

April 11, 1933.

C. G. KOPPITZ ET AL

1,903,643

ELECTRIC SWITCH

Filed April 23, 1931

3 Sheets-Sheet 1

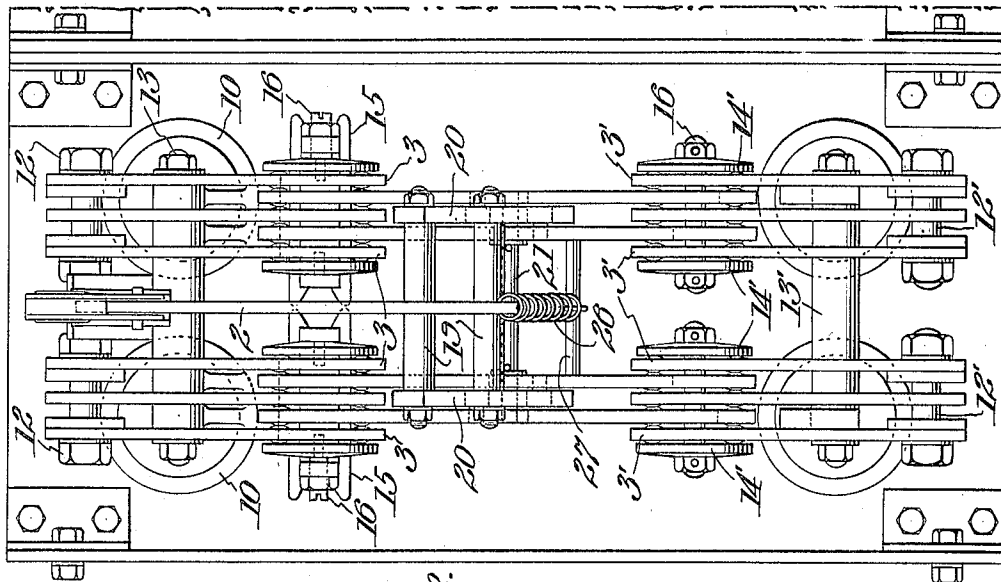


Fig. 2.

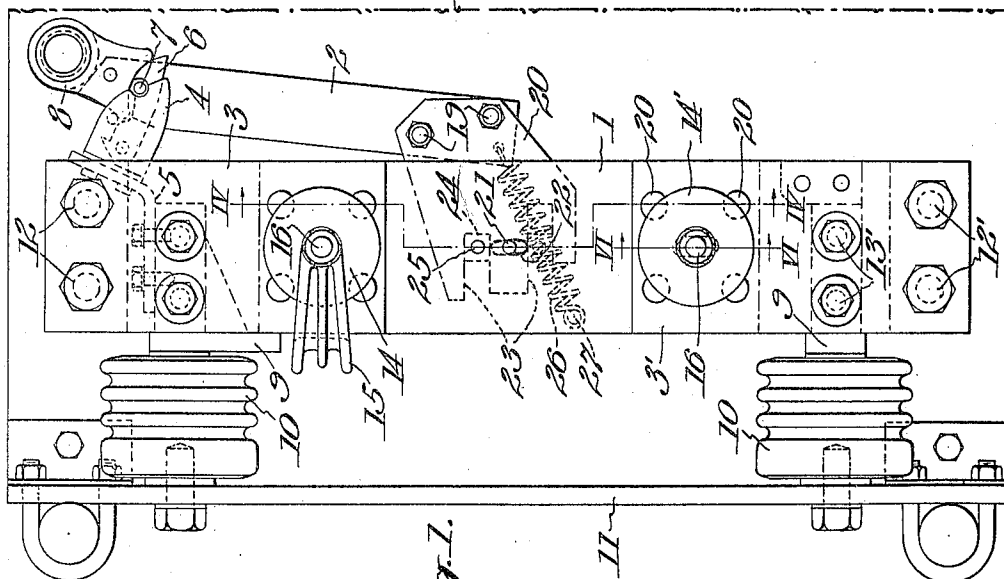


Fig. 1.

Inventors:

Carl G. Koppitz,
Harley B. Massey,
Byrne, Townsend & Potter,
Attorneys.

April 11, 1933.

