Nov. 30, 1954

A. M. DAILY ET AL

2,695,933

ELECTRICAL SWITCH

Filed June 8, 1953

Fig. 1.

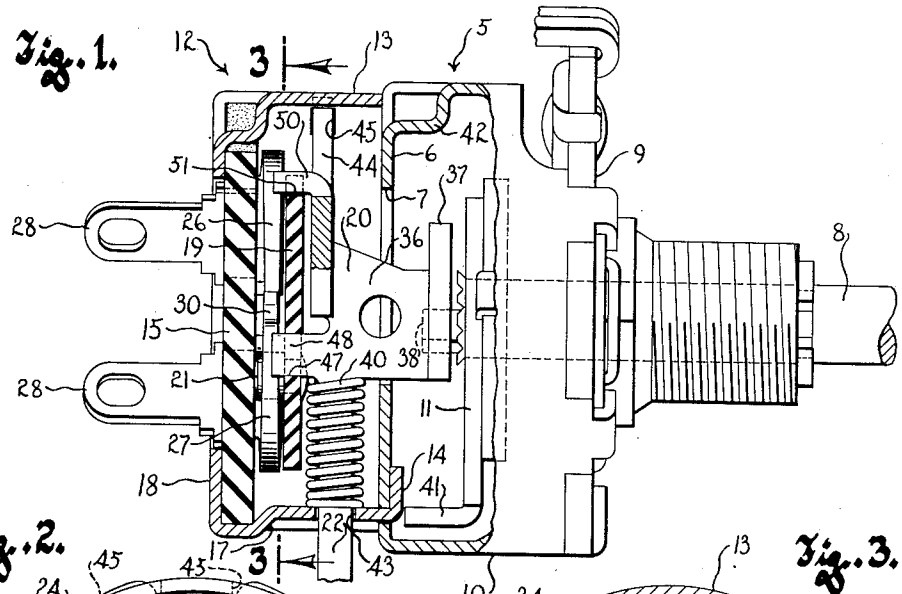


Fig. 2.

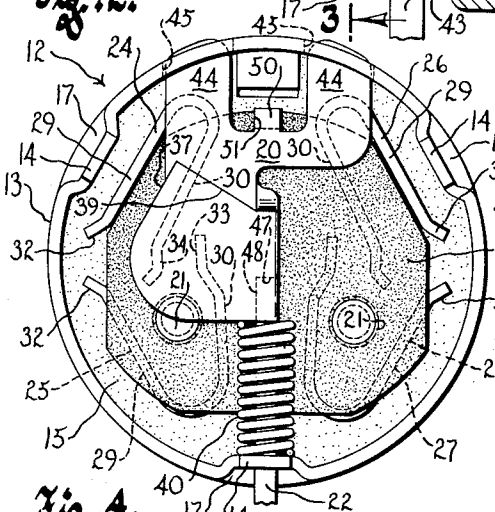


Fig. 3.

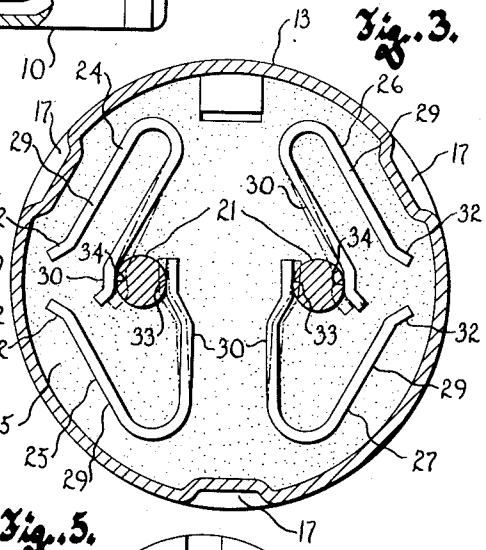


Fig. 4.

