Dec. 24, 1940. A. RAMSEY 2,226,385

SWITCH

Filed Dec. 14, 1936 7 Sheets-Sheet 1

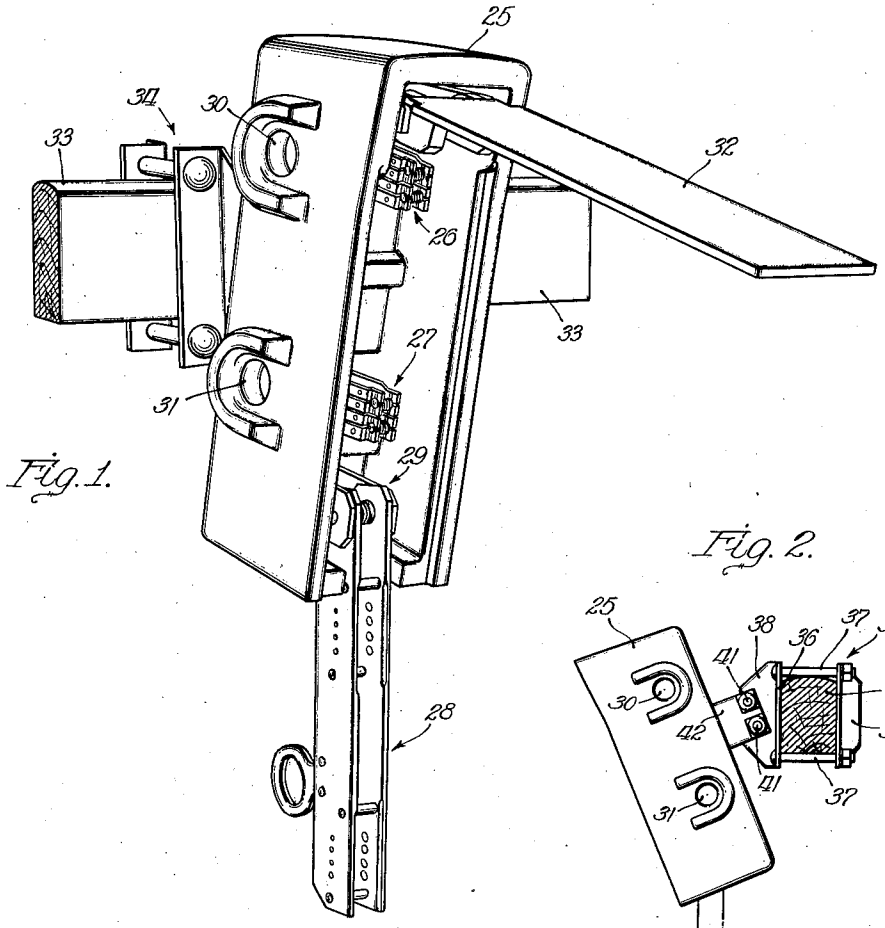


Fig. 1.

Fig. 2.

Fig. 3.

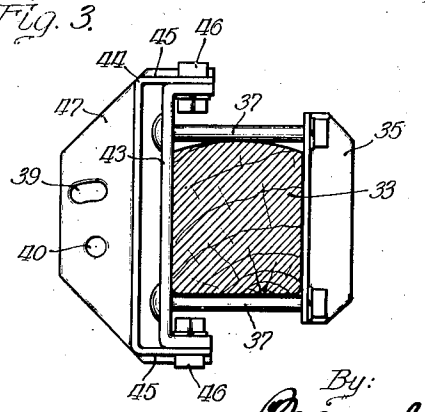
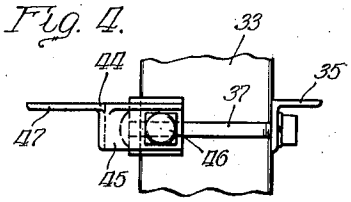


Fig. 4.



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SWITCH

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Fig. 5.

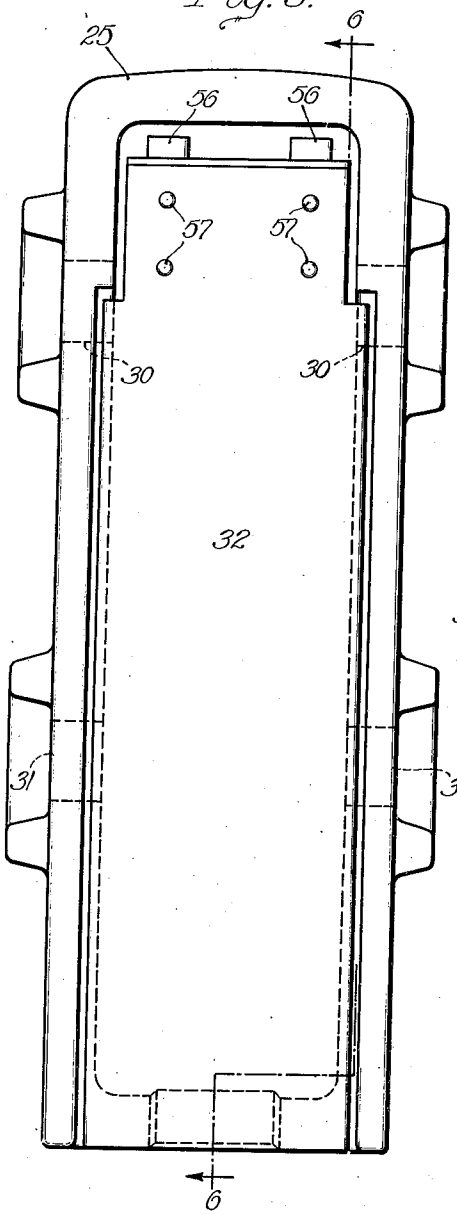
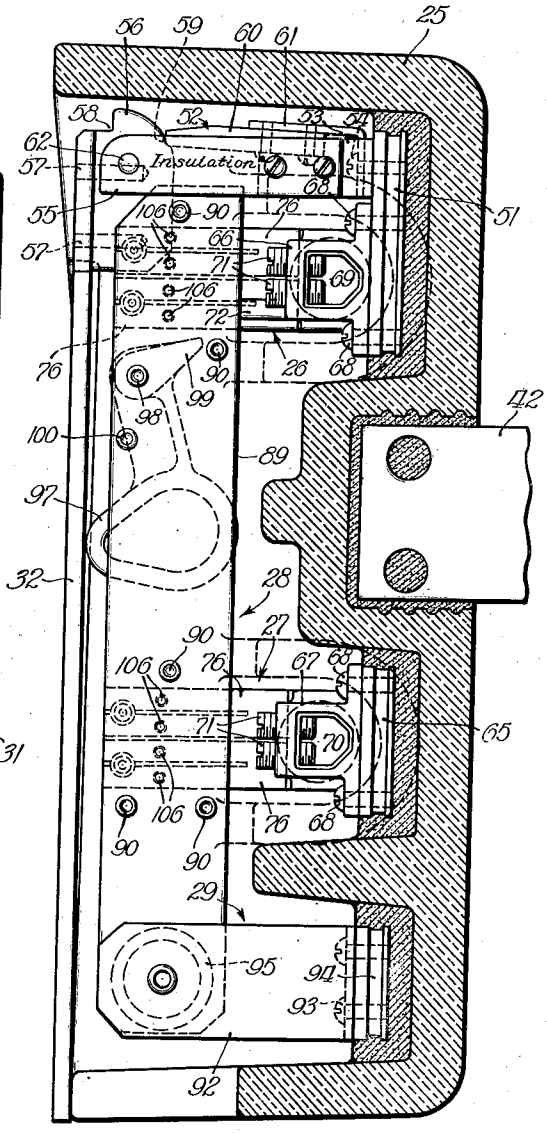


Fig. 6.



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Dec. 24, 1940. A. RAMSEY 2,226,385

SWITCH

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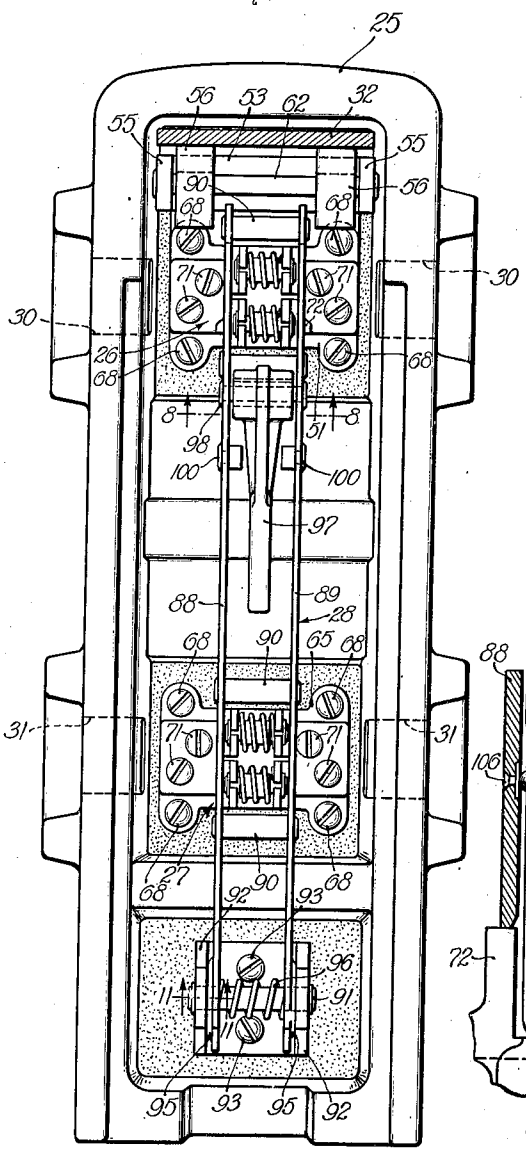
Fig. 7.



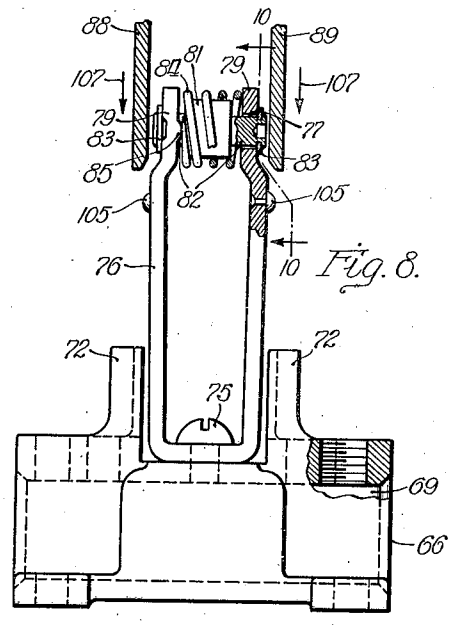


Fig. 8.

