June 9, 1942. N. C. SCHELLENGER 2,286,162

SWITCH CONSTRUCTION

Filed Oct. 20, 1939 2 Sheets-Sheet 1

Fig. 1.

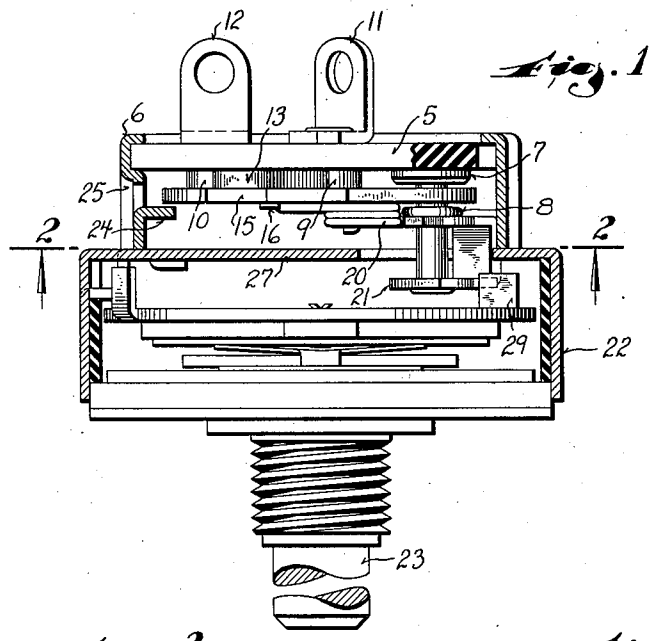


Fig. 2.

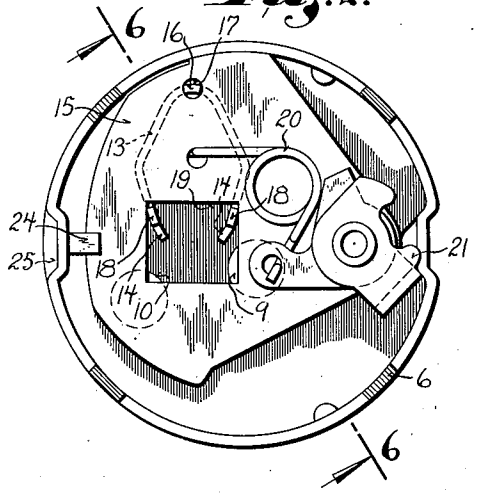
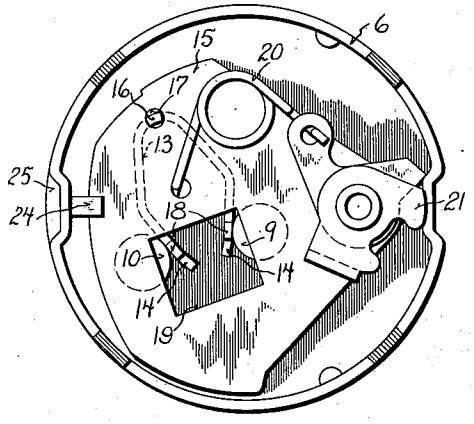


Fig. 3.



Inventor

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Fig. 4.

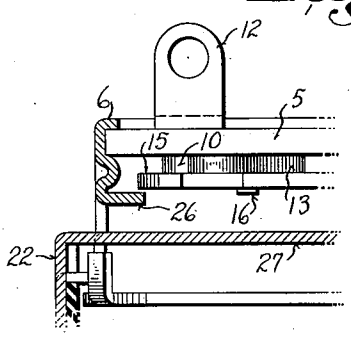


Fig. 5.

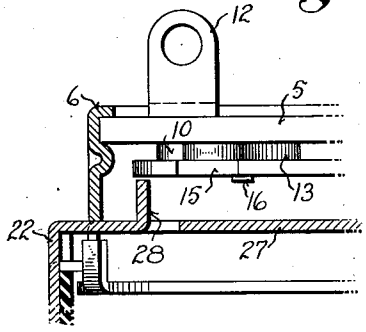


Fig. 6.

