

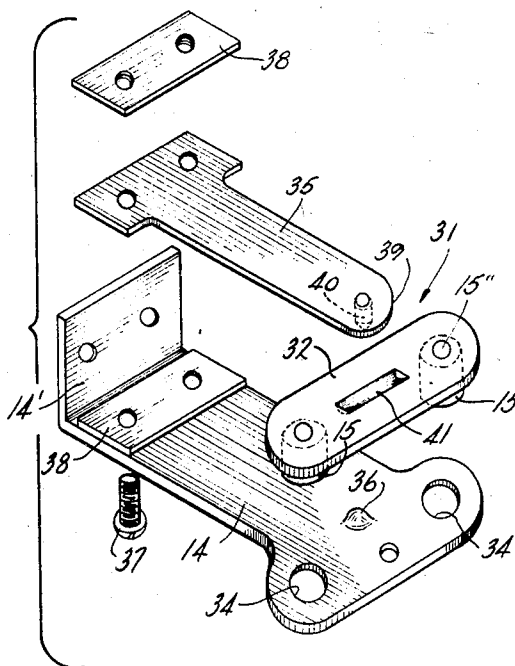
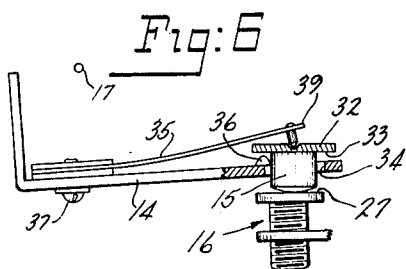
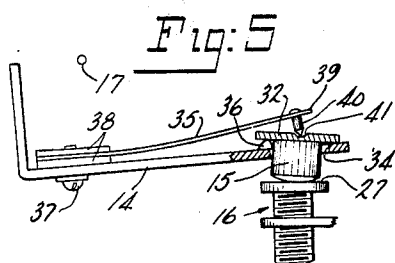
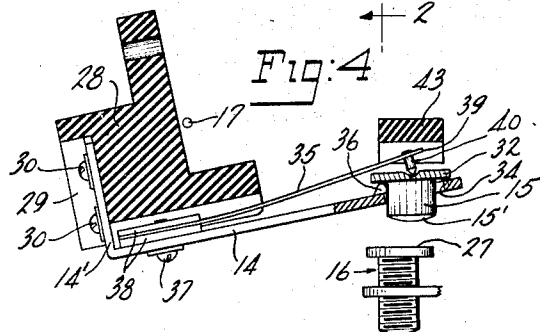
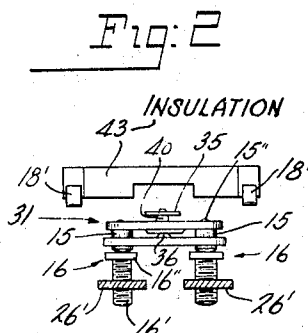
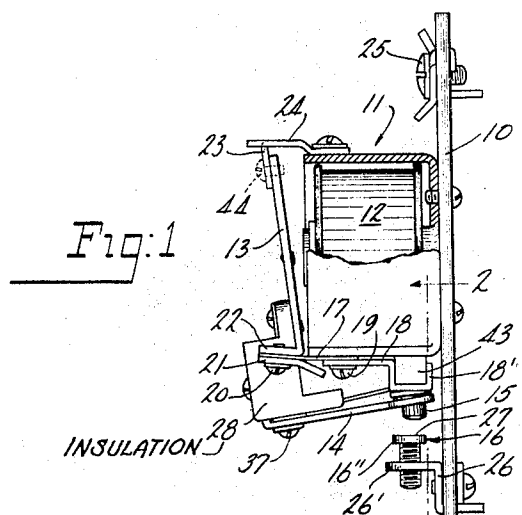
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H. E. MALONE

2,402,173

RELAY SWITCH

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## UNITED STATES PATENT OFFICE

2,402,173

## RELAY SWITCH

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The invention relates generally to relay switches and more particularly it relates to a contact structure adapted particularly for use in relay switches.

