enough to slightly more than overbalance the opening counter-torque applied by the spring 23 to the shaft 20.

As shown, the motor circuit is closed by means of a normally open push button switch 59. This connects the motor directly to the supply source 58 through the normally closed stop push button 59*a*, push button 59 and the interlock switch contacts 56 and 56*a* which at this time are in engagement with each other. The closing button 59 is held closed until the switch has been moved to its closed circuit position after which the button 59 may be released and allowed to open because it is then short-circuited by the interlock switch arm 60 operated by the cross bar 10. To open the switch the normally closed push button 59*a* is opened to deenergize the motor after which the switch is opened by the spring 23.

The speed of the contacts carried by the bridging members 29 to 32 inclusive at the instant of closing, i. e., engagement with the stationary contacts, is higher than the contact opening speed and is high enough to prevent welding of the contacts together because of high electrical contact resistance between them. Thus if the contacts are brought together at a very low relative speed, the high contact resistance between them caused by their low pressure of engagement may last long enough to cause welding of the contacts together. However, the closing speed is low enough to avoid destructive hammer blow action between the contacts.

It is contemplated that the device will be mounted in position on a panel or other support so that the bridging contact members 29 to 32 inclusive are substantially vertical. In this position it will be noted that each bridging member cooperates with a bottom stationary contact and a top stationary contact. The bar 10 is furthermore operated in such manner that during the opening movement the bridging members disengage their top stationary contacts first and thereafter disengage their bottom stationary contacts. This sequence avoids the possibility of the lower contacts separating first and generating ionized gas which would rise and envelope the top contacts at the time they open. This effect would be especially pronounced in the event of heavy overloads.

The required tilting of the cross bar 10 about its longitudinal center line to effect this sequence in the opening of the top and bottom contacts is effected by means of the mechanical crank driving connection for the cross bar. Thus the device disclosed is mounted in a position such that the stationary contacts 34 (Fig. 1) are uppermost with the bridging contact members extending substantially vertically. In this device, the gear 14 was rotated about 70 degrees by the spring 23 to effect a separation of the top bridging contacts from the stationary contacts 34. It will be observed that the pin 13 in moving through this 70-degree angle imparts an appreciable tilting action to the cross bar 10 through the operating connecting rod 12 because of the fact that the plane of rotary movement of the crank or gear 14 is substantially parallel with the planes of movement of the bridging contact members. In order to provide for this tilting of the cross bar, the bore 46 (Fig. 6) in the support 47 is made considerably larger at its right-hand end than the cylindrical portion 11 of the cross bar extending into it. After this separation of the upper contacts, continued rotation of the gear 14 separates the lower contacts.

During the opening movement the springs 35, which are compressed in the closed circuit position, apply a component of force through the bar 12 to the gear 14 in the same direction as the force applied by the opening spring 23. This component of force becomes available after a slight movement of the gear 14 from the dead center position. As the gear 14 turns, this component of force of the springs 35 increases, although this may be offset to a slight extent by the decreased pressure applied by the springs as they elongate. At the point of circuit opening, as previously stated, after the gear 14 has moved about 70 degrees, the gear 14 and other moving parts have been accelerated to a speed giving the desired optimum opening speed of the contacts. Of course, when the bridging contacts separate at one end from the stationary contacts, the force applied by the springs 35 to the rod 12 is materially decreased by reason of the fact that the cross bar has then been moved outward and tilted so that the edge at one end of each of the openings 36 engages a bridging contact. In other words, the bridging contacts become each seated at one end of its aperture 36. Thus after the circuit is open, the spring 23 is practically the sole operating means for the gear 14 and other parts. Consequently, the gear 14 is accelerated to its maximum speed, as are also the other moving parts, before the contacts open and continues at that speed until the bridging contacts have been moved approximately to their full open circuit positions.

It will be observed that the engagement of the cross bar with the bridging contacts, the cross bar and other moving parts moving at their optimum speed, gives a hammer blow on the bridging contacts which is of value in the separation of the contacts in the event of a weld. The rotating parts some of which, such as the rotor of the motor 16, rotate at quite high speeds, serve as energy inertia members or flywheel members and apply a powerful opening force to the cross bar.