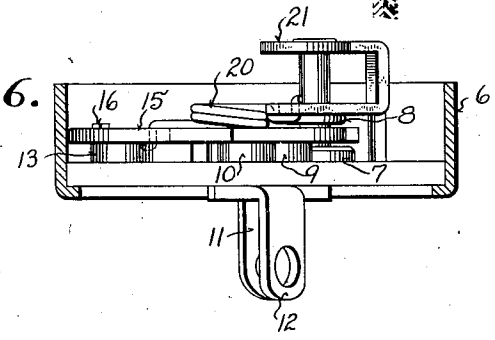


Fig. 7.

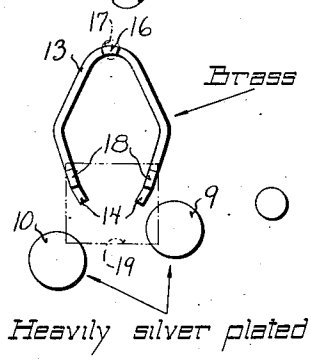


Fig. 8.

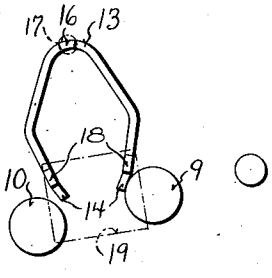
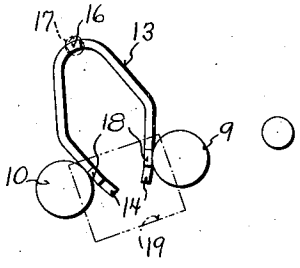


Fig. 9.



Inventor

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Patented June 9, 1942

2,286,162

UNITED STATES PATENT OFFICE

2,286,162

SWITCH CONSTRUCTION

Newton C. Schellenger, El Paso, Tex., assignor to Chicago Telephone Supply Company, Elkhart, Ind., a corporation of Indiana

Application October 20, 1939, Serial No. 300,321

9 Claims. (Cl. 200—67)

This invention relates to electric snap switches; and like the copending application of Newton C. Schellenger, Serial No. 83,963, filed June 6, 1936, now Patent No. 2,177,284, of which this application is a continuation in part, refers particularly to snap switches of the type used in radio receivers.

From the standpoint of compactness and mechanical design, the switch construction illustrated in the aforesaid copending application has proved to be exceptionally satisfactory. Briefly, this switch structure consists of a flat base of insulating material from which two spaced stationary contacts and a pivot post project, the contacts being electrically bridged to close the switch by a movable contactor which is slid across the surface of the base in an arcuate path by an insulated carrier pivoted to the post.

The carrier overlies the contactor and is connected thereto by tangs or lugs struck up from the contactor and received in apertures in the carrier. The maintenance of this driving connection depends upon the carrier being constrained against movement away from the base beyond a predetermined extent, as the tangs or lugs merely project into the apertures of the carrier.

When the switch is assembled, the carrier is yieldingly restrained against movement away from the base by the toggle spring which is so connected between the carrier and the actuating cam as to have a downward force component acting to hold the carrier against the contactor.

It has been found, however, that in some instances, where the switch is handled quite roughly during its installation, the carrier sometimes jumps away from the base sufficiently to permit its being disengaged from the movable contacts. The most frequent source of this trouble has been traced to sharp blows, as by a light hammer, applied on the end of the volume control shaft.

While reformation or strengthening of the spring to impose a greater downward thrust onto the contactor carrier would minimize this objection, it would do so only at the expense of smoothness and ease of switch operation; for any increase in spring tension would entail greater friction.

This invention, therefore, has, as one of its objects, the provision of a simple limiting shoulder or abutment carried by the switch casing or some other stationary part and overlying the contactor carrier to definitely limit movement thereof away from the base and thus insure the maintenance of the driving connection between carrier and contactor.

The connected contactor and carrier swing in an arc about a fixed pivot axis; and the stationary contacts are so positioned as to be substantially on a line radial to this axis. Consequently, one contact is closer to the pivot axis than the other.