Fig. 9.

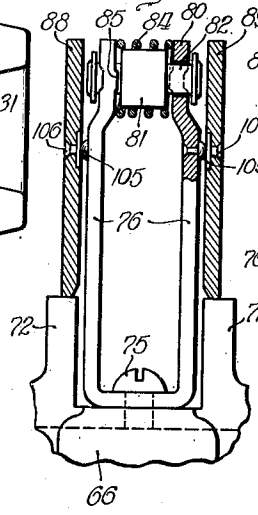


Fig. 10.

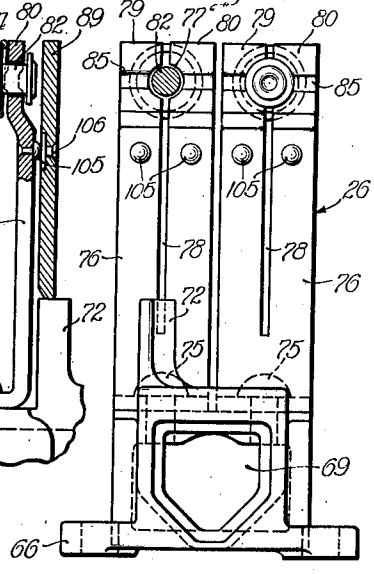
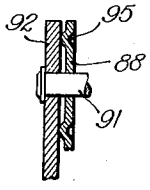


Fig. 11.



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SWITCH

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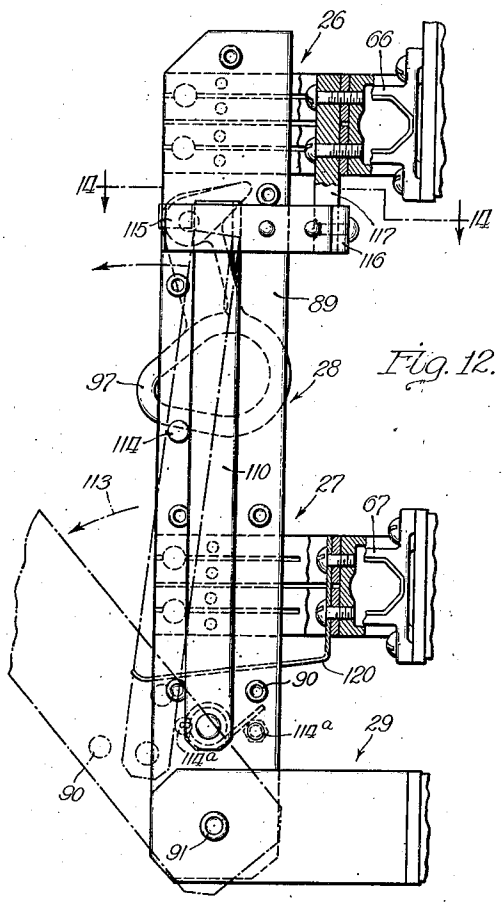

Fig. 12.

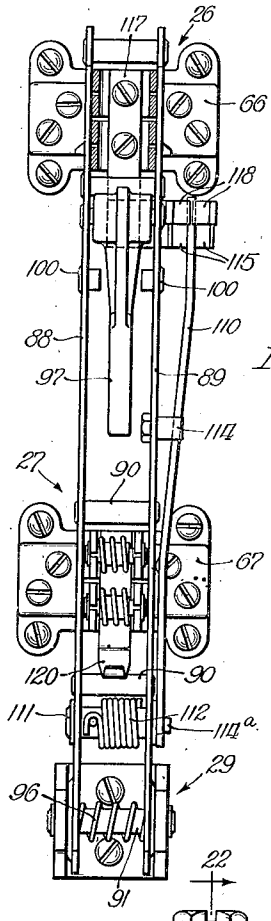

Fig. 13.

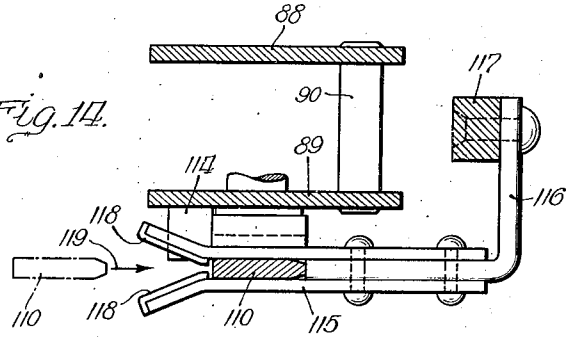

Fig. 14.

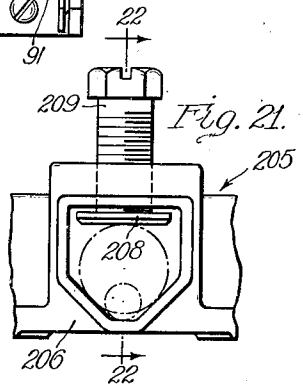

Fig. 21.

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SWITCH

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Fig. 15.

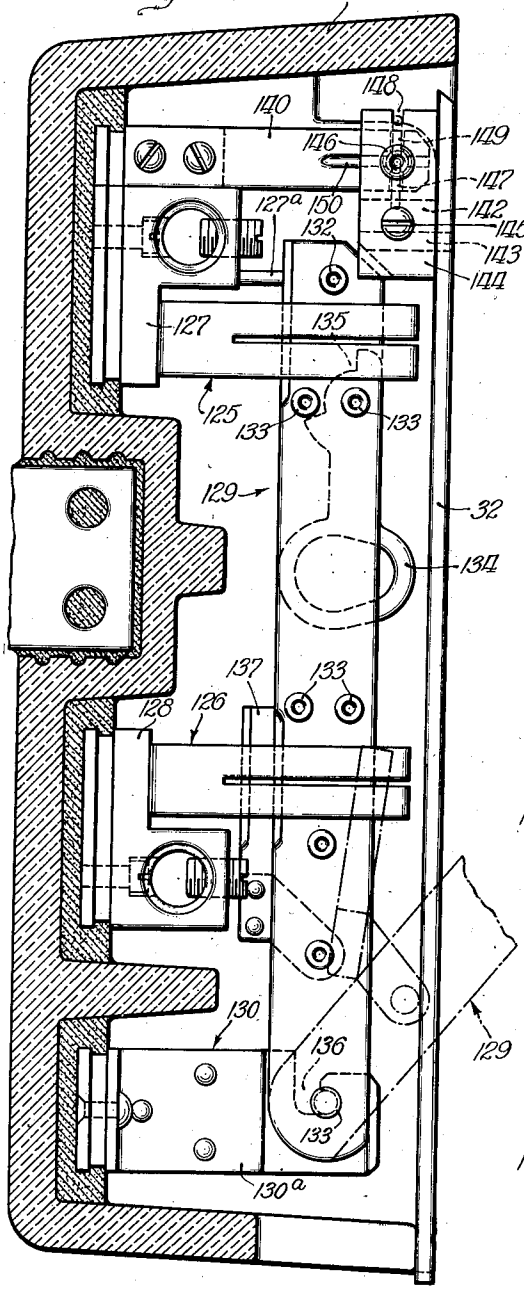
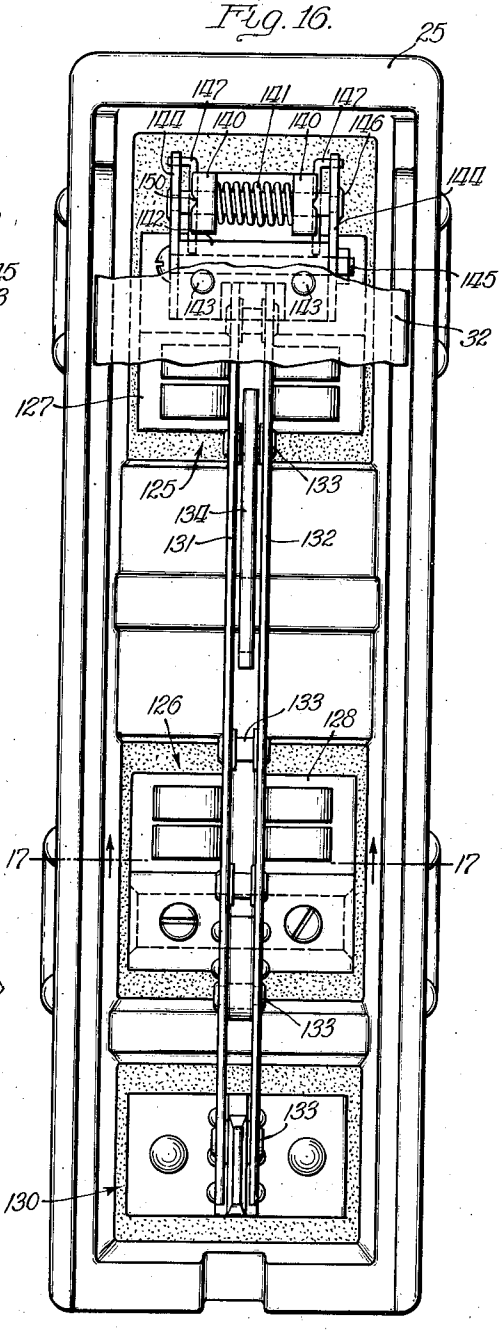


Fig. 16.