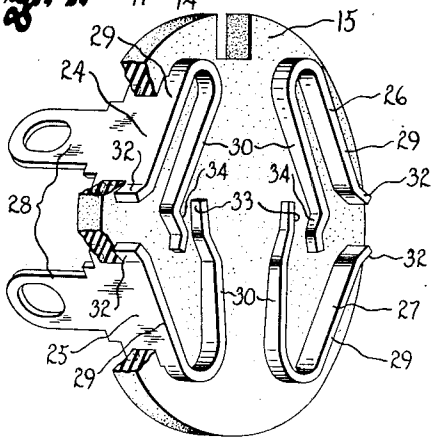
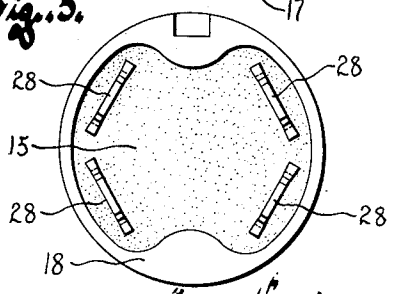


Fig. 5.



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United States Patent Office 2,695,933 Patented Nov. 30, 1954

2,695,933

ELECTRICAL SWITCH

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Application June 8, 1953, Serial No. 360,048

10 Claims. (Cl. 200—16)

This invention relates to electric switches, and refers more particularly to switches of the type used in radio and television apparatus. As a matter of convenience, but especially for compactness, such switches are generally mounted on the back of a variable resistance device and are actuated by the rotatable control shaft of the variable resistance device.

As will be readily appreciated from the fact that many of these electric switches are embodied in small portable radios, one of their most important requirements is compactness; and it is the object of this invention to provide a double pole single throw electric switch suitable especially for low power 125 volt service and featuring a reduction in size far greater than has heretofore been considered possible, enabling it to be housed in a shell having a diameter no greater than that of a 10-cent coin.

In the past it has been considered impractical to even attempt embodying a double pole single throw switch in a housing of such small diameter, and the most compact required housings which were on the order of one inch in diameter, with an area about twice that of the housing for the switch of this invention.

In any switch of this type, regardless of size, low contact resistance between the stationary and movable contacts is a prerequisite. Thus it is highly important that the stationary contacts be bridged by the movable contacts with uniform and adequate contact pressure therebetween. This is usually accomplished by the use of stationary contacts having spring arms between which the bridging contacts engage, and so spaced that they are spread apart and tensioned by such engagement of the bridging contacts therebetween. For this reason the spring arms must have maximum effective length or range so as to be able to flex properly during engagement of the bridging contacts therewith without taking a permanent set. Of equal importance is the achievement of equally effective wiping action between the bridging contacts and each set of stationary contacts.

In addition the movable contacts must have sufficient travel in the off direction to provide proper electrical clearance between them and the stationary contacts; and the switch terminals must be so spaced and arranged as to also have the proper electric clearance therebetween as well as to facilitate the soldering of lead wires thereto.

According to the present invention all of these requirements are met in a miniature switch of extremely small size partly by the particular design and arrangement of the movable and stationary contacts, and partly by the use of a switch actuating member of the sliding pitman type such as disclosed in the copending application of Wilkie H. Bush and Arthur M. Daily, Serial No. 255,270 filed November 7, 1951, now Patent No. 2,660,634 issued November 24, 1953.

With the above and other objects in view, which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described, and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawing illustrates one complete example of the physical embodiment of the invention constructed in accordance with the best mode so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a view partially in side elevation and partially in longitudinal section showing the switch of this invention mounted on the back of a variable resistance device to be controlled thereby;

Figure 2 is an elevational view showing the switch of this invention removed from the back of the resistance device, and looking into the open front end of the switch housing;

Figure 3 is a cross sectional view taken through Figure 1 along the plane of the line 3—3;

Figure 4 is a perspective view of the switch base, removed from the switch housing and showing the arrangement of the switch contacts and terminals thereon; and

Figure 5 is an elevational view looking at the rear of the switch housing.

