July 4, 1950 V. L. MARES 2,513,950

ELECTRIC SWITCH

Filed Dec. 4, 1947

Fig. 1.

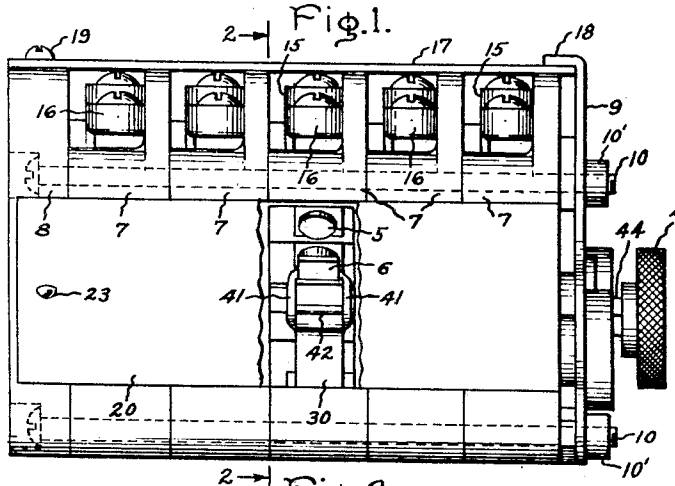


Fig. 2.

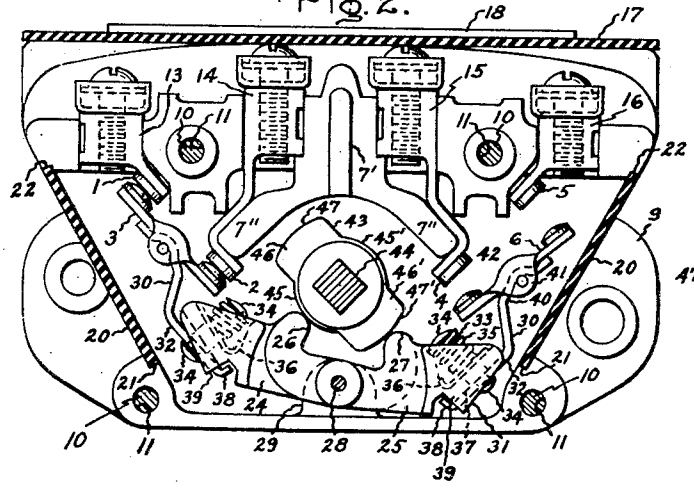


Fig. 3.

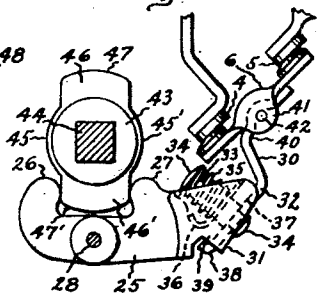


Fig. 4.

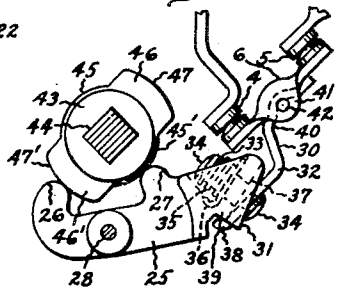


Fig. 5.

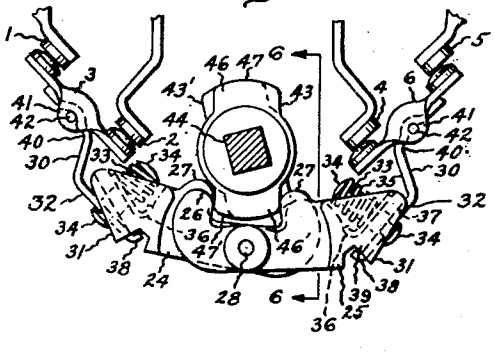
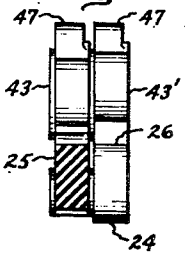


Fig. 6.