This disposition of the stationary contacts with relation to the arcuate path of the bridging contactor results in a slower break between the inner stationary contact, that is, the one nearest the pivot axis, and the bridging contactor than at the outer stationary contact; and where the movable bridging contactor is a resilient U-shaped band with the ends thereof providing its contact engaging surfaces, there is also less relative wiping action between the inner stationary contact and its cooperating leg of the movable contactor than between the outer stationary contact and its cooperating leg of the movable contactor.

As a result of this inequality in the velocity of the break and wiping action, at the two stationary contacts, the arcing load is carried primarily at the inner contact, thus accelerating the destructive effects of the arc and materially shortening the life of the switch.

To overcome this objection, the present invention has, as another of its objects, to so guide the motion of the movable bridging contactor as to insure its engaging the inner stationary contact first, during closure of the switch, and disengaging the inner contact last, during opening of the switch. In this manner, it is possible to balance the ratio of arcing at the inner and outer contacts against the cleaning action resulting from wiping engagement between the contacts and contactor so that an effect equivalent to that which would be obtained if the two stationary contacts were equidistant from the pivot axis, is achieved.

Another object of this invention, directed to the longevity of the switch, resides in the provision of cooperating contacts formed of metals chosen for their ability to keep contact resistance down to a minimum throughout a long period of use.

As in the aforesaid copending application, it is also an object of this invention to provide a switch wherein the stationary contacts are cylindrical and spaced apart a fixed distance and wherein the movable bridging contactor has contact engaging portions disposed at an acute angle lying within certain definite limits to preclude the contactor sticking in closed position and bounc-

ing away from the stationary contacts during closure of the switch.

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 drawings illustrate several complete examples of the physical embodiment of the invention constructed in accordance with the best modes so far devised for the practical application of the principles thereof, and in which—

Figure 1 is a longitudinal sectional view through a switch constructed in accordance with this invention and illustrating the same mounted on the back of a volume control;

Figure 2 is a cross sectional view taken through Figure 1 on the plane of the line 2—2 and showing the switch open;

Figure 3 is a view similar to Figure 2 but showing the switch closed;

Figures 4 and 5 are detail fragmentary views similar to part of Figure 1 and illustrating a slightly modified manner of holding the contactor carrier in place;

Figure 6 is a detail sectional view taken through Figure 2 on the plane of the line 6—6; and

Figures 7, 8 and 9 are diagrammatic views to illustrate progressively the manner in which the bridging contactor engages the stationary contacts during closure of the switch.

Referring now particularly to the accompanying drawings, in which like numerals indicate like parts, the numeral 5 designates the base of the switch which, as is customary, comprises a circular disc of suitable insulating material and closes one end of a cylindrical metal shell 6. The base and the shell thus constitute a substantially cup-shaped switch housing.

Fixed to the base and projecting from the inner flat surface thereof is a pivot post 7. This post is located near the edge of the base and has an annular enlargement or flange 8 located medially of its ends.

Also fixed to the base and projecting up from its inner surface are two spaced stationary contacts 9 and 10. These two contacts are on a line substantially radial to the axis of the pivot post, so that one (the contact 9) is located substantially medially between the pivot post and the other contact. Terminals 11 and 12 mounted on the outer face of the base and connected respectively to the contacts 9 and 10 provide for connecting the switch in the circuit to be controlled.

Closure of the switch is effected by engaging a bridging contactor 13 with the two stationary contacts. This bridging contactor consists of a substantially U-shaped band of resilient metal having its free end portions 14 directed angularly toward each other to define an acute angle so as to engage the cylindrical surfaces of the stationary contacts with a wedging action.

The movable bridging contactor is slid across the surface of the base to and from bridging engagement with the stationary contacts by an insulated carrier 15 to which the bridging contactor is connected in a manner to be hereinafter described.

The carrier preferably consists of a substantially segment-shaped piece of flat insulating material with a hole in its apex by which it is hooked onto the pivot post, the hole being large enough to permit the flange 8 to pass therethrough so that the carrier may be disposed between the flange and the base. In this position, the carrier overlies the stationary contacts and the bridging contactor.