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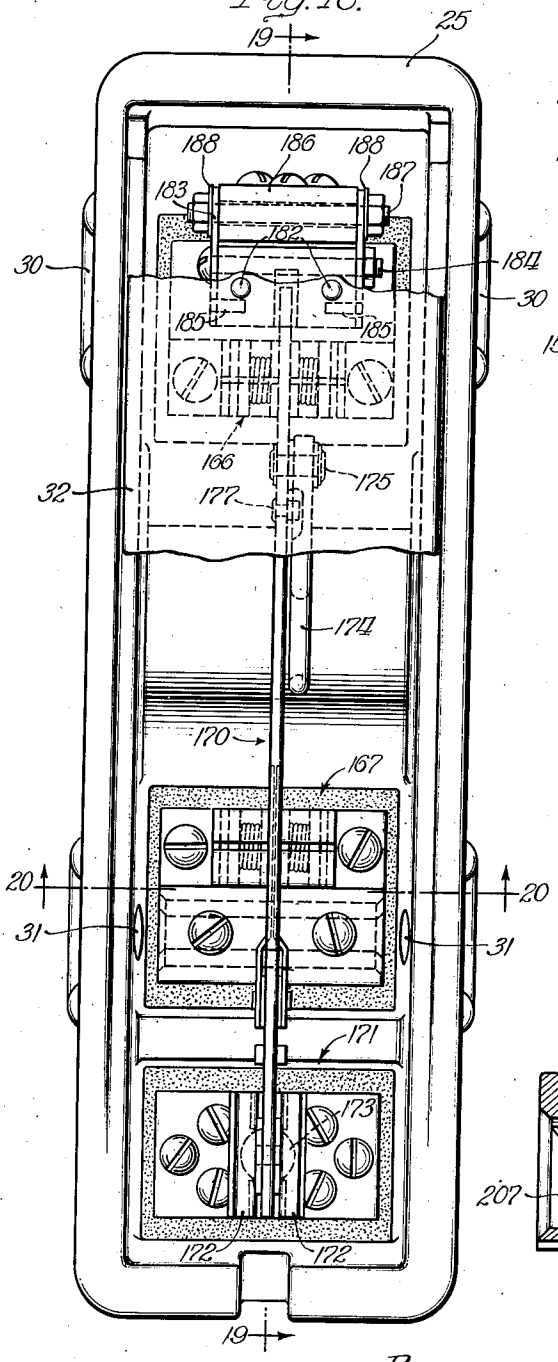
Dec. 24, 1940. A. RAMSEY 2,226,385

SWITCH

Filed Dec. 14, 1936 7 Sheets-Sheet 6

Fig. 18.



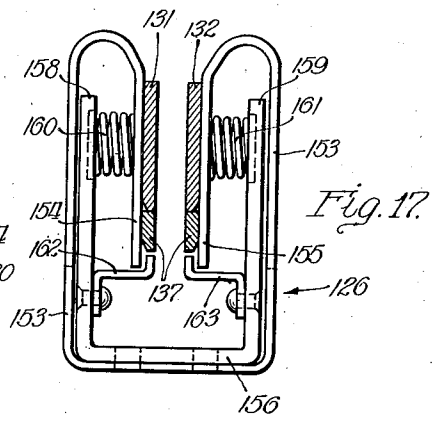


Fig. 17.

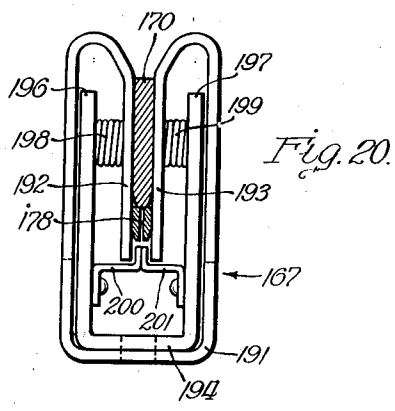
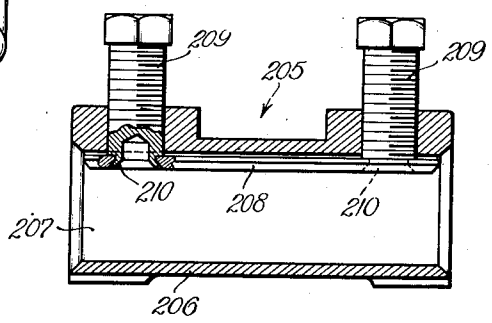


Fig. 20.

Fig. 22.



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Dec. 24, 1940. A. RAMSEY 2,226,385

SWITCH

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Fig. 19.

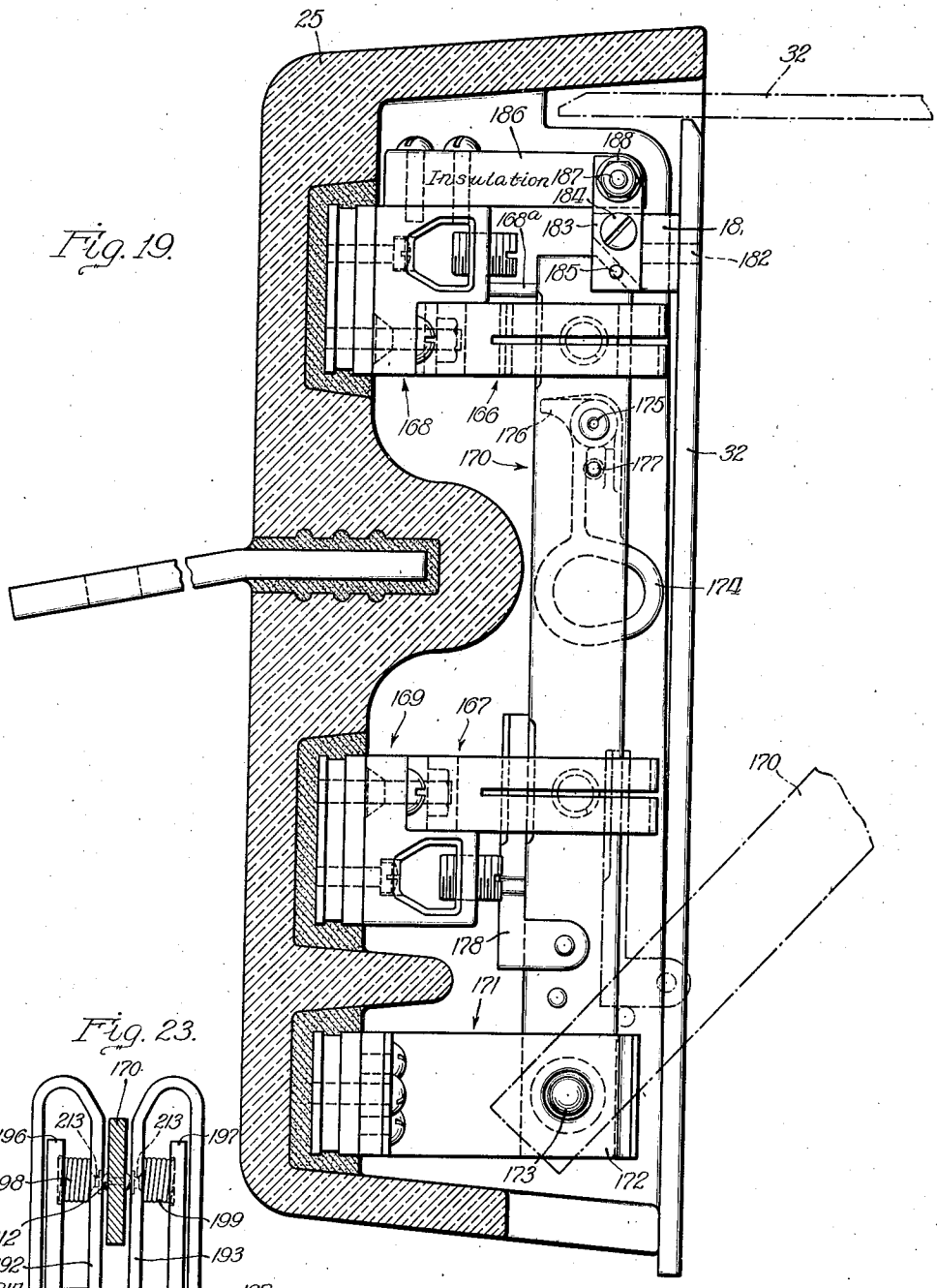

Fig. 23.

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Patented Dec. 24, 1940 2,226,385

UNITED STATES PATENT OFFICE

2,226,385

SWITCH

Allan Ramsey, Evanston, Ill., assignor to Schweitzer & Conrad, Inc., Chicago, Ill., a corporation of Delaware

Application December 14, 1936, Serial No. 115,691

27 Claims. (Cl. 200—162)

My invention relates, generally, to electric switches and it has particular relation to the construction and mounting of disconnecting switches and the like. This invention constitutes an improvement upon the switch construction shown in my copending application, Serial No. 445,548, filed April 19, 1930, Patent No. 2,063,954, and assigned to the assignee of this application.

In my copending application, Patent No. 2,063,954, I have disclosed a switch having a switch blade that is movable into and out of contact engagement with a plurality of stationary contact fingers each of which has a small area high pressure contact portion and each of which is individually resilient and prestressed to provide a relatively high contact pressure in the switch closed position without requiring highly accurate alignment of the contact fingers. The prestressing feature reduces the work required to close the switch. If the prestressing is not provided, a relatively long motion would be necessary after the switch blade engages the contact clip, thereby requiring an excessive movement of the clip or of the blade. The prestressing effect is obtained by biasing one or more contact elements or fingers into the path of relative movement of the switch members and providing restraining means which limits the movement of the contact elements or fingers to positions which are slightly within this path of movement. Without this restraining means the contact fingers would be moved under the biasing influence more fully into the path of relative movement of the switch members and, in closing the switch for example, it would be necessary to exert sufficient effort to move them completely out of the path. When the prestressed contact fingers are limited in their movement to positions slightly within the path, it is only necessary to move them through this slight distance with the result that a correspondingly small effort is required to operate the switch. At the same time the contact pressure which is exerted between the contact members will be the same as if, on closing the switch, the contact fingers had been moved from an initial unstressed condition to the position corresponding to the switch closed position.

Movement of the contact fingers from their position when the switch blade is open to that when the switch blade is closed is produced by sliding movement of the beveled edge of the switch blade in engagement with and relative to the rounded head of the contact points on the contact fingers. The force that is required to be applied to the switch blade in order to move the contact finger depends upon the angle of bevel on the edge of the switch blade. The flatter the angle the less will be the force that is required to move the switch blade to spread the contact fingers. Without a prestressed contact finger and using the same compressive stress and the same angle of bevel, it would be necessary to cut so deeply into the blade as to mechanically weaken its edge at the point where it first engages the contact points on the contact fingers.

In the conventional type of switch construction one or more flat switch blades are provided for engaging switch clips formed by upstanding spaced apart contact fingers. Each switch blade engages a pair of fingers along the sides thereof and it is intended that surface contact engagement shall take place. This switch is generally called a knife blade switch. When a switch of this type is originally installed, it is possible to approach the desired surface contact engagement between the relatively movable switch members. However, after the switch has been in service for some time this condition no longer exists under ordinary circumstances because the contact fingers may become bent or the switch blade may be moved slightly out of alinement therewith. Moreover, corrosion of the contact surfaces may take place. As a result of these various factors instead of having surface contact engagement only point contact engagement actually is present. The entire current flowing through each switch blade then must flow through the point contact engagement with the result that heating of the switch members takes place if any appreciable amount of current flows.