Figs. 5 to 8, inclusive, show various additional structural details of an electric switch constructed as described in connection with Figs. 1 to 4, inclusive.

Referring to Figs. 5 and 6, the bridging contact members 29 to 32, inclusive, are channel members whereby these members are made stiff enough to prevent their bending during the breaking of a weld between the contacts. With the switch in its closed circuit position, the bridging members each have their ends resting on stationary contacts and the cross supporting bar 10 in moving still farther compresses the helical spring 35, Fig. 6, between the upper side of each bridging contact and the upper wall of the cross bar. These springs and the bridging contacts are secured to the supporting bar 10 in accordance with my invention by means of a simple and rugged shockproof connection. This connection comprises a screw 61 extending through a hole in the cross bar and provided with a nut 62 which holds the screw or bolt in position and also forms a seat for the upper end of the spring 35. The screw has an unthreaded portion at its lower end which extends loosely through an aperture in the middle of the bridging contact member so as to hold the bridging contact member against lengthwise movement with respect to the cross bar.

Figs. 5 to 8, inclusive, show the construction of the supporting member 47 made of insulating material on which is carried the stationary contacts, and also the construction of the cross bar 10. It will be observed that the support 47 is provided with a series of electrically insulating barrier walls separating the bridging members and stationary contacts. Thus the bridging member 29 is between two walls 63 and 64 formed as part of the support 47. Each of these walls, as shown in Fig. 8, is provided with a central notch 65 to receive the cross bar 10. The cross bar likewise has arc walls 66 and 67 (Fig. 5) on opposite sides of the bridging contact 29 and overlapping, respectively, the slots or notches in the walls 63 and 64.

This electrically insulating support 47 has secured to it a rectangular metal wall 68 which forms a rectangular base for the support 47 and also encloses a space in which is mounted the motor 16 and the mechanism for opening and closing the switch. The motor is preferably secured as by screws (not shown) to opposite side walls 68. Also in this space the two condensers 54 and 55 are mounted in a sealed compartment 69 from which three condenser terminals 70, 71, and 72 are brought out. Three terminals only are required because of the fact that two terminals of the condensers are permanently connected together, as shown in Fig. 1.

Also mounted in this space of the metal wall 68 is the interlock switch constituted by the contact arms 56 and 56a, these contact arms being suitably mounted in an electrically insulating support 73 shown in outline in Fig. 6. This support 73 is secured to the metal wall 68.

The construction of the interlock switch arm 60 is shown clearly in Figs. 5 and 7. It consists of two spring contact arms which are shaped so as to move together at their upper ends and thus in a closed position grasp the stationary contact 74 between them. The opposite ends of the arms 60 are mounted on a pivot 75. This double contact arm 60 makes the interlock switch free from heavy lateral shocks for the reason that any such shock tending to move one of the two contact arms away from the stationary contact at the same time must tend to move the other contact arm more tightly against the stationary contact. The contact arms are operatively connected to the cross bar 10 by providing a notch 76 in the end of the cross bar through which

the contact arms extend. A similar interlock switch 11 is arranged on the other end of the insulating support 47.

In order that the pin 13 will be strong enough to withstand heavy shocks, it is constructed as shown in Fig. 9 as an integral part of the supporting shaft 15 for the gear 14. The pin 13 and the shaft 15 are machined from a single solid piece of hardened steel material. With this construction any shocks applied to the pin 13 are not transmitted to the gear 14 but are taken up by the shaft 15. This construction makes possible tremendous strength by means of relatively small parts. The gear 14 may be cast on the hub portion to which the pin 13 and shaft 15 are secured, or it may be pressed on the hub.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I therefore contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electric switch comprising a contact operating member mounted for movement between closed and open circuit positions, an operating rod, slidably and rotatably cooperating members rotatably secured to said operating member and a projection secured to said rod forming a bayonet joint connecting said rod to said operating member, said connecting member being rotatable with respect to said operating member and said rod to disconnect said operating member and said rod from each other, means for reciprocating said rod thereby to move said operating member between said closed and open positions, said connecting member being rotatable to provide for movement of said operating member manually between said positions independently of said rod, a latching projection secured to said connecting member, supporting means for said operating member provided with projections cooperating with said latching projection to secure said operating member in each of said positions.