The connection between the carrier and the bridging contactor consists of a lug or tang 16 extending from one edge of the closed end of the U and pivotally received in a hole 17 in the carrier and two similar lugs or tangs 18 extending up from the end portions of the legs of the U to be received in an enlarged opening 19. The width of the opening 19 is slightly less than the distance across the outermost corners of the tangs or lugs 18 when the U-shaped contactor is free so that the legs of the U are held under a slight spring tension for a purpose to be hereinafter described.

It will be apparent that this manner of drivingly connecting the bridging contactor with the carrier permits ready disassembly of these parts by movement of the carrier away from the base. Such bodily movement of the carrier is opposed by the downward force component of a toggle spring 20 which is connected between the carrier and an actuating cam 21 pivotally mounted on the post.

As described in the aforesaid copending application, the spring 20 snaps the contactor carrier from one position to the other as the actuating cam is moved from one limit of motion to the other; and by virtue of the fact that the point of connection between the spring and the actuating cam is above the connection of the spring to the contactor carrier, a downward thrust is imposed upon the carrier to maintain the same properly assembled with the contactor.

Ordinarily, this downward thrust of the spring is sufficient to keep these parts properly assembled, but in some instances, during the assembly of the switch in the radio chassis or other device with which it is used, the handling to which the switch is subjected may cause the contactor carrier to jump away from the base sufficiently to permit its disengagement from the bridging contactor.

This condition is particularly prevalent where the switch is mounted on the back of a volume control 22, as shown in Figure 1; and for some reason or other, a light blow is struck on the end of the control shaft 23 during assembly of the unit in the chassis or other device with which it is used.

To guard against this objectionable possibility, a tongue 24 is struck from the side wall or shell 6 to overlie the contactor carrier, as clearly shown in Figures 1, 2 and 3.

It is preferable to strike this tongue 24 from the wall of an indentation 25 in the shell. This permits the use of a relatively short tongue and provides a uniform overhang over the adjacent edge of the carrier which is arcuate and concentric to the pivot axis.

The location of this tongue, as best shown in Figure 1, so limits the movement of the carrier away from the base as to preclude disengagement of its driving connection with the bridging contactor.

While it is preferable to provide this tongue 24 in the manner described, it is possible, of course, to have it struck from the rim or edge of the metal side wall or shell, as shown at 26 in Figure 4; or it might be struck down from

the end wall 27 of the volume control housing as at 28 in Figure 5.

The mechanism of the volume control forms no part of this invention and, therefore, need not be described. It is sufficient to note that rotation of the shaft 23 carries a driver 29 along an arcuate path to transiently engage the actuating cam so that the switch may be opened and closed by rotation of the shaft 23.

In switches of this type heretofore in use, no provision was made to guard against the inevitable inequality in the amount of arcing and wiping action at the two stationary contacts.

The present invention, however, provides a construction by which the ratio of arcing at the contacts may be so balanced against the cleaning effect obtained by the wiping action, that the result is substantially the same as though both stationary contacts were equidistant from the pivot axis. This desideratum is achieved by constraining the arcuate motion of the bridging contactor to a defined path having a definite relationship to the positions of the stationary contacts; and it is for this purpose that the tangs or lugs 18 are held in engagement with the side edges of the opening 19 under spring tension.

As best shown in Figures 7, 8 and 9, the motion of the movable bridging contactor with relation to the stationary contacts during closure of the switch is such that engagement is first established between the inner contact 9 and its cooperating leg of the bridging contactor; and thereafter, as switch closure progresses, the engaged inner leg of the bridging contactor moves inwardly against the prevailing spring tension which should be approximately one to one and one-half ounces, to disengage its tank or lug from the edge of the opening.

Continued closure next effects engagement of the outer leg of the bridging contactor with the outer stationary contact and when this occurs, both legs of the bridging contactor are free from the guiding action of the hole 19 so that the bridging contactor is free to pivot as required to equalize the pressure on the two contacts.

Hence, it will be observed that the actual closure of the switch takes place at the outer contact.