It is recognized that in a given switch there is a definite relationship between the area of the contact surface and the contact pressure. Thus if the area of contact engagement is reduced, the contact pressure should correspondingly be increased. It has been proposed to construct a switch in which the contact engagement between the relatively movable switch members takes place at substantially a single point or a pair of spaced apart points represented for example by a pair of oppositely extending projections on a switch blade. Very high pressures are required in this type of construction because of the limited area of contact engagement. It is then necessary to provide a relatively massive construction in the stationary switch member to resist the high contact pressure. In this construction it is not practical to employ more than one point of contact engagement for each contact surface because of the difficulty in obtaining the necessary

alignment between two or more contact points. This will be obvious when it is considered that the contact surface is substantially in a fixed plane and the contact point is moved into engagement therewith. If more than a single contact point is employed, it would be necessary to keep them in exact alignment for the reason that a slight misalignment would result in only a single point of contact engagement.

In my copending application, Patent No. 2,063,954, I have provided for contact engagement between the relatively movable switch members at a plurality of points at each of which a relatively high pressure is applied. When the principle of prestressing is employed it is possible to provide a plurality of point contacts each being independent of the others and each engaging the cooperating contact surface with about the same contact pressure and at the same time a highly accurate alignment is not required.

It is well known in the art to provide contact engaging surfaces of silver for the contact members of relays and the like. Such a construction is ordinarily expensive in switches of large size because of the relatively large amount of silver that would be required. However, when the small area high pressure contact construction of my copending application is employed, it becomes practical to employ limited quantities of solid silver in the form of silver inserts in the relatively movable switch members of large current capacity switches and consequently the advantage of silver contact engaging surfaces is obtained in a construction that is economical.

An object of the present invention, generally stated, is to embody the principles of small area high pressure contact construction set forth in my copending application in other types of switches.

An important object of my invention is to provide a relatively great short time current carrying capacity in a switch employing individually resilient and prestressed contact fingers having small area contact engaging portions.

Another object of my invention is to prestress certain of the contact members of a switch in addition to the resilient effect that may be inherent in the contact members themselves.

Still another object of my invention is to arrange compression springs and stops in one or more contact members of a switch in such manner as to prestress the springs before operation of the switch to the circuit closing position.

Another object of my invention is to provide resilient means for prestressing the contact fingers in such location that current does not flow therethrough.

Another object of my invention is to reduce the contact resistance of a prestressed switch contact member to a minimum.

Still another object of my invention is to provide a low contact resistance and a high contact pressure between the relative movable contact members of a switch while still requiring a minimum of effort to operate the switch to and from the switch closing position.

Still another object of my invention is to provide a plurality of small area high pressure contact members that are individually resilient and self aligning.

A further object of my invention is to construct a switch having the foregoing desirable characteristics and adapted to use solid silver contact members without excessive cost. This is permitted since the contact engagement takes place in limited areas in each of which a small solid silver insert may be positioned.

An ancillary object of my invention is to provide for maintaining an electrical connection between a switch blade and one of two contact members bridged thereby until the switch blade is moved to a predetermined position.

Another ancillary object of my invention is to provide for clamping a conductor to a contact member of a disconnecting switch or the like in such manner that the surface of the conductor will not be pierced thereby rendering it liable to severing.

A further ancillary object of my invention is to provide for frictionally holding the cover of a box housing a disconnecting switch or the like in the open or the closed position while readily permitting the movement of the cover to either position.

Other objects of my invention will, in part, be obvious and in part appear hereinafter.

My invention, accordingly, is disclosed in the embodiments hereof shown in the accompanying drawings and it comprises the features of construction, combination of elements and arrangement of parts which will be exemplified in the constructions hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of my invention, reference may be had to the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a perspective view illustrating the arrangement and construction of one form of my novel switch mounted in a box and positioned on a cross-arm;

Figure 2 is a view, in end elevation at a reduced scale, of the switch box and mounting therefor illustrated in Figure 1;

Figure 3 is a view in end elevation of an alternate form of clamp which may be employed for mounting the switch box on a cross-arm;

Figure 4 is a view, in top plan, of the clamp shown in Figure 3;

Figure 5 is a view, in front elevation, of the switch box which contains one form of my novel switch;

Figure 6 is a view taken along the line 6—6 of Figure 5;

Figure 7 is a view in front elevation of the switch box and switch, the cover being shown in the open position to disclose the features of construction of the switch;

Figure 8 is a detail sectional view taken along the line 8—8 of Figure 7, showing the relationship of the prestressed contact fingers before they are engaged by the switch blades;

Figure 9 is a view, similar to that shown in Figure 8, but illustrating the position to which the prestressed contact member is operated when the switch blades are in engagement therewith to complete the circuit;

Figure 10 is a detail sectional view taken along the line 10—10 of Figure 8;

Figure 11 is a detail sectional view taken along the line 11—11 of Figure 7 and showing the construction of the friction rings with the switch blades;

Figure 12 is a view, in side elevation, of the switch shown in Figure 6, the box being omitted, and a quick break attachment being provided to prevent arcing between the switch blade and the main contact members;

Figure 13 is a view, in front elevation, of the

switch and quick break assembly shown in Figure 12;

Figure 14 is a sectional view taken along the line 14—14 of Figure 12;

Figure 15 is a view, in side elevation, of a modified form of switch construction and cover assembly;

Figure 16 is a view in front elevation of the switch shown in Figure 15, the cover being broken away partly to more clearly illustrate the construction details of the switch;

Figure 17 is a detail sectional view taken along the line 17—17 of Figure 16 and showing the construction of another embodiment of the prestressed contact members;

Figure 18 is a view in front elevation of another embodiment of my novel switch construction arranged for mounting in a box, the cover being broken partly away;

Figure 19 is a sectional view taken along the line 19—19 of Figure 18;

Figure 20 is a detail sectional view taken along the line 20—20 of Figure 18;

Figure 21 is a view, in end elevation, of a modified form of terminal connector which may be employed in conjunction with the contact members of my novel switch assembly;

Figure 22 is a sectional view taken along the line 22—22 of Figure 21; and

Figure 23 is a view of a modified form of the contact member shown in Figure 20.

Referring now particularly to Figure 1 of the drawings, it will be observed that the reference character 25 designates a switch box that opens outwardly and which is arranged to be mounted in a vertical position. The box 25 may be formed of any suitable insulating material, such as porcelain. An upper stationary contact member 26 and a lower stationary contact member 27 are secured to the rear wall of the box 25 by any suitable means such as by cement. A switch arm, shown generally at 28, and rotatably mounted in a fulcrum member 29 is provided for engaging the upper and lower stationary contact members to bridge them in the circuit closing position. Suitable apertures 30 and 31 are provided on opposite sides of the box 25 to permit the introduction therethrough of the circuit conductors. It will be observed that the apertures 30 and 31 are aligned with the upper and lower stationary contact members 26 and 27 respectively.

The front side of the box 25 is open to permit operation of the switch arm 28. It is desirable to close this opening in order to shield the various parts of the switch from the weather. For this purpose a cover 32 is provided and is hinged at its upper end adjacent the upper end of the box 25. As will be hereinafter set forth in detail, the cover 32 is so mounted that it is frictionally maintained in either the open or closed position, although movement between these two positions is also permitted.

The box 25 may be mounted in any suitable position such as on the cross-arm 33 which, in turn, may be mounted on a suitable pole or the like. A clamp, shown generally at 34 is provided for mounting the box 25 on the cross-arm 33. As shown in Figure 2 of the drawings the clamp 34 comprises angle brackets 35 and 36 that are arranged to be positioned on opposite sides of the cross-arm 33 and to be secured thereto by means of transversely extending bolts 37. In the embodiment of the clamp 34 shown in this figure, the angle bracket 36 is provided with an outwardly extending vertical flange 38 in which suitable apertures, such as illustrated at 39 and 40 in Figure 3 of the drawings, may be positioned. Bolts 41 extend through these apertures and through suitable apertures in a tongue 42 rearwardly extending from the box 25 to secure it in the desired position. It will be noted that the apertures 39 and 40 are arranged to register with the apertures in the tongue 42. It will further be noted that the aperture 39 is slotted to a limited extent about the lower aperture 40 as a center. This construction permits the box 25 to rotate in a vertical plane about the aperture 40 as a center, thereby providing a limited range of adjustment therefor.

With a view to providing for swiveling the box 25 in a horizontal plane, the construction shown in Figure 3 of the drawings may be employed. A strap 43 is provided having inturned end portions instead of the angle bracket 36, shown in Figure 2 of the drawings. An angle bracket 44 is provided having rearwardly extending arms 45 provided with suitable apertures for registering with corresponding apertures in the inturned ends of the strap 43. Bolts 46 are provided in these apertures for securing the angle bracket 44 and permitting swiveling thereof. The angle bracket 44 is provided with a flange 47, corresponding to the flange 38 of the angle bracket 36, and the apertures 39 and 40 permit adjustment of the box 25 in a vertical plane as described hereinbefore. It will be understood that either form of mounting may be employed for supporting the box 25 on a cross-arm or the like.

The cover 32 is formed preferably of a suitable insulating material such as "Bakelite." The manner in which the cover 32 is mounted and the arrangement for securing it in either the open or the closed position are illustrated more clearly in Figures 5, 6 and 7 to which reference now will be had. As shown, a base member 51, formed of suitable metal is cemented in the upper end of the box 25. Mounted on the base member 51 is a bifurcated support member, shown generally at 52, and comprising a U-shaped support member 53 that may be secured to the base 51 by means of screws 54, only one of which is shown in Figure 6 of the drawings. Suitably secured to the ends of the U-shaped support member 53 are arms 55 formed preferably of insulating material. At the upper end of the cover 32 a pair of cam members 56 is mounted by means of suitable threaded pins 57. The pins 57 are preferably made of a suitable insulating material such as "Bakelite," and they are threaded for their full length. The cam members 56 and the cover 32 are clamped together and the holes for the pins 57 are drilled and tapped therein. Both the holes and the pins 57 are then coated with an adhesive and insulating cement and the pins are screwed into place. The cam members 56 are provided with notches 58 and 59 that interfit with fingers 60 carried by resilient brackets 61, which may be mounted in position by means of the screws 54 which also hold the support member 53. The fingers 60 are formed preferably of insulating material such as "Bakelite." A shaft 62 extends through suitable apertures in the arms 55 and in the cam members 56 for rotatably mounting the cover 32, as will be readily understood.

