Nov. 11, 1952 M. F. KOENIG 2,617,903

ELECTRIC SWITCH

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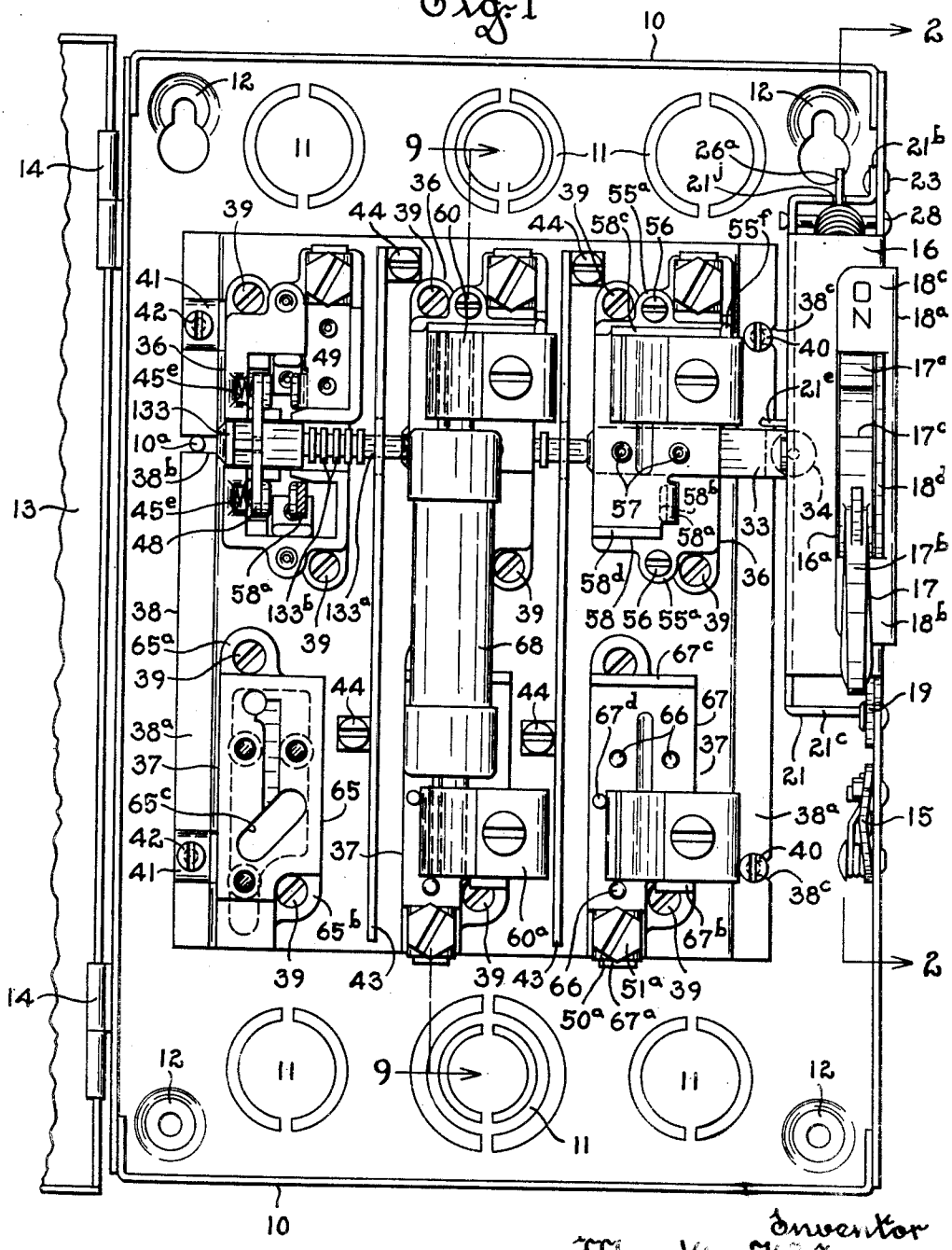
Fig. 1