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2,513,950

ELECTRIC SWITCH

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10 Claims. (Cl. 200—6)

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My invention relates to improvements in electric switches and more particularly multi-stage rotatable cam operated switches, and especially electric switches which are known to the art as auxiliary switches because they are so commonly used with circuit breakers and other devices to control auxiliary or secondary circuits in dependence upon the positioning of the parts of the device with which they are associated.

An object of my invention is to provide a compact electric switch rocker structure having an improved rotatable cam and meshing cog rocking mechanism which is particularly suited for multi-stage assembly and which has a flexibility of circuit sequences in any stage as well as in a plurality of stages. Another object of my invention is to provide an improved electric switch rocker structure embodying double break contacts for each circuit and to the extent of at least two circuits per stage wherein, with a relatively small angular movement for opening and closing, suitable wiping action and uniform contact pressure are insured. Still another object of my invention is to provide an improved electric switch rocker structure wherein rapid and positive movement of the movable contacts is insured and wherein each circuit is closed by a two-point floating and self-positioning contact member which insures equal pressure and wiping action on both stationary contacts, thus maintaining uniform wear on the contacts.

A further object of my invention is to provide an improved electric switch coordinate quadrantally related contact and operating cam structure wherein all the terminal connections are readily accessible on one side of the switch structure and wherein the contacts are totally enclosed to protect them from dust, dirt and the like. A still further object of my invention is to provide an improved electric switch structure which is free of flexible leads and also of current carrying contact pressure applying means. These and other objects of my invention will appear in more detail hereinafter.

My invention will be better understood from the following description when considered in connection with the accompanying sheet of drawings, and its scope will be pointed out in the appended claims.

In the accompanying sheet of drawings, Fig. 1 is a side elevation, partly broken away for clearness, of a multi-stage electric switch embodying my invention; Fig. 2 is a section on the line 2—2 of Fig. 1 showing the improved multi-stage cam and cog rocking mechanism with one double

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break contact of one stage in the closed position and the other double break contact of the same stage in the open position; Fig. 3 is a partial elevational view similar to Fig. 2 showing the double break contact on the right-hand side as engagement is made, ready for the wiping action; Fig. 4 is a view similar to Fig. 3 showing the double break contact in the final full pressure closed position after completion of the wiping action; Fig. 5 is a view similar to Fig. 2 showing a modified cam and cog rocking arrangement for obtaining a sequence of operation of two bridging contacts of one stage different from the sequence shown in Fig. 2; and Fig. 6 is a section on the line 6—6 of Fig. 5.

In the embodiment of my invention shown in Fig. 1, I have illustrated a five-stage electric switch, each stage of which may and, from the standpoint of space requirements, preferably does include two sets of double break contacts in planar alignment and preferably having the stationary contacts in quadrature as shown in order to save space and permit the use of duplicate parts. As shown more clearly in Fig. 2, each of these sets comprises, on the left, two spaced stationary contacts 1 and 2 in alignment and a cooperating movable bridging contact member 3 and, at the right, two spaced stationary contacts 4 and 5 in alignment and a cooperating movable bridging contact member 6. These contacts in each stage and the means for effecting their relative movements are mounted on suitable supporting means such as a support 7. This support, which is of suitable insulating material, preferably molded, also functions as a barrier between stages. The several stages are assembled and held together between a rear or end support 8 of suitable insulating material and a mounting plate 9 by bolts 10 extending through registering holes 11 in the support 7 and in the end support 8 and mounting plate 9. The holes in the end support 8 may be counterbored to receive the heads of the bolts, and the mounting plate 9 has suitably threaded bosses 10' to receive the ends of the bolts 10. For aligning the supports 7 and 8 and providing greater insulation between the terminals 14 and 15, I provide on one side of the support 7 interlocking projections 7' which register with corresponding recesses, not shown, in the other side of the support 7 and in the front side of the end support 8. For supporting the stationary contacts 2 and 4, the supports 7 are provided with projecting portions 7''.