Because of the resilient mounting of the fingers 60 and the engagement thereof with the surface of the cam members 56, a certain amount of friction is maintained therebetween. However this friction is not sufficient to prevent movement of the cover 32 when sufficient force is applied. In the closed position of the cover 32 the fingers

60 engage the notches 59 in the cam members 56. When the cover 32 is opened the ends of the fingers 60 ride along the cam surfaces of the cam members 56 until they engage the slot 58. No further movement in this direction is permitted, since the ends of the fingers 60 abut against the one side of the slot 58. At the same time the cover 32 is prevented from swinging downwardly because of the engagement of the fingers 60 with the other side of the slot 58.

Referring now particularly to Figures 6 and 7 of the drawings, it will be observed that a base member 65 is cemented to the rear wall of the box 25. Terminal clamps 66 and 67 are secured, as by screws 68, to the base members 51 and 65, as illustrated. The terminal clamps 66 and 67 are provided with transversely extending apertures 69 and 70 for receiving the line conductors and for this purpose they are positioned in alinement with the apertures 30 and 31 respectively in the side walls of the box 25. Set screws 71 are positioned in staggered relation at each end of the terminal clamps 66 and 67 and extend into the apertures 69 and 70, as shown, for the purpose of engaging the line conductors therein, as will be readily understood. It will be noted that the line conductors may be connected to the terminal clamps 66 and 67 from either side of the box 25. Ordinarily one side or the other will be more convenient and therefore provision is made for connection from either side. When connection is made from one side only the apertures 30 and 31 on the other side of the box 25 are plugged by any suitable means. Blade stops 72 are integrally formed with the terminal clamp 66 to insure the positioning of the switch arm 28 in the desired location. The terminal clamps 66 and 67 are formed preferably of cast copper in order to provide a high degree of conductivity and to more readily facilitate the manufacture and assembly thereof.

The upper and lower stationary contact members 26 and 27 are mounted on the terminal clamps 66 and 67 respectively and are secured thereto by screws 75, Figure 8. It will be observed that each of the stationary contact members 26 and 27 comprises a pair of contact fingers 76, the construction of which is shown more clearly in Figures 8 and 10 of the drawings. The contact finger or assembly 76 comprises a U-shaped copper strap, the upper ends or branches of which are slightly offset inwardly from the remaining lower portions thereof. Alined apertures 77 are provided near the upper ends of these branches and transverse slots 78, formed preferably by a saw cut, extend through the apertures 77 and divide each branch into sections 79 and 80 to provide a certain degree of independent flexibility. A spacer or stop member 81, having reduced end necks 82 slidably mounted in the apertures 77 is provided having the outer ends headed over washers 83. A compression spring 84 is positioned around the spacer 81 and between the inside faces of the upper ends of the sections 79 and 80. The external diameter of the central portion of the spacer 80 is slightly less than the internal diameter of the compression spring 84 in order to secure the spring in the desired location. The inside faces of the sections 79 and 80 are upset to form ridges 85 so that substantially point contact engagement with the ends of the compression spring 84 is provided. With this construction full spring pressure will be applied to each of the sections 79 and 80 to bias them outwardly regardless of any slight misalignment or possible cocking of the spring 84. While only a single compression spring 84 is employed, this construction functions as if an independent compression spring were provided for each pair of sections 79 and 80.

It will be understood that the spring 84 is held in compression by the headed ends of the spacer 81. With this construction a relatively high contact pressure is provided although relatively little effort is required to operate the switch to and from the switch closed position. The branches of the contact assemblies 76 could be constructed to inherently provide a resilient effect which would be the equivalent of that afforded by the compression spring 84. In such case the spacer 81 would hold the branches of the contact assemblies 76 in the prestressed condition in the same manner that it holds them when biased outwardly to obtain the same condition by means of the compression spring 84. In addition, the floating spacer 81 with headed ends, which limits the outward movement of each pair of contact fingers 76, nullifies small differences in the resiliency of the contact fingers and the compression spring 84 mounted between them. Without this restraint an impractical degree of uniformity in the manufacture and assembly of the contact fingers and springs would be required.

Referring again to Figures 6 and 7 of the drawings, it will be observed that the switch arm 28 comprises a pair of switch blades 88 and 89 that are held in spaced apart relation by transversely extending rivets 90. At their lower ends the switch blades 88 and 89 are mounted for rotation on a shaft 91 that extends through the branches 92 of the fulcrum member 29, which it will be observed, is substantially U-shaped and is secured by screws 93 to a base member 94 which may be cemented to the lower end of the rear wall of the box 25. The fulcrum member 29 is spaced from the lower stationary contact member 27 and in alinement with it and with the upper stationary contact member 26 so that they may be bridged when the contact arm 28 is moved to the switch closed position.

The switch blades 88 and 89 are formed preferably of strap copper and at their lower ends friction rings 95 are integrally formed, as by an upsetting operation, to provide the sole engagement with the branches 92 of the fulcrum member 29. A compression spring 96 is positioned around the shaft 91 and serves to bias the blades 88 and 89 apart. By means of the raised friction rings 95 it is possible to predetermine and to maintain constant the friction force that is present between the switch blades 88 and 89 and the branches 92 of the U-shaped fulcrum member 29. If the friction rings 95 were not provided, the entire outer surface of the lower ends of the blades 88 and 89 would engage with the inner surfaces of the branches 92, resulting in variable rather than constant frictional engagement. The pressure which must be exerted by the spring 96, or its equivalent, in such case may vary widely, particularly after the switch has been in operation for some time. The length of the lever arm or effective length thereof at which the frictional force reacts when the raised friction rings 95 are used is substantially constant and does not change appreciably during the life of the switch. Consequently with a given initial adjustment of the spring 96, the same friction force is always present. This effect is desirable in holding the switch arm 28 in either the closed or opened position.

In order to permit manual operation of the switch arm 28 with the customary hook stick a pull ring 97 is mounted between the switch blades 88 and 89 on a rivet 98 that extends transversely therethrough. The pull ring 97 is provided with a nose portion 99 which engages stops 100, formed by short rivets extending through the blades 88 and 89 for limiting its movement in a clockwise direction.

As indicated in Figure 2, the box 25 is ordinarily in a position slightly inclined from the vertical to protect the interior from the effects of the weather. The pull ring 97 is so constructed that it will rotate slightly as soon as the cover 32 is opened so that the eye portion thereof may be readily engaged by the hook stick. When the cover 32 is closed, the pull ring 97 is moved thereby to its position between the switch blades 88 and 89, as shown in Figure 6.

When the switch arm 28 is operated to the position shown in Figures 6 and 7, the upper and lower stationary contact members 26 and 27 are bridged and the circuit is completed therethrough, as will be readily understood. According to the generally accepted practice in the prior art this contact engagement has been provided by causing surface engagement between the blades 88 and 89 and the surfaces of the contact fingers 76. That is, the prior art teaches surface contact engagement with the switch blades 88 and 89 for whatever construction is employed for the stationary contact members. Although the specific construction of the contact assemblies 76 with the bifurcated sections 79 and 80 is new, and although this construction provides new and useful results, I have gone still further and departed from the usually accepted teaching of the prior art in the particular manner in which the contact engagement between the relatively movable parts is made, as will be presently set forth.

As set forth, surface contact engagement was desired between the relatively movable switch members. From a theoretical standpoint such contact engagement is possible and to a certain extent it is obtained in practice. However, after a switch has been in operation for a considerable length of time, the contact surface conditions change and it is actually a fact that only point contact engagement is present rather than complete surface contact. The entire current flow takes place then through these point contacts and, consequently, the entire capacity of the switch is not available.

According to my present invention I have initially provided for point rather than surface contact. For this purpose I have provided a silver insert 105 in each of the sections 79 and 80 of the contact assemblies 76. These inserts are provided with outwardly extending headed ends which engage corresponding flat headed silver inserts 106 in the switch blades 88 and 89, as shown in Figure 9 of the drawings. Since the silver inserts 105 are mounted for substantially individual movement with their supporting sections 79 and 80, complete contact engagement with the corresponding insert 106 in the switch blade 88 or 89 is assured. This independent operation is further insured by the provision of the inwardly extending ridges 85 which permit the compression spring 84 to have substantially point contact only with the sections 79 and 80 of the contact assemblies 76. The blade stops 72 serve to accurately align the inserts 105 and 106 so that they are definitely positioned in the desired relation when the switch is closed.

I have chosen silver for the inserts 105 and 106 because of its relatively high conductivity and relatively low contact resistance. Even when silver is exposed to the corrosive effects of the surrounding atmosphere the coating that forms on its surface is not unfavorable to good electrical conductivity and therefore the contact resistance remains substantially constant and does not change even though the switch arm 28 remains in the open position for long periods of time.

Since the contact resistance is a function of the pressure which is exerted on the engaging contact members, it is desirable to provide a relatively high contact pressure in order to reduce the contact resistance to a minimum. It is primarily for this purpose that the contact assemblies 76 are formed of material which inherently is resilient or the compression springs 84 are provided therebetween. Since the resulting biasing effect must be overcome in operating the switch to and from the closed position, it is desirable to so control the disposition of the biasing force as to require a minimum of effort to operate the switch. It is for this purpose that the spacer 81 with the headed ends is provided which limits the movement apart of the branches of the contact assemblies 76. As shown in Figure 8 of the drawings, when the switch blades 88 and 89 are moved to the switch closed position in the direction of the arrows 107, the outer ends of the inserts 105 are disposed in the path of travel of the inner surface of the switch blades. The adjacent edges of the switch blades 88 and 89 are beveled, as illustrated with a slope that is sufficient to properly engage the heads of the silver inserts 105 so that they will be moved inwardly the distance required to place them in engagement with the flat heads of the silver inserts 106 in the inner surfaces of the switch blades. An appreciable relative movement takes place in a direction normal to the direction in which the switch blades move which is not found in switches of the conventional knife blade type. The continued movement in the direction of the arrows 107 causes the branches of the contact assemblies 76 to be moved inwardly, as shown in Figure 9 of the drawings, relieving the spacer 81 of the biasing effects of the compression spring 84 and of the branches of the assemblies 76 and transferring its entire force to apply pressure between the silver inserts 105 in the assemblies 76 and the inserts 106 in the switch blades 88 and 89. The same contact pressure is provided between the silver inserts 105 and 106 with this construction as would be provided if the compression spring 84 were fully compressed by the movement of the switch arm 28 to the closed position and a minimum of effort is required to operate the switch arm 28 to and from the switch closed position. It will also be understood that the small movement of the branches of the contact assemblies 76, when the resilient force of the spring 84 is transferred from the spacer 81 to the switch blades 88 and 89, assures a reliable contact engagement between each of the projecting portions of the inserts 105 and the adjacent faces of the switch blades or the inserts 106 therein at about the same pressure without requiring accurate alignment.