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ELECTRIC SWITCH

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Fig. 2

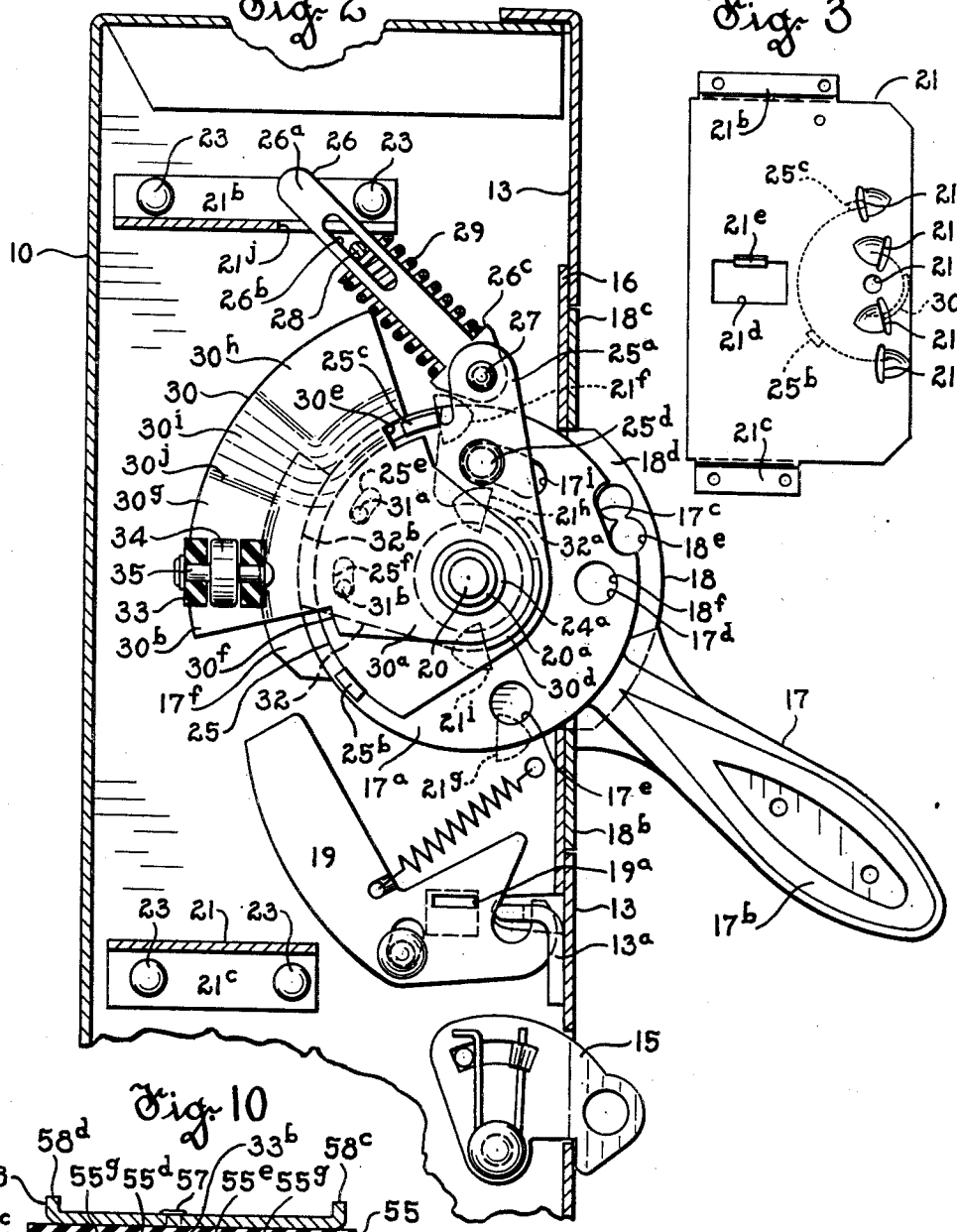
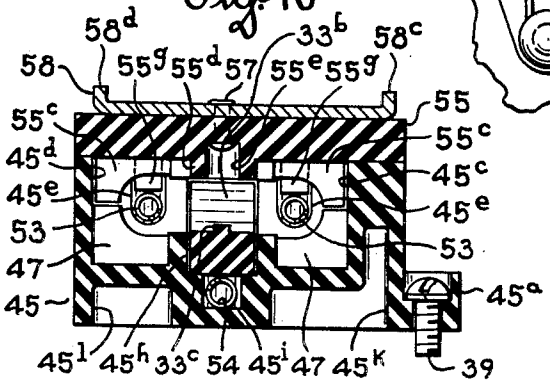


Fig. 3

Fig. 10



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Nov. 11, 1952 M. F. KOENIG 2,617,903