2. An electric switch comprising a contact operating member mounted for movement between closed and open circuit positions, an operating rod, slidably and rotatably cooperating members including a sleeve secured to said operating member and a projection secured to said rod forming a bayonet joint connecting said rod to said operating member, said sleeve being rotatably secured to said operating member, means for reciprocating said rod thereby to move said operating member between said closed and open positions, said sleeve being rotatable to provide for movement of said operating member manually between said positions independently of said rod, a latching projection secured to said sleeve, and supporting means for said operating member provided with projections cooperating with said latching projection upon rotation of said sleeve to secure said operating member in each of said positions.

3. An electric switch comprising a contact operating member provided with a bore extending in the direction of movement of said operating member, electric driving means, a connecting rod having one end connected to said driving means and its other end extending into said bore, means connecting said rod with said operating member for movement of said operating member between closed and open circuit positions by said electric driving means, manually operated means for releasing said operating member from said rod thereby to provide for movement of said operating member manually between said closed and open circuit positions independently of said rod, and manually operated means for securing said operating member in either one of said positions.

4. An electric switch comprising a contact operating member provided with a bore extending in the direction of movement of said operating member, a motor driven crank, a connecting rod having one end connected to said crank and its other end extending into said bore, means connecting said rod and said switch operating member together in a predetermined relation with each other for movement of said switch operating member between closed and open circuit positions when said crank is moved from one dead center position to the other, and manual means for releasing said operating member from said rod when said operating member is in said open circuit position thereby to provide for movement of said operating member manually between said closed and open circuit positions independently of said rod and for securing said operating member in either one of said positions, and spring means for biasing said operating member to said predetermined relation with respect to said rod.

5. An electric switch comprising a contact operating member mounted for movement between closed and open circuit positions, a sleeve rotatably mounted on said operating member extending in the direction of movement of said member, said sleeve being provided with a lengthwise slot having a circumferentially extending portion at each end, an operating rod extending into said sleeve provided with a projection extending into said slot, a spring on said rod biasing said operating member on said rod to a position in which said projection engages one end of said slot, means on one end of said sleeve for turning said sleeve thereby to bring said projection in the circumferential slot portion at said end of said slot thereby to lock said operating member to said rod, means for reciprocating said rod to move said operating member between said closed and open circuit positions, said operating member when moved by said rod to said open circuit position being releasable from said rod by rotation of said sleeve and thereafter movable manually between closed and open circuit positions and latchable in said closed circuit position by turning said sleeve to bring said projection into the other of said circumferential slots, a support for said operating member provided with projections, and a latching projection on said sleeve cooperating with the projections on said support so as to hold said operating member in each of said closed and open circuit positions.

6. An electric switch comprising a contact operating member, a sleeve rotatably secured to said operating member, a latch member on one end of said sleeve, manual operating means on the other end of said sleeve, said sleeve being provided with a slot extending lengthwise thereof with a circumferentially extending portion at each end, an operating rod extending into said sleeve provided with a projection extending into said slot, means for reciprocating said rod thereby to move said operating member between closed and open circuit positions when said projection lies in one transverse end portion of said groove, and supporting means for said operating member provided with projections cooperating with said latch member to secure said operating member

in each of said positions whereby when said operating member is in its closed circuit position, said sleeve can be turned to secure said operating member in said closed position and when said operating member is in its open position, said sleeve can be turned to bring said pin into said longitudinal portion of said slot, moved lengthwise of said rod to move said operating member to its closed circuit position and then turned to secure said operating member in said closed circuit position.