The primary object of the present invention is to provide a relay switch having contact structure of a simple and improved construction, capable of economical manufacture and assembly, and exceedingly rugged in use.

Another object is to provide such a new and improved relay switch having a contact structure capable of carrying heavy current throughout a long useful life.

Another object is to provide such a contact structure for relays and the like which is readily replaceable by a field service man.

Another object is to provide a new and improved switch structure wherein proper switch closure is attained by non-sliding engagement of the opposed contacts.

Another object is to provide a new and improved relay contact structure of this character wherein a definite rocking action is obtained between the two opposed contacts in the opening and closing of the switch.

Another object is to provide such a relay switch structure having means of a simple and effective character operable to produce rocking engagement and disengagement of the opposed contacts.

A further object is to provide a new and improved relay contact structure wherein the movable contacts are resiliently mounted on an actuating arm in a readily disengageable relation, and having means whereby the operative position and relation of these resiliently mounted movable contacts may be readily and effectually preserved during the packing and shipping of the relay.

Other objects and advantages reside in certain novel features of construction, arrangement and operation of the various parts which will hereinafter be more fully described in the specification and particularly pointed out in the appended claims.

In the drawing:

Fig. 1 is a side elevational view of a relay switch embodying the features of the invention, the relay switch being shown in its released or open position.

Fig. 2 is a fragmental cross-sectional view taken along the line 2-2 of Fig. 1 and illustrating the bridging structure of the movable contacts, with the switch in its closed position.

Fig. 3 is a perspective view showing, in extended relation, the several elements of the movable

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contact structure and the supporting means therefor.

Fig. 4 is an enlarged fragmental portion of Fig. 1 illustrating one of the switch contacts in its open relation, and showing some of the parts in cross-section.

Fig. 5 is a view similar to Fig. 4 illustrating the position of the movable contact structure on its operating arm at the time when the movable contact has just engaged the opposed stationary contact.

Fig. 6 is a view showing the relation of one of the movable contacts to its operating arm structure upon completion of the switch-closing movement of the operating arm.

While I have shown in the drawing and will hereinafter describe in detail but a single embodiment of the present invention, it is to be understood that this disclosure is made merely for purposes of illustration and that various modifications and alterations may be made therein by persons skilled in the art without departing from the spirit and scope of the invention as defined in the appended claims.

In the form chosen for disclosure herein the invention is embodied in a relay switch having a base 10 on the forward face of which is mounted a solenoid housing 11 enclosing an actuating coil 12, and this solenoid is adapted when energized to attract a pivoted armature 13 which carries a switch-operating arm member 14. Upon this operating arm 14 movable contacts 15 are mounted so that when the relay is actuated or closed, the movement of the armature 13 and operating arm 14 shifts the movable contacts 15 into closed relation to stationary contacts 16 which are mounted on the forward face of the base 10.

While many forms of pivotal mounting of the armature 13 may be employed, I prefer to utilize a spring hinge mounting 17 so that the armature 13 pivots along its lower edge. This spring hinge 17 has one end clamped by means of a clamp bar 18 and screws 19 against the lower face of the housing 11, while the projecting end of the spring hinge 17 is clamped by means of screws 20 between a clamp plate 21 and forwardly projecting ears 22 formed on the lower edge of the armature 13. The spring hinge 17 acts to urge the armature 13 in a counterclockwise direction to its released position shown in Fig. 1, this released position being determined by a lug 23 depending from a plate 24 which projects forwardly from the upper forward edge of the housing 11. Above the housing 11 the base 10 carries terminal means 25 adapted for electrical connection to the

solenoid coil 12, and to the stationary contacts 16, if desired, in a conventional manner.