Referring now more particularly to the accompanying drawing in which like reference characters indicate like parts throughout the several views, the numeral **5** generally designates a variable resistance device contained within a housing having a substantially flat rear wall **6** with a more or less central aperture **7** therein. The variable resistance device is controlled by an operating shaft **8** projecting through a bearing in the front wall **9** of the housing coaxially of its cylindrical side wall **10**. The shaft terminates about midway of the front and rear walls and has a lever **11** joined to its inner extremity to rotate therewith.

The miniature switch **12** of this invention is mounted upon the back wall **6** of the variable resistance device, and is housed within a cylindrical shell **13** having its front end abutting the back wall of the resistance device and joined thereto as by means of a series of tabs **14** on the shell projecting forwardly through slits in the back wall **6** of the resistance device and bent over upon its inner surface, as seen best in Figure 1.

The rear end of the shell is closed by a substantially flat switch base **15**, of insulative material, fixed to the shell in any suitable manner as by a series of circumferentially spaced indentations **17** in the shell immediately ahead of the base and an inturned flange **18** at the rear of the shell overlying the rear face of the base.

The movable contact carrier **19** of the switch comprises a disc of insulative material flatwise overlying the base and confined between the base and an actuating member **20**. The actuating member is of the sliding Pitman type disclosed in the copending application of Wilkie H. Bush and Arthur M. Daily, Serial No. 255,270, filed November 7,1951, now Patent No. 2,660,634 issued November 24, 1953, and will be described at greater length hereinafter. For the present it is sufficient to note that the actuating member is constrained to reciprocatory motion crosswise of the base in a path parallel to the inner face thereof, and has a transient driving connection with the lever **11** on the control shaft **8** by which the latter effects such reciprocatory motion of the actuating member. The actuating member in turn imparts back and forth motion to the contact carrier **19** along a straight path parallel to the base to carry each of a pair of bridging contacts **21** on the carrier toward and from bridging engagement with a set of cooperating stationary contacts on the switch base. The actuating member **20** also has an elongated stem portion **22** thereon lying in a plane normal to the switch base and passing through its center, parallel to the path of reciprocatory motion of the carrier and the actuating member.

One of the main features of novelty of the switch of this invention, and which makes possible its extremely small size, resides in the placement of the bridging contacts on the carrier **19** with respect to the actuating member **20**, and the shape and placement of the stationary contacts of the switch with respect to the bridging contacts **21**. The bridging contacts, it will be noted, are in the form of cylindrical rivets fixed to the carrier **19** and projecting from its underside toward the inner surface of the switch base. They are located along a line perpendicular to the path of motion of the carrier and to the plane of the stem portion **22** on the actuating member, and are spaced equal distances to opposite sides of said plane. In the switch on, or closed position of the carrier seen in Figure 3 the line joining these con-

tacts passes through the center of the switch base; while in the switch open or off position seen in Figure 2, the line joining the bridging contacts is spaced a distance below the center of the base.

There are four stationary contacts, 24, 25, 26 and 27 mounted upon the switch base at the flat inner face thereof and at locations such that each of the contacts substantially occupies one quadrant of said surface of the base. Each of the contacts is formed integrally with one of the terminals 28 of the switch in accordance with the construction disclosed in Patent No. 2,524,784 issued October 10, 1950, to A. E. Franks et al.

The stationary contacts 24 and 25 constitute a left-hand set of contacts while the stationary contacts 26 and 27 constitute a righthand set of contacts, the two sets of contacts being arranged at opposite sides of, and spaced equidistant from the plane of the actuator stem 22. In other words, the two sets of contacts are arranged symmetrically about the plane containing the stem of the actuating member and passing centrally through the base.

All of the stationary contacts are substantially U-shaped and their arms 29 which are outermost with respect to the center of the base are fixed thereto and formed as the inner extremities of the switch terminals 28 in the manner described in the aforesaid patent to A. E. Franks et al. The inner arms 30 of the stationary contacts constitute spring arms of substantial length having the bight ends of the U-shaped contacts formed as a part thereof.