The stationary contacts 1, 2, 4 and 5 are respectively secured to terminals 13, 14, 15 and 16,

all suitably mounted in the support 7 near the upper edge thereof so that all of the terminals of a multi-stage switch are accessible from one side of the switch, the upper or top side in the illustrated embodiment of my invention. In order to protect the terminals from falling objects and the like, I provide a cover plate 17 which is preferably of suitable insulating material and which is held in place by a top flange 18 on the mounting plate 9 and suitable fastening means such as one or more screws 19 which enter the rear end support 8. In order to have a dust-tight enclosure for the contacts of the several stages, I provide cover plates 20, the lower edges of which, as shown more clearly in Fig. 2, are seated in suitably shaped locking notches 21 formed in the supports 7 near the bottoms thereof while the upper edges rest in notches 22 near the tops of the supports. For holding these cover plates 20 in position, I provide suitable fastening means such as screws 23 which enter the end support 8.

For actuating the bridging contacts 3 and 6 to and from the closed circuit position in accordance with my invention, I provide for each bridging contact 3 and 6 a pivotally supported member such as rocker arms 24 and 25, respectively, each having two similarly semi-cylindrical shaped spaced cam followers 26 and 27 symmetrically offset in quadrantal convergence as shown in Fig. 3 on opposite sides of and equidistant from the axis of rotation of the associated arm which axis, as shown in Fig. 1, is in quadrature with the two sets of aligned stationary contacts 1—2 and 4—5. The arms 24 and 25, which are positioned one behind the other, in reverse juxtaposition, the arm 25 being in front as viewed in Fig. 2, are pivotally supported on a pin 28 which has one end seated in a hole in a boss 29 on one side of and near the bottom of the support 7. The other end of the pin 28 enters a hole in a similarly positioned boss on the other side of the support 7 and in the last stage a hole in the front side of the end support 8. The holes in any support, although in line, are not through holes in order to provide necessary electrical insulation and to prevent longitudinal movement or creep of the pins 28. Thus, the improved multi-stage switch structure of the present invention is provided with a row of pairs of reversely jutaposed rocker arms 24 and 25 having concentric axes 28 and each provided with opposing semi-cylindrical cam followers 26 and 27 equidistant from this axis 28 together with two rows of stationary contacts 1, 2, and 4, 5, parallel with and in quadrature with the axis 28 of the rocker arms 24 and 25 as shown in Fig. 2.

Further in accordance with my invention, the bridging contacts 3 and 6 are pivotally and resiliently mounted on their respective rocker arms 24 and 25 for movement therewith and relatively thereto in the plane of the stationary contacts 1, 2 and 3, 4 with the similarly converging and rounded cam followers of the reversely juxtaposed rocker arms 24 and 25 on opposite sides of this plane. As shown, I provide for this purpose a contact carrier 30 which is mounted between bifurcations 31 on an outboard end or extension of each of the rocker arms 24 and 25. For resiliently mounting the carrier 30, its lower or straight end portion 32 is provided with a hole through which extends a pin 33 having a head 34 at each end with suitable resilient means such as a spring 35 retained in compression between the upper head 34 and a shoe 36. The pin 33 is positioned between the bifurcations 31 with the shoe 36 bearing on inwardly extending projections 37 of these bifurcations, and the lower or straight portion 32 of the carrier has a flange 38 arranged to extend over a transverse shelf 39 between the bifurcations whereby to hold the carrier 30 locked in position but free to move relatively to the associated rocker arm and in the plane of movement of the arm. This construction provides a simple arrangement whereby the contact carrier can readily be snapped out of its position on the rocker arm for replacement of new bridging contacts. For pivotally holding the bridging contacts 3 and 6 in position on their respective carriers 30 with a limited movement relatively thereto in order better to align the bridging contact surfaces with the surfaces of the cooperating stationary contacts when brought together, the bridging contacts are longitudinally shaped to correspond to the upper curved and shouldered end portion 40 of the carrier. Also, the bridging contacts have two centrally disposed wing or flange portions 41 through which passes a holding pin 42. This pin passes through holes in the flanges 41 and seats in the bight of the curve in the upper end portion of the contact carrier 30.