ELECTRIC SWITCH

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Fig. 4

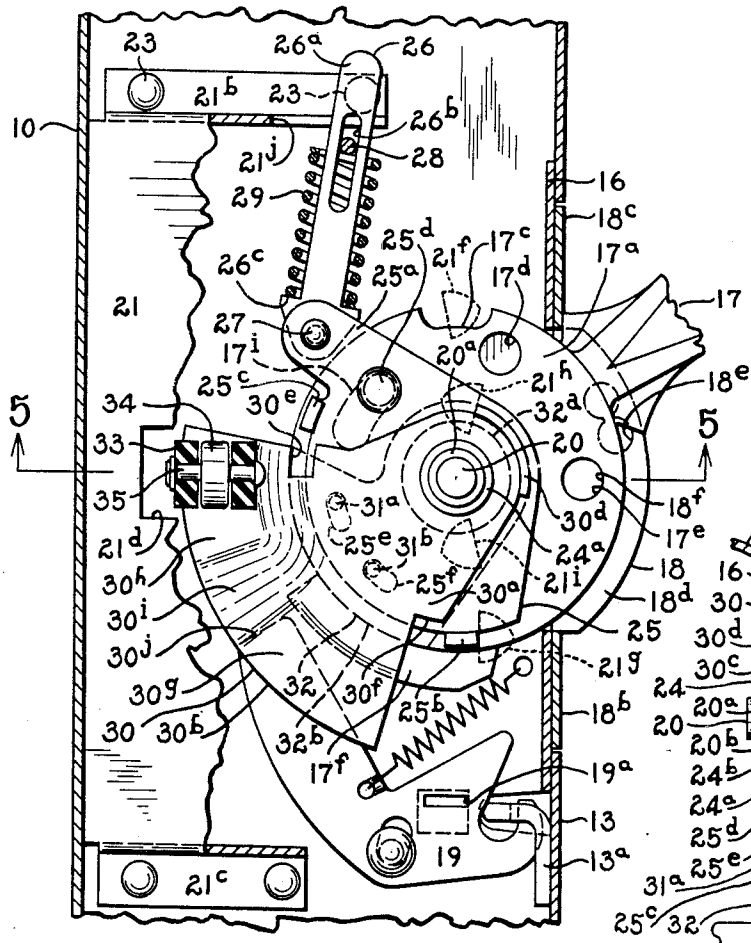


Fig. 5

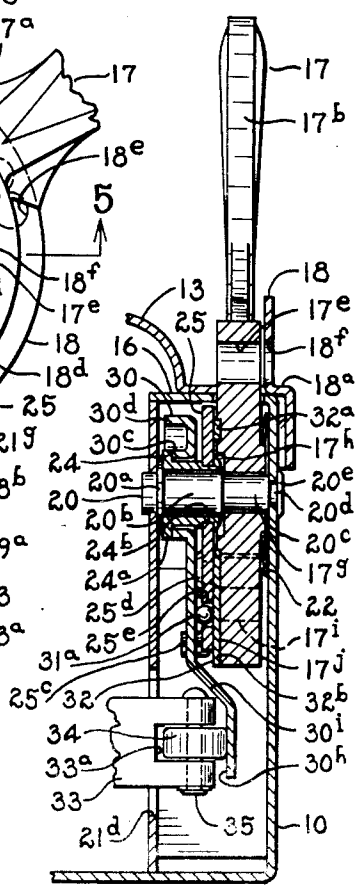
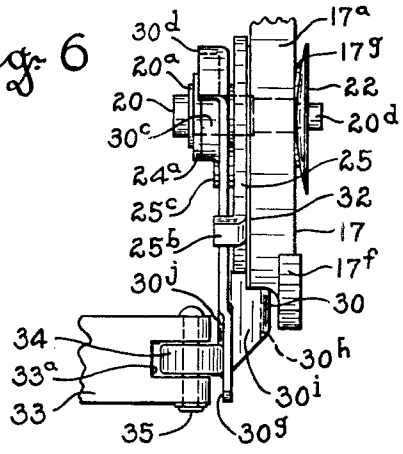