Since the two sets of stationary contacts are symmetrically arranged on the base, the following description of the lefthand set of contacts 24 and 25 applies to the righthand set as well. The contacts 24 and 25 are secured to the base with their bight ends remote from one another but substantially along a line passing through the adjacent bridging contacts 21 and parallel to said plane of the stem 22 of the actuating member, and the arms of each extend generally toward the other contact member of the set. The outer arms 29 of the two contact members are oppositely inclined with respect to said plane of the stem 22 of the actuating member and converge toward one another outwardly of the center of the base to terminate a distance short of one another.

The inner arm 30 of the contact member 25 which occupies the lower left quadrant on the switch base extends lengthwise toward the contact member 24 in the quadrant thereabove, along a line substantially parallel to the plane of the stem 22 of the actuating member. The inner flexible arm 30 of the contact member 25 is thus in divergent relationship with respect to its stationary arm 29. Hence, the arms 30 of the two lower contact members are substantially parallel to one another.

The inner flexible arm 30 of the contact member 24 is disposed substantially parallel to its fixed arm 29, and its extremity terminates substantially midway between the end portions of the arms of the contact member 25 therebeneath.

In the interests of stability, the outer ends of the fixed arms of all of the contact members are bent outwardly at a slight angle, as at 32, while the outer end portions of each of the spring arms is offset slightly with respect to the plane of its arm. Thus the free end portions of the flexible arms 30 of the two lower contact members are offset a slight distance away from one another, toward the opposite stationary arm thereof to provide a contact portion 33 thereon substantially parallel to the plane of the stem 22 of the actuating member; while the outer end portions of the flexible arms of the two upper contact members are offset slightly toward one another to provide similar contact portions 34 thereon overlapping and opposing the contact portions 33 in spaced relation thereto, and likewise substantially parallel to said central plane of the stem 22.

With the arrangement of the stationary contacts described, their terminals 28 which project from the back of the switch base are arranged tangent to a circle whose diameter is only slightly less than that of the shell 13 of the switch. Consequently, the terminals are relatively remote from one another to provide adequate electrical clearance therebetween, and their positions close to the periphery of the switch case facilitate the soldering of lead conductors thereto.

Likewise, all portions of the stationary contacts exposed at the inner face of the switch base are spaced from one another sufficiently far as to provide good electrical clearances therebetween; while at the same time their placement enables the use of relatively long spring arms to provide the desired spring range for the contacts.

As stated previously, the actuating member 20 is of the sliding pitman type, and it has a flange 36 thereon, formed as a portion of the stem 22 in the plane thereof, projecting forwardly out of the front of the switch housing through the hole 7 in the back wall of the variable resistance device and into the interior of the housing thereof. The forward extremity of the flange is bent laterally to one side to provide a cam 37 which flatwise overlies the lever 11 on the inner extremity of the operating shaft 8. A driving lug 38 on the lever coacts with an inclined surface 39 on the cam to effect rapid propulsion of the actuating member downwardly, with an accelerating motion, against the yielding bias of a compression spring 40 encircling its stem 22, during counterclockwise rotation of the operating shaft (as viewed in Figure 2) to a position at which a stop lug 41 on the lever engages a fixed stop 42 on the side wall of the housing of the variable resistance device. Such downward movement of the actuating member effects opening of the switch with the desired fast action. Clockwise rotation of the operating shaft from the position described carries the driving lug 38 off of the cam 37 and causes the actuating member to be snapped upwardly by the spring 40 to the switch closed or on position.

The actuating member 20 is constrained to reciprocatory motion across the switch base and lengthwise of its stem 22 by the engagement of the latter in a suitable hole 43 in the shell 13 of the switch housing, at one side thereof, in cooperation with a pair of lobes 44 on the opposite end of the actuating member similarly slidably engaged in circumferentially spaced holes or slits 45 in the shell 13 at the opposite sides thereof.

The movable contact carrier 19, of course, is flatwise confined between the inner face of the base, overlying the stationary contacts thereon, and the actuating member 20; and it has a hole 47 therein substantially centrally between the two bridging contacts 21 to receive a lug 48 on the actuating member projecting rearwardly from the upper portion of its stem 22. The engagement of the lug 48 in the hole 47 of the contact carrier provides a driving connection between the carrier and the actuating member by which the carrier partakes of reciprocatory motion of the latter.