In opening, the reverse order obtains, that is, the outer contact is first disengaged by the contactor. This draws an appreciable arc. Then, while this arc continues, the inner contact is disengaged by the contactor accompanied by a slight arc. The destructive effect of the arcing is thus greatest at the outer contact; but inasmuch as the outer leg of the bridging contactor not only has greater kinetic energy than the inner leg thereof but also moves farther than the inner leg, it will be seen that the inequality of the arcing at the inner and outer contacts is offset by the greater cleaning action available at the outer contact.

The desirable balance between the ratio of arcing and cleaning action is thus effected with a result, as noted hereinbefore, that the switch action is similar to that which would be obtained if the stationary contacts were equidistant from the pivot axis.

The angle formed between the inwardly directed free end portions 14 of the bridging contactor is important. If this angle is less than approximately twenty-six (26) degrees, the bridging contactor may wedge between the stationary contacts and become stuck, thereby preventing proper opening of the switch. If the angle is greater than approximately forty-five (45) degrees, the bridging contactor bounces during closure of the switch, drawing small but objectionable arcs.

It is, thus, preferable to maintain this angle substantially medially between twenty-six (26) and forty-five (45) degrees.

Heretofore, it has been customary to use copper for the staionary contacts and phosphor bronze for the bridging contactor when the U-shaped construction is employed and copper when a solid construction is employed, as in the aforesaid copending application.

In all instances, the contacts were quite heavily plated with silver so that the actual switching was done between silver to silver. This arrangement, while substantially satisfactory, has been found to be far excelled if one of the cooperating contacts, or at least its contact engaging surface, is brass and the other remains silver.

In the construction illustrated and described wherein the bridging contactor is a U-shaped resilient band, it is preferable to make the contactor of spring brass and to have the stationary contacts formed of copper heavily silver plated.

The exact reason for the greatly improved results obtained by this combination of metals has not been definitely determined; but the answer is believed to lie in the fact that the grain structure of brass is closer or at least is of such character that it causes the bridging contact to slide more easily over the silver plated stationary contacts.

In life tests conducted with switches identical in mechanical design and construction except that in one instance, phosphor bronze bridging contactors were employed and in the other, spring brass bridging contactors were used, it was found that contact resistance in the former ran as high as thirty thousandths (.030) of an ohm after only five thousand (5,000) cycles of operation and as high as sixty-six thousandths (.066) of an ohm at twenty-five thousand (25,000) cycles; whereas, in the latter case, the contact resistance during twenty-five thousand (25,000) cycles never rose above approximately seven thousandths (.007) of an ohm, and only after thirty-two thousand (32,000) cycles of operation did the contact resistance rise above ten thousandths (.010) of an ohm.

This remarkable difference in contact resistance was wholly unexpected and as unpredictable as it now appears to be inexplicable.

Because brass is susceptible to rather rapid corrosion in certain ambient atmospheric conditions; and as many plants employ corrosive gases in their manufacturing processes, it is desirable to protect the brass bridging contactor against such corrosive effects. To this end, a very light silver plating is applied thereto. This plating protects the contactor against corrosion but does not affect the functioning of the switch or in anywise increase contact resistance, as it wears off at its contact engaging portions during the first few operations of the switch so that thereafter the desirable effect of plain brass against silver is obtained.

While silver plating as a protection against corrosive atmospheres is generally satisfactory, other metals may be employed for this protective plating where the switch is to be used in locations subject to fumes or gaseous atmospheres highly active against silver.

From the foregoing description taken in connection with the accompanying drawings, it will be readily apparent that this invention provides

a substantial improvement in snap switches of the type described, for it obviates the possibility of the bridging contactor becoming disengaged from its carrier; improves the switching action and thus lengthens the longevity of the switch by balancing the ratio of arcing at the contacts with the unequal cleaning or wiping action inherent in this design; further lengthens the useful life of the switch by keeping the contact resistance low through the use of a brass contactor engaging silver contacts; and by so constructing the movable bridging contactor that it will not stick in closed position nor bounce during closure.