In attaining the desired rocking action in the engagement and disengagement of the contacts, the present invention mounts the stationary contacts 16 substantially below the pivotal axis 17 of the armature, with the contacts 16 spaced apart in a direction parallel to said axis. The mounting for each stationary contact 16 comprises an L-shaped bracket 26, one leg of which is secured as by riveting to the forward face of the base 10 so that the other arm 26' thereof projects from the base 10 in a horizontal plane as shown in Fig. 1. The leg 26' of each bracket has a screw threaded aperture therein into which a threaded stud portion 16' of the contact 16 is screwed. On its upper end each stud portion 16' has an enlarged head 16'', the upper surface 27 of which constitutes the contact surface of the stationary contact 16. The contact 27 is preferably flat and by relative adjustment of the two stationary contacts 16, the two contact surfaces 27 thereof may be positioned in a common plane which, as clearly shown in Fig. 1, is spaced a substantial distance from the pivotal axis 17 of the armature.

The operating arm 14 is, therefore, spaced a substantial distance from the rotative axis 17, and is positioned so as to be perpendicular to a radius extending from the pivotal axis 17. To attain such a mounting, the present embodiment of the invention has an insulating block 28 secured to the outer face of the armature 13 adjacent the lower edge thereof, and a substantial portion of the insulating block 28 projects downwardly from the lower edge of the armature 13. The insulating block is located between the two clamping ears 22. On its forward or left hand face, and on its lower face, the insulating block 28 has a positioning recess or channel 29, which serves to simplify the attachment of the operating arm 14 thereto. In its present form the operating arm 14 comprising an L-shaped stamping, one arm of which constitutes the operating arm 14 and the other arm of which is relatively short and is apertured to receive securing screws 30. A portion of the arm 14 and the short leg portion 14' are positioned in the recess 29, and the screws 30 extend through the apertures in the arm 14' into threaded bores in the insulating block 28. With this form and relation in the arm 14, the actuation of the armature 13 shifts the arm 14 from the position shown in Fig. 4 to the position shown in Fig. 6, and it will be noted that in its Fig. 6 position, the end portion of the arm 14 is located in closely spaced relation to the contact surface 27 and is substantially parallel to said surface. In this approaching movement of the arm 14 with relation to the stationary contacts 16 the end portion of the arm 14 may be said to have two components of movement, the first component being toward and perpendicular to the surface 27, and the second component of movement being parallel to and across the contact surface 27 and in a direction to the left in Fig. 1, or in the general direction of the pivotal axis 17.

In accordance with the present invention, these two components of movement of the end of the arm 14 are utilized in attaining the desired rocking and non-sliding engagement and disengagement of the contacts 15 with the contacts 16. To this end, the movable contacts 15 are supported on the arm 14 in such a manner that in an approaching or switch closing movement of the arm 14, the initial engagement of the leading or contact end 15' of each contact 15 with the

contact surface 27 is at a point spaced between the center and one edge of the contact end 15', and thereafter as the approaching movement of the arm 14 continues, the other or remote end 15'' of the contacts 15 is shifted laterally in a direction generally parallel to the surface 27, thereby to rock the contact end 15' on the surface 27 and establish a final contacting engagement located substantially centrally of the contact end 15'. In such engagement of the contacts the lower or contact ends 15' of the contact 15 are, in effect, freed from the arm 14 during the terminal portion of the approaching movement of the arm 14, so that there can be no sliding of the contacts 15.

In the form chosen for disclosure herein the contacts 15 are of the bridging type operable when engaged with the contacts 16 to bridge or electrically connect the stationary contacts 16. The two contacts 15 are, therefore, formed as a part of a bridging switch assembly 31 (Figs. 2 and 3) the contacts 15 being mounted on opposite ends of a relatively flat pressure bar 32 made from metal, the spacing of the contacts 15 being the same as the spacing of the contacts 16. The contacts 15 are of cylindrical form with their reduced remote ends 15'' projecting through and riveted to the bar 32. The contacts 15 project parallel to each other and in the same direction from one broad face or surface 33 of the bar 32 and are of equal length; and since each contact 15 is to rock on the surface 27, the contact end 15' of the contact has a curved form such as the spherical segment illustrated herein.