Fig. 6



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ELECTRIC SWITCH

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Fig. 7

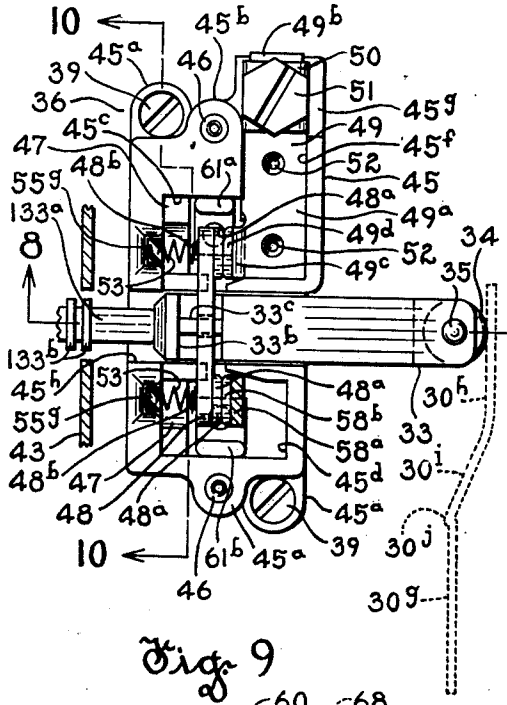


Fig. 8

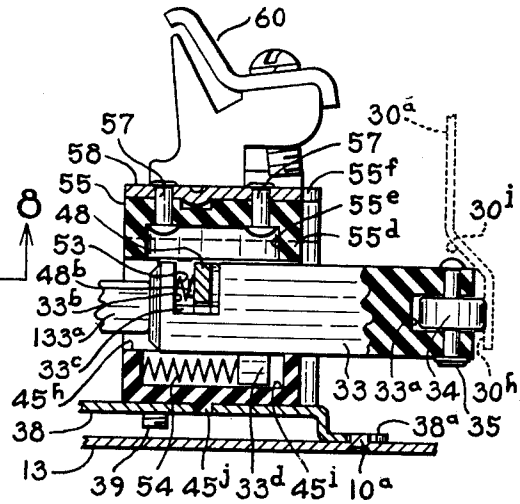
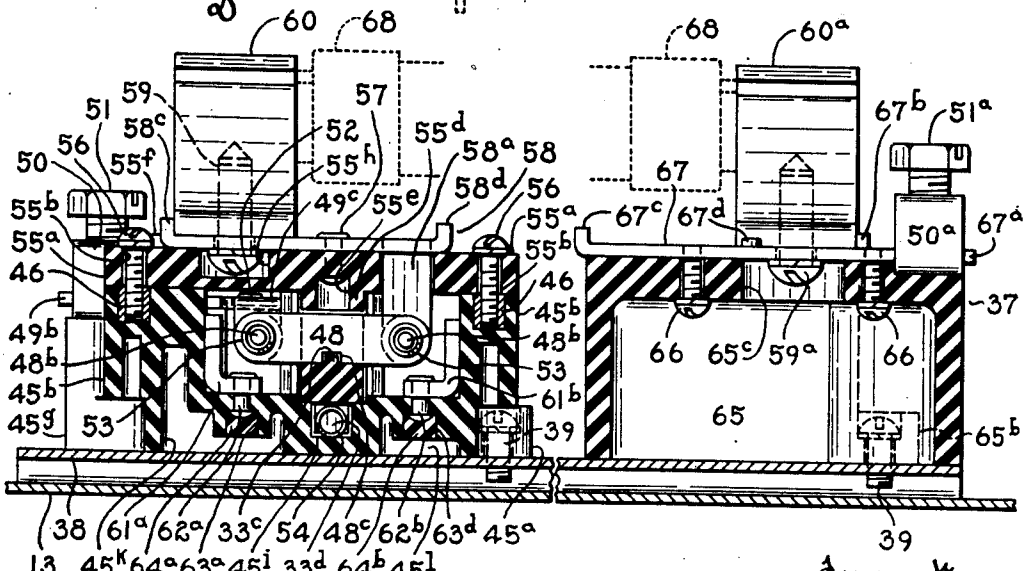


Fig. 9



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Patented Nov. 11, 1952

2,617,903

UNITED STATES PATENT OFFICE

2,617,903

ELECTRIC SWITCH

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Application February 12, 1949, Serial No. 76,150

9 Claims. (Cl. 200—76)

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This invention relates to improvements in electric switches, and more particularly to improvements in enclosed, quick make and break switches of the front-side operated type.

A primary objective of the invention is to generally improve the details of construction and assembly of the parts and the operation of switches of the aforementioned character.

Another object is to provide a compact switch of the aforementioned character wherein the fuses are mounted over the switch parts thus tending to reduce the size of the switch and make it more compact.

Another object is to provide a switch of the front-side operated type wherein a rotary motion of a snap action operating mechanism is translated through a cam surface to move a contact carrying plunger in reciprocal movement at a right angle to the plane of rotary motion.

Another object is to provide a plunger type switch wherein a plurality of switch units may be placed in tandem for joint operation through interconnection of their respective plungers.

Another object is to provide an improved type of individual switch unit in which arcing of the contacts is confined to a substantially enclosed chamber.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawings illustrate a preferred embodiment of the invention, it being understood that the embodiment illustrated is susceptible of modification in respect of certain structural details thereof without departing from the spirit and scope of the invention as defined by the appended claims.