What I claim as my invention is:

1. In a snap switch for closing and opening an electrical circuit: a movable contact assembly constrained to oscillatory motion about a fixed axis and comprising a carrier, a bridging contactor having yieldable contact engaging portions and a connection between the carrier and the contactor held tight by spring tension as long as the yieldable contact engaging portions of the contactor are free so that the contactor and its carrier are movable as a unit without relative motion therebetween; and a pair of spaced stationary contacts arranged on a line substantially radial to said fixed axis so that one contact is closer to the axis than the other, said contacts being so positioned with relation to the arcuate motion of the movable bridging contactor that during switch closure engagement is first effected between the stationary contact nearest the pivot axis and its cooperating portion of the bridging contactor and in opening disengagement is last effected between said inner contact and its cooperating portion of the bridging contactor, so that closure and opening of the electrical circuit controlled by the switch takes place between the stationary contact farthest from said fixed axis and its respective contact engaging portion of the contactor which moves faster and farther than the other contact engaging portion.

2. In an electric switch for closing and opening an electrical circuit: an insulating base; a contactor carrier; a pivotal connection between the carrier and the base constraining the carrier to an arcuate motion across the base and radial to the axis of the connection; a pair of spaced stationary contacts carried by the base and so positioned that one is closer to said pivot axis than the other; a substantially U-shaped resilient bridging contactor between the base and the carrier and having contact engaging portions at its outer free ends engageable with the stationary contacts; and a driving connection between the carrier and said U-shaped bridging contactor, said connection utilizing the resilience of the bridging contactor to hold the contactor against any motion with respect to the carrier as long as the switch is open and in such definite relationship to the stationary contacts that during switch closure engagement is first established between the bridging contactor and the stationary contact nearest the pivot axis, and in opening of the switch disengagement is first effected between the bridging contactor and the stationary contact farthest from the pivot axis, so that closure and opening of the electrical circuit controlled by the switch takes place between the stationary contact farthest from said fixed axis and its respective contact engaging portion of the contactor which moves faster and farther and thus has greater wiping action than the other contact engaging portion.

3. In an electric switch of the character described: a flat insulating base; two spaced stationary contacts carried by the base and extending up from the face thereof; a contactor carrier movable across said face of the base; a pivotal connection between the carrier and the base constraining the carrier to motion in an arc radial to a fixed axis closer to one of said stationary contacts than the other; a substantially U-shaped resilient bridging contactor between the carrier and the base with its free ends facing the stationary contacts to be engageable therewith and thereby close the electrical circuit controlled by the switch; and a driving connection between the bridging contactor and said carrier comprising a lug near the closed end of the U and engaging in a hole in the carrier; and lugs near the free ends of the U held in engagement with shoulders on the carrier by the normal resilience of the bridging contactor as long as the switch is open so that the contactor moves directly with the carrier in a definite position with relation to the carrier and in a defined path, and said stationary contacts being so positioned with relation to said defined path of the bridging contactor that during closure of the switch engagement is first established between the stationary contact nearest to said fixed axis and its leg of the bridging contactor, and in opening of the switch disengagement is first effected between the stationary contact farthest from the said fixed axis and its leg of the bridging contact, so that closure and opening of the electrical circuit controlled by the switch takes place between the stationary contact farthest from said fixed axis and its respective contact engaging portion of the contactor which moves faster and farther than the other contact engaging portion and thus has greater wiping action.

4. In an electric switch: an insulating base having a flat face; stationary contacts carried by the base and exposed at said flat face; a movable bridging contactor slidable across the flat face of the base to and from engagement with the stationary contacts; a carrier for the movable contactor overlying the same; a driving connection between the carrier and movable contactor readily disengageable by movement of the carrier away from the base; a snap actuating mechanism for the carrier including a spring so connected with the carrier as to yieldingly urge the carrier toward the base to normally hold the carrier assembled with the bridging contactor; and a fixed abutment overlying the carrier to positively limit movement of the carrier away from the base a distance insufficient to enable disengagement of the driving connection between the carrier and the bridging contactor.