To position bridging contact assembly 31 on the arm 14, positioning and guiding means is provided on the arm 14, and as herein shown this means comprises a pair of guiding apertures 34 located and spaced so as to be opposite and aligned with the axes of the contacts 16 when the relay is actuated. The contact assembly 31 is positioned on the arm 14 with the contacts 15 projecting loosely through the positioning and guiding apertures 34, so that the pressure bar 32 is located on the upper surface of the arm 14, as herein shown, and with the contact ends 15' of the contacts 15 projecting substantially below the lower surface of the arm 14. When the relay is released as shown in Fig. 4, the position of the contact assembly 31 on the arm 14 is determined by the cooperative action of a spring arm 35 and an abutment means 36 so that the desired manner of engagement of the contacts is attained, as hereinbefore described. The abutment means 36 has as its purpose the spacing of one edge of the pressure bar 32 from the upper surface of the arm 14, and preferably it is formed as a button or lug struck upwardly from the arm 14 in a symmetrical relation to the two apertures 34. The abutment or lug 36 is located on the arm 14 so as to space the left hand edge (Fig. 4) of the bar 32 away from the arm 14; and the height of the abutment and its spacing from a line joining the centers of the apertures are so related as to cause the contact end 15' to initially engage the contact 16 at a point on said contact end which lies between the center of the contact end 15 and the edge thereof.

To assure proper initial positioning of the contact assembly, and to impart the desired rocking action thereto, the spring arm 35 has one end secured, as by screws 37 and clamping plates 38, to the upper surface of the arm 14 adjacent to its juncture with the arm 14'; and the spring arm 35 projects longitudinally of the arm 14 so that its other end 39 overlies the pressure bar

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32. At the end 39 the spring arm 35 is pivotally interlocked with the pressure bar 32 by means in the nature of a knife edge pivot; and such interlocking is attained in the present instance by a pin 40 riveted to the arm 35 adjacent its end 39 and projecting toward the bar 32. The end of the pin 40 is pointed, and engages a recess 41 formed in the top of the bar 32, so that the pin 40 and recess 41 form the cooperating elements of a knife edge pivot. The proportioning of the parts is such that the recess 41 is symmetrically located with respect to the axes of the contacts 15, so that reversal of the contact assembly 31 does not affect the operation of the device. Thus assembly of the relay is simplified.

The form of the recess 41 is such that point of the pin 40 tends to slide down the sloping sides of the recess to shift the contact assembly to the left in Fig. 4, to bring the sides of the contacts 15 against the lower left sides of the guide openings 34, the size of the recess 41 being such that the pin 40 engages some part of the sloping surface of the recess in any position which the contact assembly may assume in its guiding openings 34. In the event that the proper relation is not attained in the initial assembly of the parts, the first operation of the relay causes the pin 40 to engage the bottom of the recess, thereby to attain the desired relationship.

In the operation of the relay, an approaching or switch closing movement of the arm 14 first engages the contact end 15' with the stationary contact face 27 so that the longitudinal axis of the contact 15 diverges slightly to the right from a vertical relation to the surface 27, as shown in Fig. 5; and continued approaching movement of the arm 14 produces the desired rocking movement of the contact 15 on the surface 27. This rocking movement is caused by the spring arm 35, which, in the last portion of the approaching movement, has a relatively large component of movement to the left (Fig. 5) and parallel to the contact face 27.

Since the pin 40 is in effect interlocked with the recess 41, this component of endwise movement of the arm 14 and the spring arm 35, is transmitted to the bar 32 to shift it to the left from its position of Fig. 5 to its position of Fig. 6. Thus the remote ends of the contacts 15 are shifted positively to the left, and the contact ends 15' are rocked over the surface 27. It will be observed that after the contact 15 has initially engaged the contact surface 27, the spacing of the right hand wall of the opening 34 from the contact 15 is such that in the subsequent or terminal portion of the approaching movement of the arm 14 the lower or contact end of the contact 15 is effectively freed from the arm 14. Hence the only lateral force or motion which is subsequently applied to the contact 15 is applied at its remote end 15'', with the result that sliding of the contacts is avoided and the engagement is confined to a true rocking movement. In the release of the relay, this rocking movement is reversed.