7. An electric switch comprising a contact operating member provided with a bore extending in the direction of movement of said operating member, a tubular member rotatably mounted in said bore, a transversely extending latch member on one end of said tubular member, manual operating means on the other end of said tubular member, said tubular member being provided with a slot extending lengthwise thereof with a circumferentially extending portion at each end, an operating rod extending loosely into said tubular member provided with a laterally extending pin projecting into said slot, electric motor operating means for reciprocating said rod thereby to move said operating member between switch-closed and open positions when said pin lies in one transverse end portion of said groove, and supporting means for said operating member provided with projections cooperating with said latch member to secure said operating member in closed and open circuit positions when said tubular member is operated by said manual operating means whereby when said operating member is in its closed circuit position, said tubular member can be turned to secure said operating member in said closed position and when said operating member is in its open position, said tubular member can be turned to bring said pin into said longitudinal portion of said slot, moved lengthwise of said rod to move said operating member to its closed circuit position and then turned still farther to secure said operating member in said closed circuit position.

8. An electric switch comprising a support provided with a bore, a stationary contact mounted on said support, a movable contact, an operating member for said movable contact having an elongated portion mounted in said bore for slidable movement lengthwise of said bore thereby to move said movable contact between closed and open circuit positions with respect to said stationary contact, said elongated portion of said operating member being provided with a bore extending lengthwise thereof, a sleeve rotatably mounted in said last-mentioned bore, a transversely extending member secured to one end of said sleeve, the wall of said first-mentioned bore being provided with oppositely disposed longitudinal recesses for receiving the ends of said transversely extending member to provide for said slidable movement of said operating member between closed and open circuit positions, a crank, a connecting rod having one end pivotally connected to said crank and its other end extending into said sleeve, said sleeve being provided with a slot having a longitudinally extending portion and a circumferentially extending portion at each end, a pin on said connecting rod lying normally in one of said transversely extending slot portions thereby to secure said crank to said operating member, means for turning

said sleeve to bring said pin into registry with said longitudinal slot portion whereupon said operating member when in its open position can be moved to its closed position independently of said connecting rod and secured in said closed position by turning said sleeve to bring said pin into said other circumferentially extending slot portion and the ends of said transversely extending member to a locking position with respect to the wall of said first-mentioned bore, an electric motor connected to drive said crank when said motor is energized to a dead center position in which said operating member is moved to its closed position, and a spring connected to said crank so as to be wound up by rotation of said crank for turning said crank when said motor is deenergized back to its other dead center position.

9. An electric switch comprising a support provided with a bore, a contact mounted on said support, a movable contact, an operating member for said movable contact having an elongated portion mounted in said bore for slidable movement lengthwise of said bore thereby to move said movable contact between closed and open circuit positions with respect to said stationary contact, said elongated portion of said operating member being provided with a bore extending lengthwise thereof, a sleeve rotatably mounted in said last-mentioned bore, a transversely extending member secured to one end of said sleeve, the wall of said first-mentioned bore being provided with oppositely disposed longitudinal recesses for receiving the ends of said transversely extending member to provide for said slidable movement of said operating member between closed and open circuit positions, a crank, a connecting rod having one end pivotally connected to said crank and its other end extending into said sleeve, said sleeve being provided with a slot having a longitudinally extending portion and a circumferentially extending portion at each end, a pin on said connecting rod lying normally in one of said transversely extending slot portions thereby to secure said crank to said operating member, manually operating means for turning said sleeve to bring said pin into registry with said longitudinal slot portion whereupon said operating member when in its open position can be moved to its closed position independently of said connecting rod and secured in said closed position by turning said sleeve to bring said pin into said other circumferentially extending slot portion and the ends of said transversely extending member to a locking position with respect to the wall of said first-mentioned bore, an electric motor connected to drive said crank when said motor is energized to a dead center position in which said operating member is moved to its closed position, a spring connected to said crank so as to be wound up by rotation of said crank for turning said crank when said motor is deenergized back to its other dead center position at a predetermined low speed at which said operating member is moved to its open position at a low speed giving no substantial alternating current arcing between said contacts, and stop means on said crank for limiting the movement of said connecting rod between said dead center positions.

EDGAR H. AYERS.