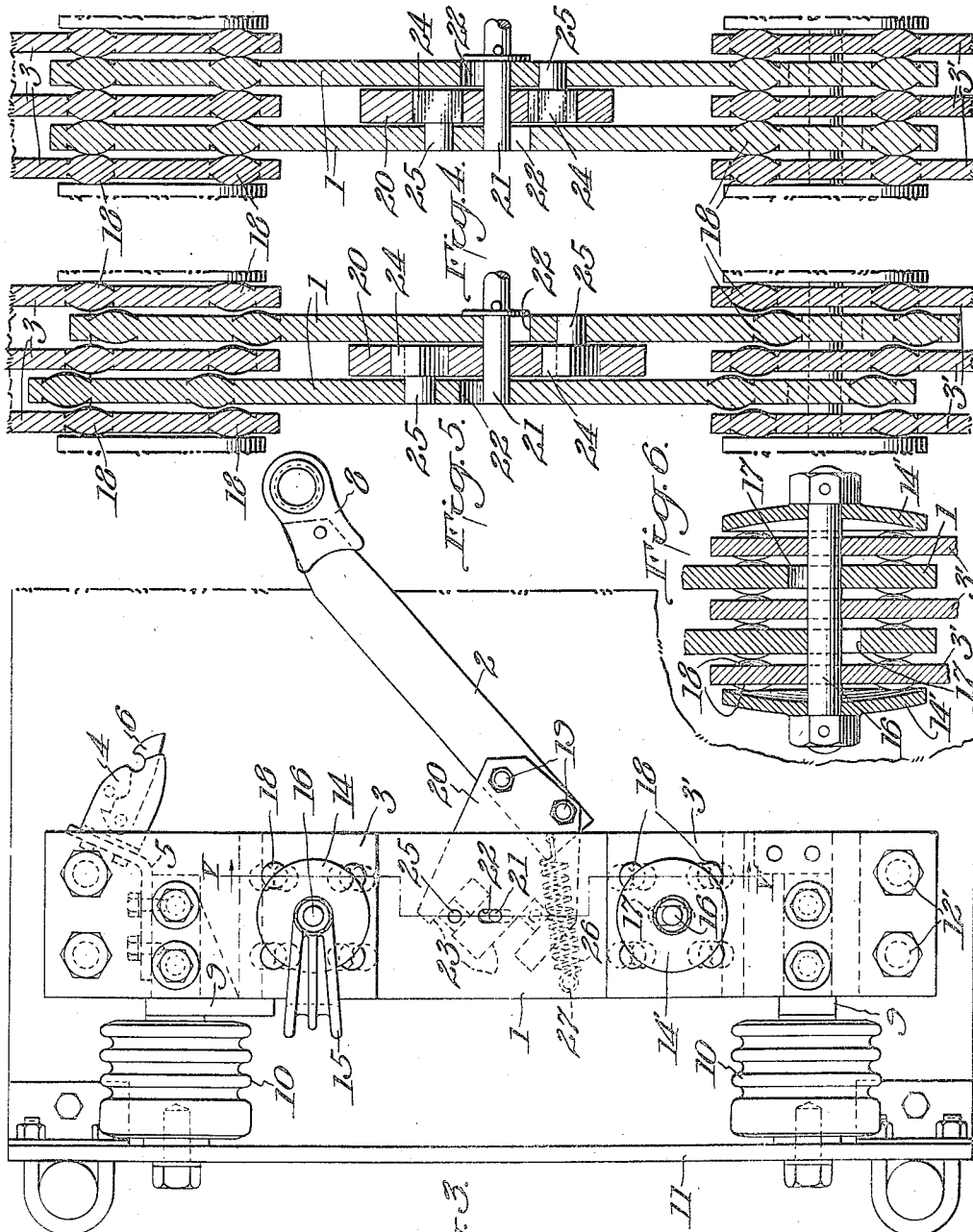
C. G. KOPPITZ ET AL

1,903,643

ELECTRIC SWITCH

Filed April 23, 1931

3 Sheets-Sheet 2



Inventors:

Carl G. Koppitz,
Hensley B. Massey,
By *James Townsend & Porter*,
Attorneys.

April 11, 1933.