To preclude any rotary motion of the contact carrier about the lug 48, however, the carrier is interconnected with the actuating member at another location, remote from the driving lug 48. This latter connection between the parts comprises another lug 50 on the actuating member bent rearwardly therefrom at a location between the lobes 44 at its upper end and engaging in a shallow notch 51 in the periphery of the disc comprising the contact carrier 19. The lug 50 is located in the plane containing the stem 22 of the actuating member, and is also employed to limit the motion of the actuating member in the switch on direction. Hence, the engagement of the lug 50 with the inner surface of the shell 13 of the switch housing defines the switch closed position of the contact carrier.

It is extremely important, in a double throw single pole switch of the type herein concerned, that the contact carrier be constrained to edgewise reciprocatory motion in a path normal to the line joining the bridging contact buttons 21, by the lugs 48 and 50 in the manner described. This assures that the bridging contacts will travel along straight lines parallel to the plane of the stem 22 of the actuating member, with their lines of travel exactly bisecting the spaces between the contact portions 33 and 34 of their respective stationary contacts. In this way, not only is equal contact pressure between the stationary contacts and their bridging contacts achieved, but a most desirable balanced wiping engagement is obtained between the bridging contacts and their stationary contacts during final switch closing motion of the carrier.

Hence, upward movement of the contact carrier toward the switch closed position effects engagement of the bridging contacts between the contact portions of their respective stationary contact and effects equal spreading of the flexible arms of the contacts to assure balanced wiping engagement therewith.

It will be noted, of course, that the bridging contacts 21 occupy positions substantially centrally of the bight

end portions of the contact members 25 and 27 occupying the two lower quadrants of the switch base in the switch off position of the contact carrier. In this position of the carrier, the bridging contacts are adequately spaced from all portions of the surrounding stationary contact members to assure the proper electrical clearance therebetween.

When the actuating member 20 is snapped upwardly to propel the contact carrier toward switch closed position, the bridging contacts 21 thereon are brought into tangential relation with surfaces on the outer end portions of the flexible arms of their respective stationary contacts which converge slightly toward one another in the direction of switch closing motion of the carrier, and which surfaces effect camming of the contact portions 33 and 34 of the stationary contacts apart the distances necessary to build up the proper spring tension in the spring arms of the contacts. After such initial camming engagement of the bridging contacts with the stationary contacts, the bridging contacts ride onto the more or less parallel contact portions 33 and 34 whose surfaces are parallel to the line of travel of the bridging contacts, to thus give the proper wiping action between the contacts.

From the foregoing description, taken together with the accompanying drawing, it will be readily apparent to those skilled in the art that this invention makes it possible to achieve extreme compactness in a double pole single throw switch while retaining all of the features heretofore considered possible only in much larger switches.

What we claim as our invention is:

1. An electric switch of the type having a flat contact carrier constrained to edgewise back and forth motion along a straight path between switch closed and switch open positions to carry each of a pair of bridging contacts on one face thereof toward and from bridging engagement with a set of cooperating stationary contacts: characterized by the fact that said bridging contacts are spaced apart along a line substantially normal to said path of carrier motion; and further characterized by the fact that each set of stationary contacts comprises a pair of spring arms fixed at one end at zones remote from one another but adjacent to the line of travel of their cooperating bridging contact, said spring arms extending toward one another and having their free end portions overlapping and opposing one another in the zone occupied by their cooperating bridging contact in the switch closed position and normally spaced from one another a distance to be spread apart and tensioned by the engagement of the bridging contact therebetween to thus assure good contact pressure between the stationary contacts and their bridging contacts.