It will be understood that any other material may be employed in lieu of silver for the inserts

105 and 106 that may hereafter become available and which has the properties of silver in providing the desired contact surface characteristics. At the present time, however, silver appears to be the most practical material to employ. It will also be understood that the positions of the inserts 105 and 106 can be reversed in which case the headed portions would be carried by the blades 88 and 89 and the flat portions would be carried by the contact assemblies 76.

While it is highly desirable to provide the inserts 105 and 106 in the switch construction, as described, it is not essential to do so and my invention may be practiced, in so far as remaining construction of the switch is concerned without using them. This construction would merely include the arrangement of the contact assemblies 76 and the switch blades 88 and 89 for surface contact engagement, as practiced in the prior art. If it is desired to provide the small area high pressure contact surface without the use of inserts, the contact fingers can themselves be upset to the same shape as the heads of the rivets 105. However, when the construction is employed, as disclosed herein, using the prestressed sectionalized construction for the contact assembly 76, improved operating characteristics are obtained because of the relatively high contact pressure which is available between the relatively movable switch parts while at the same time a minimum of effort is required to operate the switch from and to the closed position. Therefore, it will be understood that my invention may be practiced without employing the inserts 105 and 106, although it is highly desirable to use them for the reasons set forth hereinbefore.

In applications where the disconnecting switch is opened under load, it is desirable to provide a quick-break auxiliary contact member for effecting the final circuit opening, thereby avoiding arcing at the main contact members. For this purpose the construction illustrated in Figures 12, 13, and 14 of the drawings may be employed. As there shown, a disconnecting switch is provided which is similar to that shown in Figures 6 and 7 of the drawings, and in addition there is provided an auxiliary or quick-break blade 110 which is mounted on a shaft 111 that extends through the switch blades 88 and 89. A coil spring 112 is provided for biasing the shaft 111 and the blade 110 carried thereby in the direction indicated by the arrow 113 in Figure 12. A stop 114, mounted in and extending outwardly from the switch blade 89 is provided to limit the movement of the auxiliary blade 110 as biased by the spring 112 and to carry this blade into engagement with spaced apart switch jaws 115 that are associated with the upper stationary contact member 26. A similar stop 114*a*, located near the shaft 111 of the quick break blade 110, pulls this blade out of engagement with the jaws 115 as soon as its upper end is clear of the plates 118. The jaws 115 are mounted on a suitable angle bracket 116 which is carried by an arm 117, mounted between the upstanding fingers of the upper stationary contact member 26 and secured to the terminal connector 66. The outer ends of the jaws 115 are flared outwardly and have latching members or plates 118 mounted thereon.

In operation when the switch arm 28 is moved toward the switch closed position, the auxiliary blade 110 is moved therewith by the stop 114 and it approaches the flared ends of the jaws 115 as indicated by the arrow 119 in Figure 14. The continued movement of the switch arm 28 causes the auxiliary blade 110 to pass the latching members or plates 118 and to come to rest against the outer end of the bracket 116 as illustrated. When the switch arm 28 is moved toward the open position, the auxiliary blade 110 is prevented from following it by the latching members 118. As a result a circuit connection is maintained between the switch arm 28 and the upper stationary contact member 26 until after the switch blades 88 and 89 are moved out of contact engagement with the upper terminal member 26. The continued rotation of the switch arm 28 toward the open position causes the auxiliary 110 to move downwardly with a translatory motion until its upper end is below the inner edges of the latching members 118. The auxiliary blade 110 is then rotated in a counterclockwise direction, as indicated by the arrow 113, from engagement with the lower portion of the jaws 115 with a snap action, thereby quickly effecting the final circuit break. It will be understood that the latching members 118 extend downwardly over only a portion of the flared out ends of the jaws 115, as shown in Figure 13, thereby permitting the final break to be made when the auxiliary blade 110 is rotated out of the lower contact portions of the jaws 115.

In order to insure that the circuit is not opened by disengagement of the switch blades 88 and 89 from the lower stationary contact member 27 before the auxiliary blade 110 leaves the jaws 115, an auxiliary contact member 120, formed preferably of a flexible strap of copper, is secured to the lower stationary contact member 27 and extends outwardly between the switch blades 88 and 89. The auxiliary contact member 120 is arranged to maintain engagement with one of the transversely extending rivets 90 and is of sufficient length to maintain engagement therewith until after the auxiliary blade 110 has opened the circuit by leaving the jaws 115 with the snap action as previously described.

Another form of disconnecting switch construction embodying certain of the features of my invention for mounting in the switch box 25 is shown in Figures 15 and 16 of the drawings. As there shown upper and lower stationary contact members 125 and 126 are mounted on suitable terminal connectors 127 and 128 which may be cemented or otherwise secured in the box 25. The stationary contact members 125 and 126 are bridged by a switch blade assembly 129 which may be mounted for rotation in a fulcrum member 130 that is secured to the rear wall of the box 25 by cementing or any other suitable means. The switch blade assembly 129 comprises a pair of blades 131 and 132 which are secured in spaced apart relation by transversely extending rivets 133. A pull ring 134, mounted on one of the rivets 133 is provided to permit operation of the switch arm 129 by means of the usual hook stick. The upper end of the pull ring 134 is provided with a cut-away portion 135 which cooperates with the adjacent rivet 133 to limit the movement of the pull ring 134. A stop member 127*a* in the form of a pin is mounted on the terminal connector 127 to serve as a stop for the movement of the switch blade assembly 129 inwardly.

It will be observed that the fulcrum member 130 is provided with an upwardly opening slot 136 into which the lowermost rivet 133 may be positioned when it is desired to operate the switch arm 129 to the closed position. The lower end of the switch blades 131 and 132 are rounded and slide along the outer edges of side members 130*a*

forming the fulcrum member 130. This construction prevents removal of the switch blade assembly 129 until it has been rotated to its lowermost position. As soon as the switch arm 129 is moved to the lowermost position, it may be removed thereby preventing the operation of the switch by unauthorized persons or for any other suitable reason.

With a view to maintaining contact engagement with the lower stationary contact member 126 until the switch arm 129 has moved to a predetermined position corresponding to a minimum required distance from the upper stationary contact member 125, an auxiliary contact member 137 is rotatably mounted on the switch blades 131 and 132 and is arranged to maintain contact engagement with the lower stationary contact member 126. This precaution is taken to prevent the formation of an arc between the switch blade assembly 129 and the lower stationary contact member 126, in the event that the switch is opened under load. This is required because the switch blade assembly 129 is mounted for rotation on the fulcrum member 130 that is insulated from the contact member 126 rather than being mounted for rotation on the latter. Any arc that is formed is drawn between the switch arm 129 and the upper stationary contact member 125 and it will ordinarily be broken before the auxiliary contact member 137 disengages the lower stationary contact member 126.

The cover 32 for the box 25, shown in Figures 15 and 16 of the drawings, is mounted in a somewhat different manner than that illustrated in Figures 5 and 6 of the drawings. As shown a pair of spaced apart resilient support arms 140 is secured to opposite sides of the upper terminal connector 127 and they are arranged to be biased apart by a compression spring 141 positioned between the outer ends thereof. A rectangular block 142 of suitable insulating material is secured to the inside of the cover 32 by threaded pins 143 that are similar to the pins 57 shown in Figure 5 of the drawings and described hereinbefore. The block 142 constitutes a part of a support bracket which further comprises a pair of straps 144 that are secured to the block 142 by a transversely extending bolt 145. The upper ends of the straps 144 are apertured and a shaft 146 extends therethrough and through corresponding apertures in the support arms 140. It will be observed that the spring 141 is positioned around the shaft 146, the ends of which are headed to maintain it in position. A pair of latching members 147, in the form of wires extend through the shaft 146 and into the rectangular block 142. The outer ends of the latching members 147 are bent outwardly, as illustrated, into engagement with notches 148 in the upper ends of the straps 144. The latching members 147 are arranged to interfit with a vertical slot 149 in each of the outer surfaces of the support arms 140 at their upper ends when the cover 32 is in the closed position and to interfit with a horizontal slot 150 located in the same surface when the cover 32 is in the open position. When the cover 32 is moved from one position to the other, the support arms 140 are moved inwardly and toward each other against the biasing force of the spring 141. As soon as the latching members 147 engage either of the grooves 149 or 150, the cover 32 will be frictionally held in the corresponding position.

Advantage may be taken of the principle of prestressing the contact members by providing the construction illustrated in Figure 17 of the drawings. In this figure the construction of the lower contact member 126 is illustrated and it will be understood that the upper contact member 125 is of identical construction.

As shown, the contact member 126 comprises a U-shaped contact member 153 the ends 154 and 155 of which are turned inwardly for engagement with the blades 131 and 132. In this embodiment of the invention surface contact is relied upon rather than point contact using silver inserts, as previously described. A U-shaped bracket 156 having upstanding branches 158 and 159 is positioned inside of the contact member 153 and is spaced slightly therefrom, as illustrated. The flexible inturned ends 154 and 155 are biased toward each other by compression springs 160 and 161 which are positioned between these ends and the branches 158 and 159 of the bracket 156. Sufficient pressure is provided with this construction to permit a relatively complete contact engagement between the surfaces of the switch blades 131 and 132 and the coacting surfaces of the end portions 154 and 155.

In order to limit the movement of the end portions 154 and 155 under the influence of the biasing springs 160 and 161, stop members 162 and 163 are secured by suitable means, such as rivets, to the bracket 156 at one end and the other end projects upwardly into the path of movement of the end portions 154 and 155. The upper ends 158 and 159 of the bracket 156 limit the inward movement of the upper portions of the end portions 154 and 155 in the same manner as stop members 162 and 163 limit the inward movement of the lower portions thereof. In this manner the inner surfaces of the end portions 154 and 155 move in parallel planes and satisfactory surface contact engagement therewith may be had. It is thus possible to prestress the springs 160 and 161 and to so construct the stop members 162 and 163 as to position the end portions 154 and 155 slightly within the path of movement of the switch blades 131 and 132. When the switch blades are moved to the switch closed position, it is only necessary to exert sufficient force to further compress the springs 160 and 161 to permit the movement to the fully closed position. The full force of the springs 160 and 161 is then available for providing contact pressure between the relatively movable switch parts.