For positively actuating the rocker arms so as to move their respectively associated bridging contacts to and from the closed position, I provide, in accordance with my invention, a pair of coaxially juxtaposed rotatably mounted cams each having a cylindrical body and a projecting cog shaped to mesh between the cam followers on the respectively associated arm and which are movable in either direction to effect angular movement of the associated rocker arm in the opposite direction. Thus, referring to Fig. 2, I provide for the rocker arm 25 a rotatably supported cam 43 which is mounted on a shaft 44. This shaft extends lengthwise of a multi-stage switch through the intermediate supports 7 and is journaled in the end support 8 and the mounting plate 9. Thus, the axis of shaft 44 lies in a median plane through the concentric axes 28 of the rocker arms 24 and 25 between the rows of stationary contacts 1, 2, 4, 5, which are in quadrature with the axis 28 of the rocker arms. For economy and also for simplicity in assembly, the shaft 44 is square except for its rear end bearing portion, and the cams 43 are provided with suitably positioned square holes so as to turn with the shaft and so that desired sequences of operation can be provided at minimum expense. In order to have the driving and holding action of the rocker arms positive at all times, the cams 43 have opposite quadrantal arcuate portions 45, 45' illustrated as of circular contour to form a cylindrical body for alternate separate sliding engagement with the rounded cam followers 26, 27 to limit the rocking of the arm 25 in each direction and two diametrically opposite extensions 46, 46' projecting from the quadrant between the cam faces 45 and 45' and having substantially straight sides spaced apart substantially the same distance as the adjacent edges of the cam followers 26 and 27 so as to form a meshing cog therebetween to rock the arm 25 in each direction and joined by a substantially circular arc 47, 47' whose center is the axis of rotation of the cam so as to provide sliding engagement with the alternate follower after rocking the arm 25 in each direction. In the arrangement shown in Fig. 2, the cams 43 are set at the same angle relatively to the shaft 44 so that when one bridg-

ing contact 6 is in the circuit open position, the other contact 3 is in the circuit closed position, and vice versa.

Considering now only the rocker arm 25 and its associated bridging contact 6, it will be apparent that if the shaft 44 is turned clockwise until the straight cog portions 46, 46' are vertical as shown in Fig. 3, the rocker arm 25 is turned counterclockwise and the bridging contact 6 is just in engagement with the stationary contacts 4 and 5. Also, the portion 46' of the cam has its straight sides adjacent the edges of the cam followers 26 and 27 so as to mesh the cog 46' therebetween in each direction. This is due to the axis of the square shaft 44 carrying cam 43 being in quadrature with the two similarly converging and rounded followers 26 and 27 in the symmetrical position thereof as shown in Fig. 3. Upon further clockwise rotation of the shaft 44 as will appear from Fig. 4, the rocker arm 25 is turned still further counterclockwise, thus sliding the bridging contact 6 across the stationary contacts 4 and 5 whereby to produce a wiping and pressure action as the spring 35 is compressed by reason of the clockwise angular movement of the carrier 30 relatively to the rocker arm 25. The cam 43 is now further rotatable with the cylindrical cam portions serving to maintain the bridging contact 6 in engagement with the stationary contacts 4 and 5 with the circular arc portions 45' and 47' in sliding engagement with the cam followers 27 and 26, respectively.