2. An electric switch of the type having a flat contact carrier constrained to edgewise back and forth motion along a straight path between switch closed and switch open positions to carry each of a pair of bridging contacts on one face thereof toward and from bridging engagement with a set of cooperating stationary contacts: characterized by the fact that said bridging contacts comprise cylindrical contact buttons spaced apart along a line substantially normal to said path of carrier motion and having their axes normal to the plane of the carrier; and further characterized by the fact that each set of stationary contacts comprises a pair of spring arms arranged generally lengthwise of the path of carrier motion with their free end portions extending at a slight angle toward one another from zones remote from one another but located substantially along the line of travel of the cooperating bridging contact, the free end portions of the spring arms having contact portions substantially parallel to and equidistant from the line of travel of the cooperating bridging contact and overlapping one another in the zone occupied by said bridging contact in the switch closed position but normally spaced apart a distance less than the diameter of said bridging contact, whereby the engagement of the bridging contacts between the contact portions of the spring arms takes place with a wiping action and effects equal spreading and tensioning of the arms to assure good contact pressure of their contact portions with the bridging contacts.

3. In an electric switch: a base of insulative material having a flat face; a movable contact carrier comprising a disc of insulative material flatwise overlying the base with its underside opposite said face and in spaced parallel relationship thereto; a pair of spaced apart bridging contacts on the underside of the carrier; means constraining the carrier to edgewise motion, along a straight path normal to the line joining said bridging contacts, between a switch open position and a switch closed position at which said bridging contacts occupy positions substantially at opposite sides of and spaced from the center of said face of the base; right and left sets of stationary contacts on said face of the base arranged symmetrically about and spaced from a line midway between and parallel to the lines of travel of said bridging contacts, each set of stationary contacts comprising a pair of substantially U-shaped contact members arranged with their bight ends remote from one another and lying along the line of travel of the cooperating bridging contact and with the arms of each extending generally toward the other contact member of said pair thereof to have their extremities adjacent to but spaced from one another, the arms of said pair of contact members which lie remote from the center of the base being fixed thereto and oppositely inclined with respect to the line of travel of the adjacent bridging contact so as to recede from said line toward their outer extremities, the inner arms of said pair of contact members being flexible toward and from their respective fixed arms, one of said pair of contact members extending around the adjacent bridging contact in spaced relation thereto in the switch open position of the carrier, and the flexible arm of said one contact member having a contact portion on its outer end offset outwardly toward and substantially parallel to the line of travel of the adjacent bridging contact to have wiping engagement therewith during closure of the switch, the flexible arm of the other contact member of said pair thereof having a contact portion at its outer end in substantially parallel opposing relation to said first designated contact portion to likewise have wiping engagement with the adjacent bridging contact during closure of the switch, said contact portions being so spaced from one another as to require substantially equal flexure of their respective arms by the engagement of the adjacent bridging contact therebetween.

4. The electric switch set forth in claim 3 further characterized by the fact that the contact member which extends around the adjacent bridging contact has the major portion of its flexible arm arranged substantially parallel to the line of travel of said bridging contact; and further characterized by the fact that the flexible arm of the other contact member is substantially parallel to its fixed arm while the outer end portion of its flexible arm is disposed substantially midway between the outer end portions of the arms of the first designated contact member and has its contact portion offset inwardly toward the line of travel of the adjacent bridging contact.

5. In an electric switch: a base of insulative material having a substantially flat face; a movable switch actuating member overlying said face of the base in spaced relation thereto; means constraining the actuating member to reciprocatory motion along a path parallel to said face of the base with a portion of the actuating member lying in a plane normal to said face of the base and substantially passing through the center thereof; two sets of spaced stationary contacts on said face of the base arranged at opposite sides of said plane and spaced equal distances therefrom, each set of stationary contacts comprising a pair of spring arms having their free ends extending generally toward each other and provided with spaced opposing contact portions thereon substantially parallel to said plane; a movable contact carrier comprising a disc of insulative material interposed between the actuating member and said face of the base and constrained to movement in a plane parallel to said face of the base, said carrier having a hole therein on said plane; a driving lug on said portion of the actuating member engaged in said hole so that the carrier partakes of the movement of the actuating member and is moved to and from a switch on position thereby; a pair of bridging contacts fixed on the carrier at the face thereof adjacent to the base and engageable between the contact portions on the stationary contacts in the switch on position of the carrier, said bridging contacts being arranged along a line normal to said plane and each being so spaced therefrom that its line of travel passes midway between the contact portions on one set of stationary contacts; and interengaging means on the carrier and the actuating member spaced from said driving lug for pre-

cluding rotary movement of the carrier on said lug to thereby assure that the bridging contacts will travel in straight lines parallel to said plane and will accordingly have equally effective wiping contact with said contact portions on the spring arms.