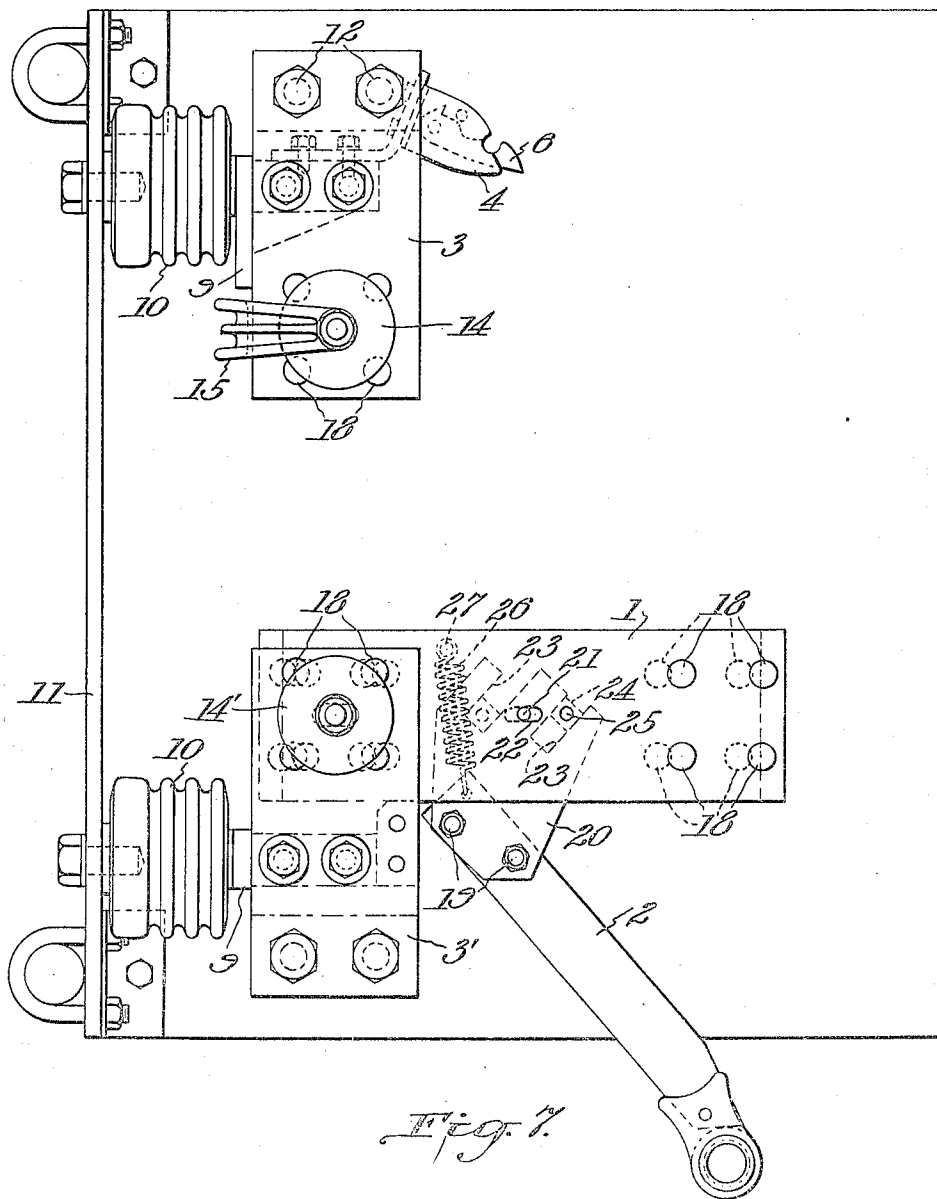
C. G. KOPPITZ ET AL

1,903,643

ELECTRIC SWITCH

Filed April 23, 1931

3 Sheets-Sheet 3



Inventors:

Carl G. Koppitz,
 Stanley B. Massey,
 By *Raymond J. Downard & Co.* Attorneys

UNITED STATES PATENT OFFICE

CARL G. KOPPITZ AND HEMSLEY B. MASSEY, OF GREENSBURG, PENNSYLVANIA, ASSIGNORS TO RAILWAY AND INDUSTRIAL ENGINEERING COMPANY, OF GREENSBURG, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

ELECTRIC SWITCH

Application filed April 23, 1931. Serial No. 532,293.