While the contact member 153 has been illustrated as being of substantially U-shape, it will be understood that it could be formed by two independent contact fingers, mounted separately on a suitable base. However, I have found that a relatively economical construction is provided when the contact member 153 is formed of one piece, but it will be understood that the alternative form of construction comes within the scope of my invention.

Another embodiment of my invention is shown in Figures 18 and 19 of the drawings. As there shown upper and lower stationary contact members 166 and 167 are mounted on terminal connectors 168 and 169 in the box 25. A switch arm 170 is provided for bridging the upper and lower stationary contact members. In this embodiment of my invention the switch arm 170 comprises a single blade which is mounted for rotation on a fulcrum member 171. A stop pin 168a carried by the terminal connector 168 serves to limit the inward movement of the switch arm 170.

The fulcrum member 171 comprises a pair of

spaced apart jaws 172, the outer ends of which are flared outwardly. A rivet 173 extends through the lower end of the switch arm 170 and its ends are headed, as illustrated, for interfitting with suitable openings in the jaws 172 the inner edges of which are beveled to provide more complete engagement therewith. It will be understood that the switch arm 170 may be readily removed by merely withdrawing it from the jaws 172 after it has been operated to the open circuit position. In order to close the switch, the switch arm 170 is first inserted in the jaws 172 and then is rotated about the rivet 173 as an axis to contact engagement with the stationary contact members 166 and 167.

In order to permit operation of the switch arm 170, a pull ring 174 is rotatably mounted on a suitable rivet 175 that extends through the switch blade. The pull ring 174 is provided with a nose portion 176 that is arranged to engage a stop pin 177 for limiting this movement in a counterclockwise direction, as viewed in Figure 19 of the drawings. An auxiliary contact member 178 is rotatably mounted on the switch arm 170 in order to maintain contact engagement with the lower stationary contact member 167 until the switch arm 170 is moved a predetermined distance from the upper stationary contact member 166.

With a view to rotatably mounting the cover 32 a rectangular block 181 is provided near its upper end and is secured thereto by threaded pins 182 that are similar to the pins 57 shown in Figure 5 of the drawings and described hereinbefore. The block 181 is formed preferably of insulating material and it has positioned along its opposite sides straps 183 that are secured thereto by means of a transversely extending bolt 184 and by dowel pins 185. The straps 183 extend upwardly and alongside of a support member 186 that is formed of a suitable insulating material and secured to the terminal connector 168, as illustrated. A bolt 187 extends transversely through the straps 183 and the support member 186 in order to rotatably mount the cover 32. Spring washers 188 are provided at each end of the bolt 187, as shown, in order to provide a certain amount of friction between the inner surfaces of the straps 183 and the support member 186 while still permitting the cover 32 to be moved to and from the closed position and to hold the cover 32 in the open position so that the switch blade 170 may be opened and closed without interference therewith.

The construction of the upper and lower stationary contact members 166 and 167 may be identical and similar to the construction of the stationary contact members in the switch shown in Figures 15 and 16 of the drawings and in detail in Figure 17. The details of construction of the stationary contact member 167 are more clearly illustrated in Figure 20, to which reference will now be had. As shown, a U-shaped contact member 191 is provided having inturned flexible ends 192 and 193 between which the switch arm 170 is moved for contact engagement. The auxiliary contact member 178 is also positioned therebetween, as illustrated. A U-shaped bracket 194 is positioned inside of the contact member 191 and is provided with upwardly extending branches 196 and 197. Compression springs 198 and 199 are provided between the branch 196 and the end portion 192 and between the end portion 193 and the branch 197 to provide the desired contact pressure. Stop brackets 200 and 201, mounted by rivets or other suitable means on the bracket 194 and extending upwardly to limit the inward movement of the ends 192 and 193, are provided. The upper ends 196 and 197 of the bracket 194 serve to limit the inward movement of the upper portions of the flexible ends 192 and 193 in the same relation as the stop brackets 200 and 201 limit the inward movement of the lower portions thereof. The stop brackets 200 and 201 and the bracket 194 serve to prestress the springs 198 and 199 by retaining them in this condition prior to the movement of the switch arm 170 to the switch closed position.

In operation when the switch arm 170 is moved to the position illustrated in Figure 20 of the drawings, it will be understood that only sufficient force must be exerted to compress the springs 198 and 199 a slight distance to permit the movement of the switch arm 170 to the desired position. The inturned ends 192 and 193 are then lifted off of the upturned ends of the stop brackets 200 and 201 and the full spring pressure is applied to provide the desired contact pressure.

In the construction of the various forms of conductor clamps shown in connection with the different embodiments of the disconnecting switch set screws are provided for directly engaging the conductor that is positioned therein. In some cases I have found that it may be undesirable to provide for this direct engagement because of the nicking of the conductor that results. If the conductor is subjected to considerable tension and vibration, it may break off. If flexible conductors are employed the strands may be severed to a certain extent and complete contact may not be obtained.

In order to provide a terminal clamp in which the conductor is not directly engaged by the set screws, the construction illustrated in Figures 21 and 22 may be employed. As there shown a conductor clamp 205 is provided which comprises a casting 206 of suitable conducting material, such as copper, and having a transversely extending aperture 207 therein. It will be observed that the lower surface of the aperture 207 is inclined to permit the insertion of various sizes of conductors without requiring special sizes of clamps therefor. A contact plate 208 is provided in the upper portion of the aperture 207 and extends substantially entirely therethrough. The contact plate 208 is provided for engaging the conductor that is inserted in the aperture 207, as will be readily understood. Set screws 209 are threaded in the upper side of the casting 206 and the lower ends 210 extend through suitable apertures in the contact plate 208 and are headed over to cause conjoint movement therewith. The lower ends 210 of the set screws 209 are so constructed that they are permitted to turn relative to the contact plate 208 and therefore the latter is moved downwardly or upwardly depending upon the direction of rotation of the set screws 209. Moreover, the lower ends 210 are so formed that they do not extend downwardly a sufficient distance to engage the conductor. As a result the only engagement therewith is provided by the contact plate 208 which, because it is flat, does not cause a nicking of the conductor as might otherwise be the case.

In Figure 23 of the drawings I have shown a modified form of the contact member 167 that is illustrated in Figure 20 and described hereinbefore. In the embodiment of the contact member 167 shown in Figure 23 the switch blade 170 is provided with a rivet 212, the headed ends of

which are arranged to engage corresponding rivets or inserts 213 in the flexible ends 192 and 193 of the U-shaped contact member 191. The lower ends of the flexible end portions 192 and 193 are provided with aligned apertures in which the stop member 214 is slidably mounted. It will be observed that the central portion of the stop member 214 is enlarged to provide a limit to the movement of the end portions 192 and 193 toward each other under the influence of the springs 198 and 199. In this manner these springs are prestressed as will be readily understood. The ends of the stop member 214 are headed to limit the movement apart of the end portions 192 and 193. In this manner a floating construction is provided which permits considerable latitude in the movement of the end portions 192 and 193 within the confines of the bracket 194.

It will be understood that the inserts or rivets 212 and 213 are preferably formed of silver or of a silver alloy to provide the desired contact surface characteristics as described in detail hereinbefore.

While I have disclosed herein various types of prestress stationary contact members, it will be understood that these contact members may be mounted on a movable arm for engagement with stationary contact members in the form of blades or the like. This alternative form of construction is disclosed in my copending application filed December 14, 1936, Serial No. 115,692, and assigned to the assignee of this application.

Since further changes may be made in the foregoing constructions and different embodiments of the invention may be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. A switch comprising, in combination, a pair of switch members mounted for relative movement to open and close an electric circuit, a plurality of individually flexible contact fingers on one of said switch members, a small area high pressure contact member extending from each of said contact fingers, resilient means cooperating with each of said contact fingers and disposed out of the path of current flow therethrough for individually biasing the contact member carried thereby into high pressure contact engagement with the other switch member, and stop means extending transversely through said contact fingers and arranged and adapted to limit the movement of said small area high pressure contact members to positions slightly within the path of relative movement with said other switch member whereby said contact fingers are prestressed.

2. A switch comprising, in combination, a pair of switch members mounted for relative movement to open and close an electric circuit, a plurality of contact fingers carried by one of said switch members, a small area high pressure contact portion extending from each of said fingers and constituting the sole contact engaging portion with the other switch member, resilient means biasing said contact fingers, and stop means extending transversely through and limiting the movement of said fingers to position said contact engaging portions carried thereby slightly within the path of relative movement with said other switch member, said other switch member being beveled sufficiently to move said contact engaging portions out of said path when the switch is closed.

3. A switch comprising, in combination, a pair of switch members mounted for relative movement to open and close an electric circuit, one of said switch members including a plurality of individually flexible contact fingers having a relatively large cross-section in proportion to their length, a small area high pressure contact engaging portion extending from each of said fingers and constituting the sole contact engaging portions with the other switch member, said small area contact engaging portions being disposed in substantially a straight line, resilient prestressing means disposed out of the path of current flow through said contact fingers for biasing said contact engaging portions into high pressure contact engagement with said other switch member, and stop means extending transversely through said contact fingers to limit the movement of said contact engaging portions to positions slightly within the path of relative movement with said other switch member.

4. A switch comprising, in combination, a pair of switch members mounted for relative movement to open and close an electric circuit, one of said switch members including a flexible contact finger arranged and adapted to engage the other switch member, the contact engaging portions being limited to a small area of said contact finger and said other switch member, solid silver insert means in said switch members forming the contact engaging portions in said small areas, resilient means disposed to bias said contact finger into the path of relative movement of said switch members and to provide relatively high unit pressure therebetween, stop means for limiting the movement of said contact finger to a position slightly inside of said path whereby said resilient means is prestressed before said other switch member engages said contact finger, and additional stop means limiting the relative movement of said switch members toward the switch closed position to accurately align the silver insert means carried by said switch members.

5. A switch comprising, in combination, an arm guided for movement in substantially a predetermined plane, a contact member adapted to be engaged by the arm with a wiping motion when the arm is moved to switch closing position, the contact engaging portions being limited to a small area of said arm and said contact member, silver inserts in said arm and contact member forming the contact engaging portions in said small areas, resilient means disposed to bias said contact member into the path of movement of said arm and to provide a relatively high unit pressure, stop means for limiting the movement of said contact member to a position slightly inside of said path whereby said resilient means is prestressed before said arm engages said contact member, and additional stop means limiting the movement of said arm toward the switch closed position to accurately align said silver inserts.