6. The electric switch set forth in claim 5 wherein said interengaging means on the carrier and actuating member comprises a stop lug on the latter engaging in an aperture in the carrier disc; and further characterized by the fact that said stop lug is engageable with a part fixed with respect to the base to define the switch on position at which the bridging contacts are engaged between the contact portions on the stationary contacts.

7. In an electric switch: a housing comprising a cylindrical sheet metal shell, and a relatively flat circular insulating base fixed in one end of the shell; a movable switch actuating member extending across the inner face of the base in spaced relation thereto; cooperating means on the shell and the actuating member constraining the latter to reciprocatory motion along a path parallel to the inner face of the base with a portion of the actuating member lying in a plane normal to the base and substantially passing through its center; two sets of spaced stationary contacts on the inner face of the base arranged at opposite sides of said plane and spaced therefrom, each set of contacts comprising a pair of spring arms arranged with their free ends extending toward one another substantially along the path of motion of the actuating member and having spaced opposing contact portions at their adjacent outer ends substantially parallel to said path of motion of the actuating member and adjacent to a central zone of the base; a movable contact carrier comprising a disc of insulative material interposed between the actuating member and the inner face of the base and constrained to edgewise movement parallel thereto, said carrier having a hole therein on said plane; a driving lug on said portion of the actuating member engaged in said hole in the carrier whereby the carrier partakes of the movement of the actuating member and is movable thereby toward and from a switch closed position; a pair of rivets fixed to the carrier at the face thereof adjacent to the base and providing bridging contacts on the carrier arranged along a line normal to said plane and to travel therewith along lines passing midway between the contact portions of the stationary contacts, said rivets having a diameter slightly larger than the spaces between said contact portions and having wiping engagement therewith during closure of the switch; a stop lug on the actuating member spaced from the driving lug thereon and lying in said plane, said stop lug being adapted to engage the inner surface of the housing shell to define the switch closed position of the actuating member and consequently of the contact carrier; and means on the carrier engaged by said stop lug for precluding rotary movement of the contact carrier about said driving lug to thereby assure that the bridging contacts will have equally effective wiping engagement with said contact portions on the spring arms.

8. A double pole single throw electric switch of the type having a contact carrier movable between switch closed and switch open positions to carry each of a pair of bridging contacts thereon toward and from bridging engagement with a set of cooperating stationary contacts mounted on one flat face of a base of insulative material: characterized by the fact that said face of the base is substantially circular, and each of the stationary contacts is disposed in one quadrant thereof, while the contacts comprising each set thereof lie in circumferentially adjacent quadrants; and further characterized by the fact that said stationary contacts have a substantially U-shape, with the bight ends of the contacts of each set thereof remote from one another and their arms extending generally toward one another, the outer end portion of the inner arm of one stationary contact of each set lying intermediate the outer end portion of the inner arm of the other stationary contact of said set and the center of the base, and said outer end portions of the inner arms of the stationary contacts of each set thereof having spaced opposing contact surfaces thereon between which one of the bridging contacts engages in the switch closed position of the contact carrier.

9. The double pole single throw electric switch set forth in claim 8 further characterized by the fact that the portions of the outer arms of the stationary contacts outwardly of their bight ends are rigidly secured to the base while the inner arms of the stationary contacts are resiliently joined to the outer arms through the bight ends of the stationary contacts and constitute spring arms which are yieldable toward and from their respective rigidly secured arms.

10. The double pole single throw switch set forth in claim 9 further characterized by the fact that said rigidly secured outer arms of the stationary contacts overlie portions of the base close to its periphery and have integral terminals thereon projecting through the base to be exposed at the opposite face thereof and to likewise lie close to the periphery of the base.

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