This invention relates to multi-blade knife switches of the type which carry relatively high currents.

Knife switches have been proposed in which the contact elements have exceedingly small contact areas held in engagement under relatively high unit pressures. By forming the contact elements with protruding bosses which provide contact areas of the order of about one one-hundredth of a square inch, each pair of contacting bosses may safely carry currents of the order of two or three hundred amperes when the contact pressure is such as to give rise to unit pressures of the order of 20,000 to 30,000 pounds per square inch. Although the total pressure between the knife blade and jaws may be comparatively low, it will be apparent that difficulty will be encountered in the manual operation of multi-blade knife switch which, for carrying currents of several thousand amperes, are provided with a plurality of cooperating bosses or approximately point contacts.

In accordance with the present invention, the manual operation of such switches is facilitated by so arranging the several switch blades and their operating mechanism that contact surfaces are disengaged prior to the translation or angular movement of the knife blades, the disengagement being effected by movement in a direction substantially normal to the direction of translation of the blades.

An object of this invention is to provide a knife switch which, though relatively light in weight, will carry a relatively large current.

A further object is to provide a knife switch the current carrying contact surfaces of which are pressed together under extremely high unit pressure.

A still further object is to provide a knife switch in which current carrying contact is not made until the blades have made a slight longitudinal movement from a preliminary closing position.

These and other objects will be more fully disclosed in the following specification and the accompanying drawings, in which

Figure 1 is a side elevation, showing, in

closed position, a switch embodying the invention,

Figure 2 is a corresponding plan view,

Figure 3 is an elevation showing the switch in preliminary open or preliminary closed position,

Figure 4 is a fragmentary section taken on the line IV—IV of Figure 1,

Figure 5 is a fragmentary section taken on the line V—V of Figure 3,

Figure 6 is a fragmentary section taken on the line VI—VI of Figure 1, and

Figure 7 is an elevation of the invention in open position.

Referring to the drawings, the blades 1 are adapted to be moved by the handle 2 into position between the jaws 3. The handle 2, mounted upon the blade 1 in a manner later to be described, has associated with it a locking device of known design and which forms no part of this invention. The locking device has a frame 4 attached to the bracket 5. Yieldingly pivoted within the frame is a latch 6 and a pin 7 fixed to the handle 2 is in position for cooperative engagement with the latch 6. A releasing element 8 on the handle 2 will, upon downward movement when the handle is locked, engage with the latch 6 to release the pin 7. It is therefore seen that a continued downward movement of the handle 2 will first unlock and then open the switch.

The switch jaws and also the pivotal support for the switch blades 1 are preferably of like construction and comprise a plurality of plates 3, 3', respectively, which are arranged in two groups, thus permitting the handle 2 to be arranged at the center of the switch. Each of the four groups of blades is mounted on a bracket 9 fixed to insulators that serve to support the switch upon an appropriate base or panel 11. The blades of each group are held together by bolts and spacers 12, 12' respectively, and the two groups constituting, respectively, the switch jaws and the blade support are held in spaced parallel relation by the bolts and spacers 13, 13'.

Each group of the stationary jaw blades 3 are yieldingly held between heavy resilient

washers 14 that are carried by yokes 15, bearing pins 16 extending through the washers 14 and seating in recesses in the outer blades 3. The groups of supporting blades are similarly held against spreading by the resilient washers 14', the pairs of washers being mounted upon bolts 16 which serve as pivots for the groups of knife blades 1. As shown in Fig. 6, the apertures 17 in the knife blades are elongated to permit sliding as well as angular motion of blades 1 on the bolts 16.

Each knife blade 1 and the cooperating jaw and supporting blades 3, 3' are provided with a plurality of protruding bosses 18 which engage, when the switch is closed, to restrict the engagement of the contacting members to exceedingly small areas. The protruding bosses may be formed by inserts, or cutting away the metal plates to leave raised bosses, but they are preferably formed by die stamping, as described in the copending application of Musgrave, Serial No. 444,579, filed April 15, 1930. The spring washers 14, 14' and their respective supporting means are so designed that substantial pressure is exerted upon each group of knife blades and cooperating plates when the switch is closed. Due to the restriction of the contact areas, the unit pressure at contact areas may be of the order of 20,000 pounds per square inch. It will be apparent that considerable friction must be overcome in closing and in opening a switch of this general type.