5. In an electric switch: a flat substantially circular base; a metal side wall encircling the periphery of the base and cooperating therewith to form a substantially cup-shaped switch housing; spaced stationary contacts carried by the baes and exposed on its inner face; a movable bridging contactor slidable across the inner face of the base to and from engagement with the stationary contacts; a carrier for the bridging contactor overlying the inner face of the base and having the bridging contactor confined between it and the base; a driving connection between the carrier and bridging contactor readily disengageable by movement of the carrier away form the base; a pivotal connection between the carrier and the base constraining the carrier and the bridging contactor to an arcuate motion ra-

dial to a fixed pivot, said carrier having an arcuate outer edge concentric to the pivot axis; and a lug struck from the metal side wall and overlying the arcuate edge portion of the carrier to limit movement of the carrier away from the base and preclude disengagement of the driving connection between the carrier and bridging contactor.

6. In an electric switch: a flat substantially circular base; a metal side wall encircling the periphery of the base and cooperating therewith to form a substantially cup-shaped switch housing; spaced stationary contacts carried by the base and exposed on its inner face; a movable bridging contactor slidable across the inner face of the base to and from engagement with the stationary contacts; a carrier for the bridging contactor overlying the inner face of the base and having the bridging contactor confined between it and the base; a driving connection between the carrier and bridging contactor readily disengageable by movement of the carrier away from the base; a pivotal connection between the carrier and the base constraining the carrier and the bridging contactor to an arcuate motion radial to a fixed pivot, said carrier having an arcuate outer edge concentric to the pivot axis; an indentation in the metal side wall having its bottom surface close to the concentric edge of the carrier; and a lug extending from the bottom wall of said indentation to overly the concentric edge of the carrier to limit movement of the carrier away from the base and preclude disengagement of the driving connection between the carrier and bridging contactor.

7. In an electric snap switch: an insulating base; a pair of spaced stationary contacts on the base; a bridging contactor movable across the base to and from a position electrically bridging the contacts, said contactor comprising a resilient U-shaped band the free ends of which provide the contact portions engageable with the stationary contacts; a contactor carrier for moving the contactor to and from bridging position; and means for connecting the contactor with the carrier comprising a loose pivotal connection between the closed end of the U-shaped contactor and the carrier and abutments on the free ends of the contactor engaging spaced shoulders on the carrier, said shoulders being spaced apart a distance such that the resiliency of the contactor holds the abutments on the free ends of the contactor resiliently in engagement with the shoulders so that the contactor is at all times under an initial spring tension and retains a predetermined fixed position with relation to the carrier while allowing the free ends of the contactor to yield as they engage their respective stationary contacts.

8. In an electric snap switch: an insulating base; a pair of spaced stationary contacts on the base and projecting up from the base to provide contact surfaces substantially perpendicular to the base; a bridging contactor comprising a resilient U-shaped band having its free end portions directed toward each other to provide the sides of a wedge engageable between the stationary contacts; a contactor carrier overlying the base and confining the contactor between it and the base; and means connecting the contactor with the carrier comprising a lug on the closed end of the contactor loosely engaging in a hole in the carrier, and lugs on the free end portions of the contactor held in engagement with the opposite sides of a hole in the carrier by the resiliency of the contactor so that the contactor is at all times under an initial spring tension and is held in a definite fixed position with relation to the carrier.

9. In an electric snap switch: a pair of spaced stationary contacts; a movable bridging contactor comprising a U-shaped resilient band, the free ends of which provide its contact engaging portions; means constraining the contact engaging portions to motion along radially spaced inner and outer arcs during travel of the contactor to and from switch closing position and as long as the contactor is disengaged from the stationary contacts, while enabling said contact engaging portions to be sprung in consequence to engagement with their respective stationary contacts, both of said arcs being concentric to a fixed axis, and said constraining means so holding the contact engaging portions that deflection of one by engagement with its respective stationary contact does not shift the other from its defined arcuate path, one of said stationary contacts being in the path of each of said contact engaging portions and said stationary contacts being so located with relation to the contact engaging portions that a line passing through the points on the stationary contacts initially engaged by the contact engaging portions intersects a line passing through the points on the contact engaging portions which initially engage the contacts, at a point lying between the fixed axis and the outer arc, so that closure and opening of an electric circuit controlled by the switch at all times occurs between the outer contact engaging portion and its respective stationary contact.

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