In the drawings,

Figure 1 is a somewhat reduced top plan view of a three-pole, front-side operated switch of the fused type; the switch being shown in the "off" position and with a fragment of the open cover—two of the fuses, an insulating cover of one of the switch units, and a cover of one of the complementary fuse clamp assemblies being omitted for clarity of illustration of the parts of the switch.

Fig. 2 is a sectional view on the broken line 2—2 of Fig. 1, with the cover closed, and fixed stops shown in dotted lines.

Fig. 3 is a somewhat reduced side elevation of the guard for the operating mechanism with the movable stops shown in dotted lines.

Fig. 4 is a sectional view similar to Fig. 2, but with the switch operating parts in the "on" position.

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Fig. 5 is a sectional view on the broken line 5—5 of Fig. 4, the switch operating parts being shown in the "on" position.

Fig. 6 is a fragmentary elevation view of the details of the switch operating mechanism, similar to that shown in Fig. 5, but with the parts shown in the "off" position.

Fig. 7 is a top plan view of the one of the switch units adjacent the switch operating mechanism, the cover being omitted but with certain of the depending portions of the cover being shown in section, and the switch parts being shown in the "on" position—a developed view of the cam portion of the switch operating mechanism also being shown in dotted lines, and a fragment of the next adjacent switch unit being shown to illustrate the interrelation of the switch units.

Fig. 8 is a sectional view on the broken line 8—8 of Fig. 7, but with the switch unit cover and fuse clamp in place and a portion of the mounting plate and back wall of the casing being shown; the cam portion of the switch operating mechanism being shown in dotted lines.

Fig. 9 is a sectional view on the broken line 9—9 of Fig. 1, but with the switch parts shown in the "on" position.

Fig. 10 is a sectional view on the broken line 10—10 of Fig. 7, but with the cover member in assembled position, the fuse clamp being omitted.

Referring first to Figs. 1 to 6 inclusive, the numeral 10 designates the body portion of a sheet metal casing or enclosure of substantially the same construction as that illustrated in the patent to Millermaster et al. No. 2,325,697 to which reference is made for the details of construction thereof. Casing 10 may be provided with suitable knockouts as shown for example at 11, and mounting holes as shown at 12. A cover 13 is removably hinged to casing 10 as for example at 14 in the manner disclosed in the aforementioned patent to Millermaster, the switch preferably embodying as a whole the ornamental design disclosed and claimed in Design Patent No. 126,465, granted April 8, 1941, to Millermaster and Stevens. A manually releasable cover latch 15 of the type disclosed in the aforementioned patent to Millermaster et al. No. 2,325,697 and more fully described therein is also provided.

Formed integrally with one side wall of casing 10 and bent inwardly at a right angle thereto is a flange portion 16, having an opening 16a. Said opening 16a is of elongated rectangular contour to accommodate and to provide oscil-

latory clearance for a flat, substantially circular plate-like portion 17a (Fig. 2 and Fig. 4) of a die cast metal operating lever 17, said lever having a handle or hand grip portion 17b preferably of the type described in the aforementioned Millermaster Patent No. 2,325,697. As best illustrated in Fig. 1, there is rigidly attached, as by spot welding, to the one side wall of casing 10, a metal member having a portion 18a and integral portions 18b and 18c bent inwardly at a right angle to portion 18a, and an integral intermediate portion 18d offset slightly inwardly from and extending upwardly in a plane parallel to said portion 18a. Portion 18d is provided with two merging circular openings 18e (Fig. 2) for cooperation with a peripheral notch 17c in plate-like portion 17a of operating lever 17 thereby to accommodate the hasps of padlocks for locking the switch in the "off" position. Portion 18d is also provided with a circular opening 18f (Fig. 5) for registration with circular openings 17d and 17e (Figs. 2 and 4) in plate-like portion 17a to enable padlocking of the operating lever in the "on" and "off" positions respectively.

Plate-like portion 17a also has a peripheral, arcuate, cam like extension 17f (Figs. 2 and 4) for engagement with a latch member 19 of the type disclosed in the aforementioned Millermaster Patent No. 2,325,697 to which reference is made for the details of construction and operation thereof. Latch member 19 is adapted to hook a lug 13a on cover 13. The arrangement of portion 17f and latch member 19 is such that the switch operating lever 17 cannot be moved to the "on" position when the cover 13 is open, nor can the cover 13 be opened unless the operating lever 17 is in the "off" position. However in order to provide for manual release of the aforedescribed cover interlock afforded by member 19 when the switch is in the "on" position, said member is preferably provided with a substantially rectangular opening or slot 19a (adapted to accommodate the end of screw driver or the like), the side wall of casing 10 being provided with a registering opening as shown in dotted lines in Figs. 2 and 4, the operation of said manual release being more particularly described in the abovementioned Millermaster Patent No. 2,325,697.