In accordance with the present invention, the operating force and the stresses imposed on the switch are reduced materially by moving the blades axially at the end of the closing movement and at the beginning of the opening movement of the switch.

For simplicity of operation, it is desirable that both the angular and the axial movement of the blades shall result from a single manipulation of but one operating member, i. e., the handle 2 of the switch as above described. These two movements of the blades may be derived from a simple angular movement of the handle by the introduction of a cam or lever mechanism between the handle and the blades. The axial movement of the blades sets up relatively heavy reaction stresses on the switch jaws and the blade supporting plates and, to reduce the effect of these reaction stresses, the blades may be divided into two sets which move axially in opposite directions. One form of cam mechanism for effecting these operations is shown in the drawings.

A pair of bolts or supporting rods 19 extend through the handle 2 and have fixed thereto plates 20 that lie between the pair of blades 1 which are at each side of the center line of the switch. The plates 20 are pivoted upon the pin 21 that extends through both pairs of blades 1, being seated in elongated slots 22 which thus provide a loose piv-

otal connection between the handle 2 and the knife blades. Each plate 20 has a pair of parallel slots 23 and the sliding blocks 24 in the respective slots constitute bushings for pins 25 that are fixed to the respective blades 1. When the switch is in closed position, as shown in Fig. 1, the axes of the slots 23 are approximately normal to the longitudinal axis of the knife blades, and for each pair of blades the pins 25 lie at opposite sides of the rod 21 that provides the pivotal connection between the handle 2 and the blades 1. The blades of each pair are therefore moved axially in opposite directions by the lever and cam mechanism, thereby reducing the stresses imposed upon the insulator pillars or other jaw supports.

A spring 26 is connected between handle 2 and a pin 27, fixed to blades 1, to exert a force tending to move handle 2 to open the switch.

Assuming the switch to be in closed position, the several parts have the relative arrangement depicted in Figs. 1, 2, 4 and 6. To open the switch, a pull is exerted on the ring 8 of handle 2 and the first effect of such a force is to release the locking pin 7 from latch 6, in the known manner. The pull applied to ring 8 then tends to move the blades 1 angularly to open the switch, but this angular movement of the blades is resisted by the friction due to the high pressure contacts. The handle 2 therefore pivots about the axis of the rod 21, thus rotating the cam plates 20 and exerting pressure upon the slides or bushings 24 to force the several pins 25 away from the rod 21. As the pins 25 partake of this movement, the knife blades 1 are moved axially to separate the several pairs of cooperating contact bosses 18, as shown in Fig. 5. Due to the mechanical advantage secured by the cam action of slots 23 and the cooperating elements 24, as well as the leverage afforded by handle 2, this separation of the contact surfaces may be effected by forces substantially less than those which would be required if the blades were moved angularly to separate the contacts. As soon as the respective contacts separate, the friction is substantially eliminated and the force required to rotate the blades 1 on pin 16 is comparatively small. The spring 26 normally holds the plate 20 in such position that the blades 1 of each pair have their contacting bosses 18 out of transverse alinement.

In closing the switch, the spring 26 prevents longitudinal movement of the blades 1 until the required angular movement of the blades 1 is completed. When the angular movement of blades 1 is arrested by the flange on the bracket 6 of the jaw support, or by other appropriate stop means, the plates 20 rotate about the pin 21 to force the blades 1 longitudinally thereby completing the closing movement of the switch. As there is but little resistance to the initial angular move-

ment of the switch blades, even a relatively small force is sufficient to impart a high angular velocity to blades, and the kinetic energy of the moving blades facilitates the longitudinal movement which completes the closing of the switch.

It will be apparent that the invention is not limited to the specific construction which is herein described and illustrated, as other forms of mechanisms may be employed to facilitate the opening and closing movement of switches in which the contacts are engaged under high pressure.

We claim:

1. In a switch of the knife blade type, a blade, means providing a pivotal support for said blade, a switch jaw comprising members having opposed faces between which said blade may be moved, and bosses projecting respectively from the opposed faces of said members and from said blade to restrict the contact area when said switch is closed.