While the relay is in its closed position the spring arm 35 acts to apply a yielding contact engaging force which is equalized between the two contacts 15 by the pressure bar 32; while in the release or opening of the relay, the relatively rigid arm 14 applies a positive contact separating force to prevent sticking of the contacts. The reverse rocking of the contacts by the spring arm 35 also tends to eliminate any tendency toward sticking of the contacts.

Since the contact assembly 31 is held in place

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solely by the spring arm 35, provision is made to assure maintenance of the desired positioning of these parts during the rough handling encountered in packing and shipping of the relay. To this end an abutment means such as an insulating bar 43 is provided on the lower face of the housing 11 to lie relatively close to the upper faces of the arm 35 and the bar 32 when the relay is in its released position of Figs. 1 and 4. This bar 43 is held in place by the extensions 18' of the clamp bar 18. Adjacent its central portion the bar 43 is slotted so as to just clear the end 39 of the spring arm 35 when the relay is released; while the ends of the bar 43 just clear the end portions of the bar 32. Thus when the relay armature 13 is held in its released position, as by a screw 44 passing through the armature and threaded into the lug 23, the pin 40 is held in position in the recess 41 of the bar 32; and the contacts 15 are held in place in the guiding openings 34 of the arm 14. Thus the present relay will withstand considerable rough handling during packing and shipping.

The present contact structure is such that the contacts may be readily replaced, merely through substitution of a new contact assembly 31; and in such substitution the symmetrical formation of the assembly prevents mistakes on the part of the worker and assures proper mounting of the assembly on the arm 14.

The rocking action of the contacts attained in the present relay assures proper circuit connections in each operation, and prevents arcing and sticking of the contacts, and since it avoids sliding of the contacts the life of the contacts is much greater than heretofore. Extensive testing and use of the present relay have shown that it is extremely rugged and has a long useful life under heavy load conditions.

What is claimed is:

1. In a contact structure, the combination of a relatively rigid elongated arm, a spring arm fixed to said rigid arm, said rigid arm having a pair of positioning apertures formed therein adjacent to and symmetrically positioned on opposite sides of the other end of said spring arm, a contact assembly comprising a pressure bar having a pair of contacts similarly projecting therefrom adjacent opposite ends, said contacts projecting loosely through said positioning apertures and being freely withdrawable from said apertures, said pressure bar being located between said spring arm and said rigid arm, and said pressure bar having an interlocked pivoted connection with said spring arm at a point on said pressure bar which is symmetrically related to said contacts, and means on said operating arm operable to space one side of said pressure bar from said operating arm.

2. In a contact structure, the combination of a relatively rigid elongated arm, a spring arm having one end fixed to said rigid arm, said rigid arm having a pair of positioning apertures formed therein adjacent to and symmetrically positioned on opposite sides of the other end of said spring arm, and a contact assembly comprising a pressure bar having a pair of contacts similarly projecting loosely through said positioning apertures and being freely withdrawable from said apertures, said pressure bar being located between said spring arm and said rigid arm, and said pressure bar having an interlocked pivoted connection with said spring arm at a point on said pressure bar which is symmetrically related to said contacts.

3. In a contact structure, the combination of a relatively rigid elongated arm, a spring arm having one end fixed to said rigid arm, said rigid arm having a pair of positioning apertures formed therein adjacent to and symmetrically positioned on opposite sides of the other end of said spring arm, said other end of said spring arm having a part secured therein with a pointed end projecting toward said rigid arm and symmetrically located with respect to said positioning apertures, a contact assembly comprising a pressure bar having a pair of contacts similarly projecting therefrom adjacent opposite ends, said contacts projecting loosely through said positioning apertures and being freely withdrawable from said apertures, said pressure bar being located between said spring arm and said rigid arm, and said pressure bar having a recess with sloping walls formed therein engaged by the pointed end of said pin and forming an interlocked pivoted connection with said spring arm at a point on said pressure bar which is symmetrically related to said contacts, and means on said rigid arm operable to space said pressure bar therefrom on the side of said pressure bar which is adjacent to said fixed end of the spring arm.