From Fig. 2 and the foregoing, it will be obvious that the movement of the cam 43 associated with the rocker arm 24 in back of the rocker arm 25, as viewed in Fig. 2, will produce just the opposite movement of the bridging contact 3, that is, from the closed circuit position to the open circuit position. It will be apparent from Figs. 2, 3 and 4 that the rocker arm and the contact carrier in effect constitute a toggle for providing the necessary mechanical advantage to insure both a good wiping action and a relatively high contact pressure. As shown in Fig. 1, the shaft 44 is provided with an operating knob or handle 48, but as will be obvious to those skilled in the art, the shaft may be coupled to a circuit breaker or other device by suitable mechanism comprising a crank on the shaft so as to actuate the shaft and the switches associated therewith in accordance with predetermined positions of the parts of the circuit breaker or device. Thus, the shaft 44 may be oscillated to reversely operate the bridging contacts into and out of engagement with the corresponding stationary contacts although if it should ever be desired, shaft 44 may be continuously rotated to produce two reverse operations of the switches in each revolution of the shaft in either direction.

In Figs. 5 and 6, I have illustrated an embodiment of my invention wherein the two movable bridging contacts 3 and 6 of one stage have a different sequence of circuit controlling operations than that shown in Fig. 2. Thus, as shown in Fig. 5, the rocker arms 24 and 25 of one stage are driven by their respectively associated cams 43 and 43' which have square holes located so that they are at slightly different angles to the shaft 44 and so that one of the bridging contacts 3 is moved to the full circuit closed position just as the other bridging contact 6 is about to move off its associated stationary contacts 4 and 5. This arrangement illustrates the flexibility of control in only one stage. Obviously, in a plurality of stages, the variations in control are practically

unlimited even with only a few cams whose square shaft holes differ in angularity relative to the cam contour.

While I have shown and described my invention in considerable detail, I do not desire to be limited to the exact arrangements shown, but seek to cover in the appended claims all those modifications that 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 an insulating support, at least four spaced stationary contacts respectively mounted in two pairs on one side of said support and on opposite sides of a central axis thereof, terminals for said contacts all mounted along one edge of said support, and means for bridging said pairs of contacts comprising for each pair a rocker arm having two spaced cam followers, a bridging contact mounted on said rocker arm for movement therewith and relatively thereto into and out of engagement with the respectively associated pair of stationary contacts upon movement of the rocker arm about its axis, and a rotatably mounted cam having a cog projecting therefrom shaped and positioned to mesh between said cam followers and movable in either direction to effect angular movement of the rocker arm in the opposite direction.

2. A multi-stage electric switch comprising a plurality of interlocking insulating supports, at least four spaced stationary contacts respectively mounted in two pairs on one side of each of said supports and on opposite sides of a central axis of the support, terminals for the contacts of each stage all mounted along one edge of the support of the respective stage, and means for bridging the two pairs of contacts of each stage comprising for each pair a rocker arm having two spaced cam followers on opposite sides of its axis of rotation, a bridging contact pivotally and resiliently supported on said rocker arm for movement therewith and relatively thereto into and out of engagement with said stationary contacts upon movement of the respective rocker arm about its axis, and a rotatably mounted cam for each rocker arm and having a cog projecting therefrom shaped and positioned to mesh between the cam followers of the respectively associated rocker arm and movable in either direction to effect angular movement of the associated rocker arm in the opposite direction.

3. A multi-stage switch having in combination two double break switches per stage in planar alignment and having aligned stationary contacts in quadrature and bridging contacts movable in planar alignment therewith, two reversely juxtaposed coaxial rocker members having an axis in quadrature with said stationary contacts and each carrying a corresponding one of said bridging contacts and provided with equiangularly spaced cam followers on opposite sides of said axis, and a rotatable shaft having an axis in quadrature with said followers in the symmetrical position thereof and provided with two juxtaposed cams, each having a cog projecting therefrom for meshing between the cam followers of a corresponding rocker member to effect rotation of one of the rocker members in the contact closing direction and rotation of the other rocker member in the contact opening direction upon rotation of said shaft in each direction.

4. In combination, a rocker arm having two laterally convergent cam followers equidistant from the axis thereof, a switch provided with a

connection for reversely operating the switch upon reverse rocking movements of the arm, and a rotatable cam having an axis at the point of convergence of the cam followers in the mid-position of the rocker arm and provided with diametrically opposite cylindrical cam faces for separately engaging a corresponding one of said followers to limit the rocking of the arm in a corresponding direction and having a projecting cog therebetween provided with parallel side faces and a cylindrical end for meshing between said cam followers in either direction to effect angular movement of the rocker arm in the opposite direction.