2. In a switch of the knife blade type, a blade, means providing a pivotal support for said blade, a switch jaw comprising members having opposed faces between which said blade may be moved, bosses projecting from the opposed faces of said jaw and from said blade to restrict the contact area to the engagement of said bosses when the switch is closed, and resilient means tending to so position said jaw members that the distance between the bosses thereon is less than the thickness through said blade at the bosses thereon.

3. The invention as set forth in the next preceding claim, wherein said supporting means permits movement of said blade longitudinally of its axis, in combination with a handle loosely pivoted on said blade, and means between said handle and blade for effecting longitudinal movement of said blade to disengage said cooperating bosses prior to angular opening movement of said blade and to engage said bosses at the end of the angular closing movement of said blade.

4. In a switch of the knife blade type, the combination with a plurality of spaced parallel knife blades, a plurality of spaced parallel jaw members, means supporting said blades for pivotal movement into and out of the gaps between said jaw members, and cooperating bosses projecting from the opposed faces of said blades and jaw members to restrict the contact area of said switch, said bosses on each blade being in transverse alignment, and resilient means establishing a high contact pressure when said bosses are engaged to restrict the contact area, of operating means for moving one of said blades to disengage the bosses thereof from the cooperating bosses of the adjacent jaw members prior to the angular movement of another blade.

5. In a switch, a set of parallel jaw members, a blade, contact bosses on the opposed faces of said jaw members and said blade,

means supporting said blade for annular and for longitudinal movement, and operating means effective upon closing movement thereof to turn said blade angularly to position the same within said jaw members and thereafter to effect longitudinal movement of said blade to engage the bosses of said jaw members and said blade.

6. In a switch, the combination with a switch jaw, a switch blade, a pivotal support for said blade, cooperating bosses on said jaw and blade restricting the contact area between said jaw and blade, and resilient means establishing a high unit contact pressure between said cooperating bosses when said switch is closed, of a handle for moving said blade angularly on said support to move said blade into and out of said jaw, and means between said handle and blade for effecting longitudinal movement of said blade at the end of the closing movement and the beginning of the opening movement of said switch blade.

7. In a switch, a contact jaw comprising members having opposed faces, a knife blade, means supporting said blade for angular movement into and out of said jaw and for longitudinal movement, cooperating projections on said members and blade restricting the contact area of said switch when said projections are aligned, resilient means tending to maintain said blade at such position within its range of longitudinal movement that said projections will not be aligned when said blade is moved angularly on said supporting means to enter said jaw, and operating means for moving said blade into position within said jaw and for thereafter moving said blade longitudinally to effect engagement of said projections.

8. In a knife switch, a set of jaws, a blade, means to rotatively move said blade to a preliminary closing position and to impart a longitudinal movement to said blade to complete the closing operation, and means comprising resilient members acting upon said jaws and cooperating bosses on said blade and jaws for establishing limited contact areas engaged under high unit pressure at the close of the longitudinal movement of said blade.

9. In a switch, the combination with contact elements comprising a plurality of spaced parallel jaw members and a plurality of knife blades, means supporting said blades for angular and for longitudinal movement, and operating means effective to move said blades angularly into preliminary closing position and thereafter to move said blades longitudinally, of contact bosses upon the opposed faces of said blades and jaw members, said bosses being so positioned that the bosses on the respective contact elements engage only at the close of said longitudinal movement of said blades.

10. The invention as set forth in the preceding claim, wherein said operating means

comprises a handle loosely pivoted upon said blades, spring means yieldingly holding said blades at that limit of their range of longitudinal movement which prevents engagement of the contact bosses, and cam means between said blades and handles for effecting longitudinal movement of said blades upon continued movement of said handle after the said blades complete their angular movement into position between said jaw elements.

11. In a switch of the knife blade type, the combination with spaced parallel jaw members, a knife blade, and a support for said blade comprising spaced parallel members and a pivot pin carried by said members and extending through an aperture in said blade, of resilient means for yieldingly pressing said jaw members and said plates towards said blade, alined projections on the opposed faces of said blade, and alined projections upon the opposed faces of said jaw members and of said plates, the respective projections being so positioned that the projections on said blade are alined with cooperating projections on said members and plates only when the switch is closed.