4. A movable contact structure for relay switches and the like, comprising, in combination, a contact assembly having a pressure bar, and a pair of contacts fixed to said pressure bar adjacent to opposite ends thereof and projecting the same direction from one face of said bar, said pressure bar being formed with a recess in its other face located symmetrically with relation to said contacts and forming one element of a pivot, and an operating and supporting structure for said assembly comprising a relatively rigid arm having a pair of guiding openings therein adjacent to one end through which said contacts project, a spring arm secured to said rigid arm, and a pin fixed to said spring arm and engaging said recess.

5. In a switch structure of the class described, the combination of, a relatively stationary contact having a contact surface, a relatively movable contact having a curved contact surface, a pivoted actuator for said movable contact adapted to shift the same into and out of engagement with the stationary contact in a direction generally perpendicular to the surface thereof, the actuator being constructed and arranged relative to its pivot point so that the movable contact structure engages the stationary contact in a direction having a component extending laterally of the stationary contact, movable mounting means for mounting the movable contact structure upon said actuator, said movable mounting means comprising resilient means and stop means for causing the movable contact structure to assume a fixed position with respect to the pivoted actuator when the contacts are disengaged to insure initial engagement of said contact surfaces in predetermined relation with each other, said movable mounting means also being constructed and arranged to release the portion of the movable contact structure adjacent its contact surface of lateral restraint when the contact surfaces are engaged to thereby provide a pure rocking non-sliding engagement of the contacts.

6. A switching mechanism comprising, in combination, a pivoted operating member normally urged to a first position and adapted to be shifted to a second position, a pair of stationary contacts spaced apart in a direction paral-

lel to the pivotal axis of said operating member with said contacts spaced from said axis and having contact faces lying substantially in a plane which is spaced from said axis, said operating member being constructed and arranged so that when it is in its second position a portion thereof is positioned parallel and relatively close to said plane and has an end portion in slightly spaced opposed relation to said stationary contacts, said portion having a pair of guide openings therein opposite said stationary contacts, a movable contact assembly comprising a pressure bar member and a pair of movable contacts rigidly fixed thereto, said movable contacts projecting from said pressure bar member loosely through said guide openings toward said stationary contacts, a spring arm having one of its ends fixed to said operating member and having its other end bearing upon said pressure bar member substantially midway between said movable contacts and acting to yieldingly press said pressure bar member against said portion, cooperating means on said other end of said spring arm and said pressure bar member operable to pivotally interlock said other end and said pressure bar member in a direction longitudinally of said spring arm, and abutment means acting between said pressure bar member and said operating member between said axis and said interlocked other end of said spring arm to maintain the edge of said pressure bar member which is nearer said axis in spaced relation to said operating member, said spring arm acting when said operating member is in its first position to press the other edge of said pressure bar member against said operating member and thereby position said movable contacts on said operating member for initial engagement with said stationary contacts at an angle to the contact surfaces of said stationary contacts, said interlocked other end of said spring arm acting in continued movement of the operating member toward its second position after initial engagement of the contacts to shift said pressure bar member slightly toward said axis and thereby impart a positive rocking action to said movable contacts while applying a yielding contact-engaging force thereto.

7. A switching mechanism comprising, in combination, a pivoted operating member normally urged to a first position and adapted to be shifted to a second position, a stationary contact mounted in spaced relation to the pivotal axis of said operating member and having a contact face lying substantially in a plane which is spaced from said axis, said operating member being constructed and arranged so that when it is in its second position a portion thereof is positioned parallel and relatively close to said plane and has its end portion in slightly spaced opposed relation to said stationary contact, said portion having guide means forward thereon including a guide opening therein opposite said stationary contact, a movable contact structure projecting loosely through said guide opening toward said stationary contact, a spring arm having one of its ends fixed to said operating member and having its other end bearing upon said movable contact structure and acting to yieldingly press the same toward said fixed contact, cooperating means on said other end of said spring arm and said movable contact structure operable to pivotally interlock said other end with said movable contact structure in a direction longitudinally of said spring arm, and abutment means acting between

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said movable contact structure and said operating member between said axis and said interlocked other end of said spring arm to maintain the portion of said movable contact structure which is nearer said axis in spaced relation to said operating member, said spring arm acting when said operating member is in its first position to press another part of said pressure member against said operating member and thereby position said movable contact structure on said operating member for initial engagement with said stationary contact at an angle to the contact surface of said stationary contact, said interlocked other end of said spring arm acting in continued movement of the operating member toward its second position after initial engagement of the contacts to shift said pressure member slightly toward said axis and thereby impart a positive rocking action to said movable contact while applying a yielding contact-engaging force thereto.