Lever 17 (Fig. 5) is pivotally supported upon the inner surface of the side wall of casing 10 as by means of a pin 20, one end of which has a flange portion 20a; said pin having a relatively long intermediate shank portion 20b, a reduced intermediate shank portion 20c for insertion through a correspondingly shaped opening in lever 17, and a still further reduced portion 20d for insertion through a correspondingly shaped opening in the side wall of casing 10, pin 20 being upset over the outer surface of said side wall as at 20e. The flange portion 20a abuts the inner surface of a sheet metal housing member or guard 21 which substantially encloses all of the snap actuating elements of the switch; guard 21 having an aligned opening 21a (Fig. 3) for insertion therethrough of the flanged end of pin 20. A flat, annular resilient member or spring washer 22 (Fig. 6) is interposed between operating lever 17 and the side wall of casing 10, the resiliency of said spring washer tending to hold the various parts to be hereinafter described firmly against the inner surface of flange 20a of pin 20. Lever 17 is provided with a substantially circular portion 17g offset slightly outward for insertion with a close fit through a corresponding opening in spring washer 22 to support the latter when in assembled relation.

The aforementioned guard member 21 (Fig. 3) has flanges 21b and 21c at opposite ends thereof which are rigidly attached to the side wall of casing 10, as by means of rivets 23 (Figs. 2 and 3). Guard 21 extends from the bottom wall of casing 10 to substantially meet the inner edge of flange 16 of casing 10. Guard 21 is further provided with a preferably rectangular opening 21d and an outwardly extending lug 21e the purposes of which will be hereinafter described. Guard member 21 is also provided with two pairs of stops 21f, 21g, 21h, and 21i the purposes of which will become apparent hereinafter, said stops being formed by punching and forming inwardly portions of guard 21 to form a cup shaped structure as shown best in Fig. 3.

Intermediate shank portion 20b of pin 20 is fitted with a sleeve-like bearing 24 (Fig. 5) one end of which is flanged as at 24a, said flange 24a abutting flange portion 20a of pin 20. The outer end of bearing 24 is reduced as at 24b for insertion through a corresponding opening in a flat sheet metal cam operating member 25, and is spun over the outer surface of the latter to rigidly secure the parts together. A shallow annular recess 17h is formed in plate-like portion 17a of lever 17 to provide clearance for the spun over end 24b of bearing 24.

Said cam operating member 25 is generally of arcuate form and has an arm or extension 25a to which is pivotally connected one end of a plunger 26, as by means of a rivet or pin 27. The other end 26a of plunger 26 is afforded sliding and oscillatory clearance (Figs. 2 and 4) by a slot 21j in guard 21. Plunger 26 is provided with a slot 26b which is adapted to accommodate the shank of a pin 28 which penetrates alined openings in the side wall of casing 10 and guard 21 (Fig. 1) and is headed at each end to retain the same in position. Pin 28 thus acts to permit both reciprocatory and oscillatory movement of plunger 26 with respect to slot 21j.

Plunger 26 is surrounded by a relatively heavy compression spring 29, one end of which abuts pin 28 and the other end of which abuts shoulders 26c formed on said plunger 26; wherefore upon going over center spring 29 acts to effect snap movement of cam operating member 25 to one or the other of its extreme positions, respectively shown in Figs. 2 and 4. Said member 25 is provided with a pair of angularly spaced integral lugs 25b and 25c, bent inwardly at substantially right angles to the plane of the major portion thereof; the inner edges of which are adapted for alternate engagement with the side edges of a cam member 30 to provide a lost motion connection between members 25 and 30 for a purpose that will hereinafter appear, while the outer edges of said lugs are adapted to alternately engage fixed stops 21f and 21g of guard 21 respectively. (Said fixed stops are shown in dotted lines in Figs. 2 and 4 to indicate the aforedescribed relationship of the same with said lugs 25b and 25c.)

Cam operating member 25 is further provided with a rigidly attached outwardly extending pin 25d, which pin extends into an arcuate slot 17i in plate-like portion 17a of lever 17 to provide a lost motion connection therewith. Member 25 is also provided with a pair of arcuate slots 25e and 25f (Figs. 2 and 4) in each of which is seated a ball bearing, 31a and 31b respectively; said bearings being confined within slots 25e and 25f, being trapped between the inner surface of cam

member 30 and a bearing plate 32 (Fig. 5). Bearing plate 32 is preferably a relatively thin sheet metal member having an annular portion 32^a (shown in doted lines in Figs. 2 and 4) and a wing-like arcuate extension 32^b, the whole of said bearing plate being closely fitted into a shallow recess 17^j of corresponding shape in plate-like portion 17^a of lever 17. Said bearing plate 32 provides a bearing surface for ball bearings 31^a and 31^b thus to facilitate substantially frictionless movement of cam member 30.