6. A switch comprising, in combination, a pair of switch members mounted for relative movement to open and close an electric circuit, one of said members including a pair of prestressed contact fingers, the other of said members including a pair of spaced apart contact members for engagement with said contact fingers therebetween, silver inserts in said switch members forming the contact engaging portions therebetween, and means extending transversely through

said contact fingers for limiting movement thereof to positions slightly within the path of relative movement of said switch members.

7. A switch comprising, in combination, a pair of switch members mounted for relative movement to open and close an electric circuit, one of said members including a pair of spaced apart contact fingers, the other of said members including a pair of spaced apart contact members for engagement with said contact fingers therebetween, spring means biasing said contact fingers apart, and stop means extending transversely through said contact fingers for limiting movement thereof apart.

8. A switch comprising, in combination, a pair of spaced apart blades guided for movement in parallel paths, a prestressed bifurcated stationary contact member the branches of which individually engage the inner surfaces of said blades when they are moved to the switch closing position, the contact engaging portions being limited to a small area of each branch of said bifurcated contact members and corresponding areas on said blades, silver inserts in said blades and branches forming the contact engaging portions in said small areas, and stop means extending transversely through said branches for limiting movement of said silver inserts carried thereby to positions slightly within said paths of said blades.

9. A switch comprising, in combination, a pair of spaced apart blades guided for movement in parallel paths, a bifurcated stationary contact member the branches of which individually engage the inner surfaces of said blades when they are moved to the switch closing position, resilient means for biasing said branches into engagement with said blades, and stop means extending transversely through said branches for limiting movement thereof apart.

10. A switch comprising, in combination, a pair of switch members mounted for relative movement to open and close an electric circuit, one of said members including a pair of spaced apart bifurcated contact fingers, the other of said members including a pair of spaced apart contact members for engagement with said contact fingers therebetween, resilient means for biasing said contact fingers into engagement with said contact members, and stop means extending transversely through said branches for limiting movement thereof apart.

11. A switch comprising, in combination, a pair of spaced apart blades guided for movement in parallel paths, a bifurcated stationary contact member having bifurcated branches for individually engaging the inner surfaces of said blades when they are moved to the switch closing position, resilient means for biasing said bifurcated branches into engagement with said blades, and stop means extending transversely through said branches for limiting movement thereof apart.

12. In combination for a switch having relatively movable switch members for closing an electric circuit, a pair of bifurcated prestressed spaced apart contact fingers disposed to be carried by one of said switch members for engagement with the other switch member, the contact engaging portions being limited to a small area of each branch of each of said bifurcated contact members and corresponding small areas on said movable switch members, and means extending transversely through said fingers for limiting movement thereof apart.

13. In combination for a switch having relatively movable switch members for closing an electric circuit, a pair of prestressed spaced apart contact fingers disposed to be carried at one end by one of said switch members for engagement near the other end with the other switch member and having aligned apertures at said other end, and stop means slidably mounted in at least one of said apertures and extending transversely through said apertures for limiting movement apart of said fingers.

14. In combination for a switch having relatively movable switch members for closing an electric circuit, a pair of spaced apart contact fingers disposed to be carried at one end by one of said switch members and having aligned apertures near the other end, means intermediate the ends of said fingers and extending outwardly therefrom to form small area contact engaging portions with said other switch member, a coil spring disposed coaxially with said apertures for biasing said fingers apart, and stop means slidably mounted in said apertures and having headed ends for limiting the movement apart of said fingers to position said contact engaging portions slightly within the path of relative movement of said switch members.

15. In combination for a switch having relatively movable switch members for closing an electric circuit, a pair of spaced apart contact fingers disposed to be carried at one end by one of said switch members and having aligned apertures near the other end, contact means intermediate the ends of said fingers and extending outwardly therefrom to form small area contact engaging portions with said other switch member, a coil spring disposed coaxially with said apertures for biasing said fingers apart, and a spacer having neck portions at each end slidably mounted in said apertures and having headed outer end portions to limit the movement apart of said fingers to position said contact means slightly within the path of relative movement of said switch members, the diameter of the central portion of said spacer being slightly less than the internal diameter of said spring.

16. In combination for a switch having relatively movable switch members for closing an electric circuit, a pair of spaced apart contact fingers disposed to be carried at one end by one of said switch members and having centrally located aligned apertures near the other end, each of said fingers having slots extending from said apertured end toward said other end, contact means in each section formed by said slots to provide small area contact engaging portions with said other switch member, a coil spring disposed coaxially with said apertures for biasing said fingers apart, and stop means slidably mounted in said apertures and having headed ends for limiting the movement apart of said fingers to position said contact means slightly within the path of relative movement of said switch members.

17. In combination for a switch having relatively movable switch members for closing an electric circuit, a pair of spaced apart contact fingers disposed to be carried at one end by one of said switch members and having centrally located aligned apertures near the other end, each of said fingers having slots extending from said apertured end toward said other end, contact means in each section formed by said slots to provide small area contact engaging portions with said other switch member, a coil spring disposed

coaxially with said apertures for biasing said fingers apart, an inwardly extending ridge on each of said sections providing the sole engagement with the ends of said spring whereby substantially point engagement is provided between said spring and said sections, and stop means slidably mounted in said apertures and having headed ends for limiting the movement apart of said fingers to position said contact means slightly within the path of relative movement of said switch members.

18. In combination for a switch having relatively movable switch members for closing an electric circuit, a pair of spaced apart contact fingers disposed to be carried at one end by one of said switch members and having centrally located aligned apertures near the other end, each of said fingers having slots extending from said apertured end toward said other end, contact means in each section formed by said slots to provide small area contact engaging portions with said other switch member, a coil spring disposed coaxially with said apertures for biasing said fingers apart, an inwardly extending ridge on each of said sections providing the sole engagement with the ends of said spring whereby substantially point engagement is provided between said spring and said sections, and a spacer having neck portions at each end slidably mounted in said apertures and having headed outer end portions to limit the movement apart of said fingers to position said contact means slightly within the path of relative movement of said switch members, the diameter of the central portion of said spacer being slightly less than the internal diameter of said spring.

19. A terminal member for an electric circuit comprising, in combination, a substantially U-shaped contact member having aligned apertures centrally disposed near the ends of its branches, each branch having a longitudinal slot through its aperture forming two sections in each branch, contact means in each section to provide a small area contact engaging portion, a coil spring disposed coaxially with said apertures for biasing said ends apart, a transverse ridge extending inwardly from each section in alignment with said apertures and providing the sole engagement with the ends of said spring whereby substantially point engagement is provided between said spring and said sections, and stop means slidably mounted in said apertures and having headed ends for limiting the movement apart of said branches.

20. A terminal member for an electric circuit comprising, in combination, a substantially U-shaped contact member having aligned apertures centrally disposed near the ends of its branches, each branch having a longitudinal slot through its aperture forming two sections in each branch, contact means in each section to provide a small area contact engaging portion, a coil spring disposed coaxially with said apertures for biasing said ends apart, a transverse ridge extending inwardly from each section in alignment with said apertures and providing the sole engagement with the ends of said spring whereby substantially point engagement is provided between said spring and said sections, and a spacer having neck portions at each end slidably mounted in said apertures and having headed outer end portions to limit the movement apart of said branches, the diameter of the central portion of said spacer being slightly less than the internal diameter of said spring.

21. In combination for a switch having relatively movable switch members for closing an electric circuit, a pair of spaced apart contact fingers disposed to be carried by one of said switch members and having downturned flexible end portions for contact engagement with the other switch member, bracket means interfitting with said contact fingers, resilient means reacting against said bracket means for biasing said end portions into contact engagement with said other switch member, and stop means for limiting the movement of said end portions to positions slightly within the path of relative movement of said switch members.

22. A switch comprising, in combination, an arm guided for movement in substantially a predetermined plane, a pair of spaced apart stationary contact fingers having downturned flexible end portions for contact engagement with said arm, bracket means interfitting with said contact fingers, resilent means reacting against said bracket means for biasing said end portions into contact engagement with said arm, and stop means for limiting the movement of said end portions to positions slightly within the path of said arm.

23. A switch comprising, in combination, an arm guided for movement in substantially a predetermined plane, a pair of spaced apart stationary contact fingers having inturned flexible end portions for contact engagement with said arm therebetween, a bracket interfitting with said contact fingers, resilient means reacting against said bracket for biasing said end portions toward each other, and stop means for limiting the movement of said end portions to positions slightly within the path of said arm whereby said resilent means is prestressed.

24. A contact member comprising, in combination, a pair of spaced apart contact fingers having downturned flexible end portions for engagement with a relatively movable cooperating contact member, bracket means interfitting with said contact fingers, resilient means reacting against said bracket means for biasing said flexible ends in opposite directions, and stop means for limiting the movement of said end portions to positions slightly within the path of relative movement of said contact members whereby said resilient means is prestressed.

25. A contact member comprising, in combination, a pair of spaced apart contact fingers having inturned flexible end portions for engagement with a relatively movable cooperating contact member therebetween, a bracket interfitting with said contact fingers, a spring individual to each end portion and reacting against said bracket for biasing it into engagement with said movable contact member, and stop means for limiting the movement of said end portions to positions slightly within the path of relative movement of said contact members whereby said springs are prestressed.

26. A terminal member for an electric circuit comprising in combination, a substantially U-shaped contact member having inturned flexible end portions for engagement with a relatively movable cooperating contact member therebetween, a substantially U-shaped bracket secured within said contact member, a coil spring interposed between each branch of said bracket and each inturned end portion for biasing the latter toward each other, and stop means carried by said bracket for limiting the movement of said

inturned end portions to positions slightly within the path of relative movement of said contact members whereby said springs are prestressed.

27. A terminal member for an electric circuit comprising in combination, a substantially U-shaped contact member having inturned flexible end portions for engagement with a relatively movable cooperating contact member therebetween, a substantially U-shaped bracket secured within said contact member, a coil spring interposed between each branch of said bracket and each inturned end portion for biasing the latter toward each other, and stop means extending through the free ends of said flexible end portions for limiting the movement thereof to positions slightly within the path of relative movement of said contact members whereby said ends are free to float between the arms of said U-shaped bracket.

ALLAN RAMSEY.