8. In a switch structure of the character described, the combination of, a stationary contact having a contact surface, a movable contact structure having a curved contact surface, supporting and operating means for said movable contact structure operable to move the same in a direction generally perpendicular to the contact surface of the fixed contact for causing engagement and disengagement of said contact surfaces, and means for providing a nonsliding, pure rocking engagement of said contact surfaces, said last mentioned means comprising pivot means between said supporting and operating means and said contact structure, said pivot means engaging the contact structure at a point spaced rearwardly of said curved contact surface, and means for causing said supporting and operating means to move said pivot means laterally of said contact structure after initial engagement of said contact surfaces.

9. A switching mechanism comprising, a stationary contact having a contact surface, a movable contact having a contact surface adapted for engagement with the contact surface of the stationary contact, one of said surfaces being curved, a pivoted supporting and operating structure for carrying said movable contact, said structure being pivoted at a point spaced both laterally and longitudinally of the stationary contact so that as the structure approaches the stationary contact its end has a component of movement lateral of the stationary contact, means for pivotally supporting one of said contacts at a point spaced from its contact surface and in a manner to permit said one contact to rock in the direction of said lateral component of movement, and means for permitting continued movement of the structure in contact engaging direction after the contacts are engaged, said lateral component of movement of the structure and the pivotal support for said one contact causing a rolling motion between the two contacts after engagement.

10. A switching mechanism comprising, a stationary contact having a contact surface, a movable contact having a contact surface adapted for engagement with the contact surface of the sta-

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tionary contact, one of said surfaces being curved, a pivoted supporting and operating structure for carrying said movable contact, said structure being pivoted at a point spaced both laterally and longitudinally of the stationary contact so that as the structure approaches the stationary contact its end has a component of movement lateral of the stationary contact, means for pivotally supporting the movable contact on said structure, and resilient means for permitting continued movement of the structure in contact engaging direction after the contacts are engaged, said lateral component of movement of the structure and the pivotal supporting of the movable contact on said structure causing the movable contact to roll on the fixed contact.

11. A switching mechanism comprising, a stationary contact having a contact surface, a movable contact having a contact surface adapted for engagement with the contact surface of the stationary contact, one of said surfaces being curved, a pivoted supporting and operating structure for carrying said movable contact, said structure being pivoted at a point spaced both laterally and longitudinally of the stationary contact so that as the structure approaches the stationary contact its end has a component of movement lateral of the stationary contact, and means providing a resilient pivotal connection between said structure and said movable contact, said resilient pivotal connection permitting continued movement of the structure in contact engaging direction after the contacts are engaged and permitting the movable contact to rock relative to the structure due to said lateral component of movement of the structure, to cause the movable contact to roll on the fixed contact after engagement of said contacts.

12. A switching mechanism comprising, a stationary contact having a contact surface, a movable contact having a contact surface adapted for engagement with the contact surface of the fixed contact, one of said surfaces being curved, a pivoted supporting and operating structure for carrying said movable contact, said structure being pivoted at a point spaced both laterally and longitudinally of the stationary contact so that as the structure approaches the stationary contact its end has a component of movement lateral of the stationary contact, means providing a resilient pivotal connection between said structure and said movable contact, said resilient pivotal connection being arranged to rock the contact surface of the movable contact in the direction of said lateral component of movement when the contacts are disengaged, stop means between the movable contact and the structure for determining the position of the movable contact on the structure when the contacts first engage, said resilient pivotal connection permitting continued movement of the structure in contact engaging direction after the contacts are engaged so as to cause the movable contact to roll on the stationary contact.

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