Cam member 30 comprises a flat metal member of the contour best illustrated in Figs. 2 and 4, having a body portion 30^a and an arcuate wing-like extension 30^b, the latter providing a cam surface as will hereinafter be described. The body portion 30^a has a circular opening having an upstanding collar 30^c (Fig. 5), pin 20 and sleeve bearing 24 being inserted through the aforementioned circular opening to provide pivotal support for cam member 30, collar 30^c closely fitting bearing 24, the outer edge of collar 30^c abutting the inner surface of flange 24^a of bearing 24. Body portion 30^a is further provided with an integral arcuate lug 30^d bent outwardly at approximately a right angle to the body portion 30^a. Said lug 30^d is adapted to alternately engage the fixed stops 21^h and 21^i on guard member 21 in one or the other of its extreme positions as best shown in Figs. 2 and 4. The opposite side edges of cam member 30 are also notched as at 30^e and 30^f to alternately engage lugs 25^c and 25^d respectively on cam operating member 25, as will hereinafter be described.

The arcuate extension 30^b of cam member 30 is formed to provide two flat surfaces 30^g and 30^h, the former being in substantially the same plane as body portion 30^a (Fig. 6), while the latter lies in a plane parallel to but offset inwardly from that of body portion 30^a (Fig. 5), and an intermediate sloping portion 30^i connecting surface 30^h to surface 30^g and extension 30^b, the relationship of the foregoing portions being such as to present an inclined cam surface to a roller 34 of plunger 33 as cam member 30 is moved from one to the other of its extreme positions, this relationship being best illustrated in Fig. 7 wherein the dotted lines represent a developed view of the cam surface of member 30. A slight upstanding ridge 30^j, the purpose of which will hereinafter be described, is also provided at the juncture of surfaces 30^g and 30^i.

Contact actuator or plunger 33 is preferably a substantially rectangular bar of insulating material and is notched at one end as at 33^a to provide clearance for a metal roller 34, which is adapted to engage the cam surface of cam member 30. Said roller 34 is pivotally attached to plunger 33 by a pin 35 extending through alined openings in plunger 33 on both sides of the aforementioned notch 33^a and through a centrally located opening in roller 34, said pin being headed on both ends, thereby to retain the same in assembled relation with plunger 33. Said plunger 33 is biased by means to be hereinafter described to extend through a clearance opening 21^d in guard member 21 to maintain roller 34 in contact at all times with the cam surface of cam member 30, lug 21^e affording an alinement bearing for plunger 33.

The operation of the aforedescribed snap action switch operating mechanism is as follows: Assuming the parts to be in the "off" position as illustrated in Fig. 2, raising of handle 17^b of lever 17 results in counter-clockwise rotation of plate-like portion 17^a, it being pivotally supported on the side wall of casing 10 by pin 20. A certain amount of lost motion between portions 17^a and cam operating member 25 being afforded by the interconnection provided by pin 25^d and slot 17^i, cam operating member 25 is not actuated until pin 25^d engages the end of slot 17^i in lever 17. The lost motion having been taken up, further upward movement of handle 17^b and hence further counter-clockwise movement of portion 17^a causes cam operating member 25 to similarly move in a counter-clockwise direction, it also being pivotally supported by pin 20. Movement of cam operating member 25 is against the biasing afforded by compression spring 29 and causes an upward and clockwise movement of plunger 26 relative to its pivotal support, pin 28. A second increment of lost motion occurs before lug 25^e engages notch 30^e of cam member 30. This second increment of lost motion having been taken up, further upward movement of handle 17^b causes further counter-clockwise movement of portion 17^a of lever 17, cam operating member 25, and cam member 30 simultaneously, the last mentioned movement resulting in downward passage of surface 30^g of cam 30 relative to plunger 33, its roller 34 having rolled along surface 30^g. Upward movement of handle 17^b thus far has not resulted in lateral displacement of contact plunger 33 until roller 34 engages ridge 30^j on cam member 30, the latter being provided to prevent further downward movement of cam 30 by virtue of its own weight. At this moment plunger 26 is carried over center, lever 17 is disengaged from the other moving parts by virtue of the aforementioned lost motion connection, pin 25^d and slot 17^i, while compression spring 29 propels cam operating member 25, lug 25^c of which in turn carries cam member 30, in further counter-clockwise movement at great speed, cam surfaces 30^i and 30^h passing rapidly by roller 34, the offset surface 30^h permitting plunger 33 and its roller 34 to be laterally displaced outwardly with great rapidity. Movement of cam operating member 25 is ultimately halted by engagement of lug 25^d with fixed stop 21^g on guard 21, the aforementioned lost motion connection permitting further movement of cam 30, the latter being stopped ultimately by virtue of lug 30^d engaging fixed stop 21^h. Finally the movement of lever 17 is stopped when handle portion 17^b engages member 18^c on casing 10.