12. In a switch of the knife blade type, two sets of longitudinally alined, spaced parallel plates, one of said sets constituting switch jaws, a pin extending through the other set of plates, switch blades pivotally supporting upon said pin, said blades being slotted longitudinally to permit longitudinal movement of said blades on said pivot pin, operating means including a handle loosely pivoted upon said blades and cam means between said handle and blades, spring means normally retaining said handle and blades at one limit of their range of relative angular movement, and cooperating bosses on said blades and each of said sets of plates, said bosses being engageable only when said blades are moved angularly into position between said jaws by said handle and said cam means has moved said blades longitudinally.

13. The invention as set forth in the next preceding claim, wherein said cam means comprises a plate fixed to said handle, said plate extending between two adjacent blades and having two parallel slots, pins secured to said adjacent blades and engaged in the respective slots.

14. The invention as set forth in claim 12 wherein said sets of plates are divided in two groups at opposite sides of the center of said switch, and said handle is arranged between the two said groups.

15. The invention as set forth in claim 12, wherein said cam means moves one of said blades longitudinally in one direction and another of said blades longitudinally in the opposite direction at the final closing and at the initial opening movement of said switch.

16. In a switch, a support, two sets of contact elements carried by said support, a

plurality of switch blades, means supporting said blades on one of said sets of contact elements for axial movement and for translatory movement, and operating mechanism for imparting translatory and axial movement to said blades to move the same into and out of engagement with said second set of contact elements, said mechanism including means for moving one of said blades axially in a direction opposite to that of the axial movement of another of said blades.

17. A switch comprising a pair of contact members and means mounting the same for relative movement into mutual engagement; said members being each provided with raised contact surfaces engaging, when the switch is fully closed, to restrict the contact of the said members to an order not substantially greater than that of line contacts.

18. A switch comprising a hinge element, a blade pivoted thereon, and a contact member, said blade and contact member being provided with cooperating raised contact portions which engage to restrict the engagement of said blade and contact member to the order of point contacts when said switch is closed.

19. A switch comprising a hinge member, a blade pivoted thereon and a contact member, said blade and said member being each provided with raised contact surfaces restricting the engagement of said blade and member to the order of point contacts when the switch is closed.

20. In a high contact pressure switch, a hinge, a blade member pivoted to said hinge, a contact member engaged by said blade member when said switch is closed, one of said members being resilient and bifurcated to provide sections lying at opposite sides of the other member, and raised contact surfaces on each of said members for limiting the engagement of adjacent faces of said members to a plurality of substantially point contacts when said switch is closed.

21. In a high contact pressure switch, a tongue, a bifurcate blade element, means mounting said blade element for rotation into engagement with said tongue, and cooperating, raised contact means on said blade element and said tongue for providing contact areas between said switch elements substantially of the order of point contact when said blade element is in engagement with said tongue.

22. In a high contact pressure switch, a pair of spaced blades, means mounting said blades for rotation about an axis, means connecting said blades for simultaneous movement, a tongue disposed in the path of said blades for engagement therewith, said tongue and blades being provided with raised contact surfaces disposed to restrict the contact area of said blades and tongue when the switch is closed.

23. In a high contact pressure switch, a

pair of spaced blades, means mounting said blades for rotation about an axis, means connecting said blades for simultaneous movement, a tongue disposed in the path of said blades for engagement therewith, said tongue and said blades being provided with raised contact surfaces disposed to restrict the contact area of said blades and tongue, when the switch is closed, to an order substantially less than that of the transversely alined surfaces of said blades and tongue.

24. In a switch, a blade, a hinge member supporting said blade for pivotal movement, a terminal cooperating with said blade, means restricting the contact area of said hinge member and blade to an order of not substantially more than line contact when the switch is closed, means resiliently pressing said hinge member and blade together, and means for reducing the pressure on said hinge member and blade when the switch is in open and partially open position.

25. In a switch, a blade, a hinge member on which said blade is pivoted, a resilient jaw member, contact bosses on said hinge member, cooperating contact bosses on said blade for engagement with said first contact bosses only when said switch is in substantially closed position.

In testimony whereof, we affix our signatures.

CARL G. KOPPITZ.
HEMSLEY B. MASSEY.

35

40

50

55

60