5. In combination, a rocker arm having two semi-cylindrical cam followers offset in quadrantal convergence equidistant from the axis thereof, a switch provided with a connection for reversely operating the switch upon reverse rocking of the rocker arm about its axis, and a rotatable cam having an axis in quadrature with the convergent cam followers in the mid-position of the rocker arm and provided with diametrically opposite quadrantal arcuate cam faces, each for separately engaging one of said followers to limit the rocking of said arm in a corresponding direction and having a cog projecting therefrom and provided with parallel sides and a cylindrical end for meshing between the cam followers in either direction to rock the rocker arm in the opposite direction.

6. In combination, a rocker arm having two semi-cylindrical cam followers offset in quadrantal convergence equidistant from the axis thereof, a switch provided with a connection for reversely operating the switch upon reverse rocking of the rocker arm, a rotatably mounted cam having opposite quadrantal cam faces for alternate sliding engagement with said followers to limit the rocking of said arm in the corresponding direction and provided with two diametrically opposite cog extensions having parallel sides spaced apart substantially the same distance as the adjacent edges of said cam followers for meshing therebetween to rock said arm in either direction and provided with a cylindrical end for sliding engagement with the alternate follower after rocking said arm in each direction.

7. In combination, a rotatably mounted rocker arm having two semi-cylindrical cam followers offset in quadrantal convergence equidistant from the axis thereof, a switch provided with a connection for reversely operating the switch upon opposite rocking movement of the arm about its axis, and a rotatably mounted cam having an axis in quadrature with said followers in the symmetrical position thereof and provided with opposite quadrantal cam faces for separately engaging each of said followers to limit the rocking of said arm in a corresponding direction and opposite cogs projecting from the quadrants therebetween and provided with parallel sides to mesh between said cam followers in either direction to effect angular movement of the rocker arm in the opposite direction and each provided with a cylindrical end for engaging the other cam follower when either cam follower is in engagement with one of the quadrantal cam faces.

8. An electric switch having in combination two pairs of abutting stationary and movable contacts having the stationary contacts in quadrate alignment, two reversely juxtaposed rocker arms having concentric axes in quadrature with the stationary contacts and provided with equiangularly spaced cam followers and each carrying a corresponding one of the movable contacts at one end thereof, and a rotatable shaft having an axis in quadrature with said followers in the symmetrical position of each arm and provided with two juxtaposed cams each having a cog projecting therefrom for meshing between the cam followers of a corresponding rocker arm to rock one of the rocker arms in the contact closing direction and rock the other rocker arm in the contact open direction upon rotation of said shaft in each direction.

9. A multi-stage electric switch having in combination, a row of pairs of reversely juxtaposed rocker arms having concentric axes and each provided with opposing cam followers equidistant from said axes, two rows of stationary contacts parallel with and in quadrature with said axes, a movable contact yieldingly supported on each rocker arm for engagement and disengagement with a corresponding stationary contact upon reverse rocking of the arm from a mid-position, and a rotatable shaft having an axis in a median plane through the concentric axes between the rows of stationary contacts and provided with cam means for meshing between the cam followers in the mid-position of each rocker arm for reversely rocking said arm therefrom.

10. A multi-stage electric switch having in combination, a row of pairs of reversely juxtaposed rocker arms having concentric axes and each provided with opposing cam followers equidistant from said axes, two rows of pairs of spaced-apart stationary contacts parallel with and in quadrature with said axes, a movable bridging contact yieldingly supported on each rocker arm for engagement and disengagement with a corresponding pair of stationary contacts upon reverse rocking of the arm from a mid-position, and a rotatable shaft having an axis in a median plane through the concentric axis of the rocker arms between the rows of pairs of stationary contacts and provided with cam means for meshing between the cam followers in the mid-position of each rocker arm for reversely rocking said arm therefrom.

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