In moving from the "on" position as illustrated in Fig. 4 to the "off" position illustrated in Fig. 2 the operation is substantially the reverse. Downward movement of handle 17^b of lever 17 results in clockwise rotation of plate-like portion 17^a. Upon traversing the distance afforded by the lost motion connection, slot 17^i and pin 25^d, cam operating member 25 is picked up and likewise rotated in a clockwise direction, lug 25^b finally engaging notch 30^f of cam member 30 to cause the latter also to rotate in a clockwise direction. This latter motion results in passage of surface 30^h along roller 34 of plunger 33. Plunger 26 having reached center lever 17 is disengaged from the other moving parts, and spring 29 suddenly and with great force propels cam operating member 25, lug 25^b in turn carrying cam 30, in further clockwise rotation at great speed. The rapid movement of cam 30 along roller 34 results in a sudden lateral displacement of plunger 33 to the left as roller 34 rides up onto surface 30^g of cam 30. Movement of cam 30 is finally halted when lug 30^d engages fixed stop 21^i on guard 21

while movement of cam operating member 25 ceases when lug 25c strikes fixed stop 21f, and lever 17 is stopped when its handle 17b engages member 18c on casing 10.

It will be apparent that the operation just described affords a snap action, quick make and break operation that is substantially immune to "teasing" inasmuch as all manual control over the moving parts is lost the moment plunger 26 and its spring 29 go over center.

Having described the snap action mechanism reference will now be made to Fig. 1 wherein is illustrated a switch having three individual switch units 36, though it is to be understood that any number of said units might be employed. Each of the switch units 36 has a separate complementary fuse clamp assembly 37 each of the latter including an insulating base properly alined with switch units 36 and spaced therefrom, this arrangement minimizing the cost and weight thereof, though it is to be understood that if desired a single integral base of proper size might be employed. The fuse clamp assemblies 37 are identical, as also are the three switch units 36 except as to their contact carrying plungers as will hereinafter appear. The switch units 36 and complementary fuse clamp assemblies 37 are individually removably attached to a common mounting plate 38 as by screws 39.

Mounting plate 38 is formed of sheet metal and is provided with flanged portions 38a at opposite side edges thereof, said flanges being adapted to engage the back wall of casing 10 and provide for removable attachment of mounting plate 38 to said back wall of casing 10 as will hereinafter be described. Flange portions 38a are provided with a pair of edge notches 38b to accommodate respectively a pair of positioning lugs 10a formed integrally with and extending upwardly from the back wall of casing 10. One of flange portions 38a is further provided with a pair of edge notches 38c to accommodate a pair of screws 40 for removably attaching said flange portion to the back wall of casing 10; while the opposite flange portion 38a is provided with a pair of humps 41 formed integrally therewith, each of which has an opening to accommodate a self-retaining screw 42 of well known structure for removably attaching said flange portion of mounting plate 38 to the back wall of casing 10. From the foregoing it will be apparent that the entire switch mechanism may be readily and easily removed from the casing 10 by merely loosening screws 40 and 42 and lifting mounting plate 38 from the casing, all the other switch parts being individually removably attached to said mounting plate as hereinbefore described.

A pair of stiff sheets of insulating material 43 extending upwardly from mounting plate 38 to substantially meet cover 13 when closed and running substantially the full length of said mounting plate are interposed between the switch units 36 to provide sufficient electrical spacing between live parts of adjacent poles, said insulating sheets being attached to mounting plate 38 by screws 44.

Referring primarly to Figs. 7 to 10 inclusive, the individual switch units 36 include a substantially rectangular base 45 molded from insulating, arc resisting material. Insulating base 45 is provided at opposite ends thereof with a pair of integrally formed substantially circular peripheral projections 45a which projections extend upwardly from the bottom plane of said base, said proections 45a being countersunk to accommodate screws 39 for attachment of the base to mounting plate 38 as hereinbefore described. An integrally formed preferably circular positioning lug 45j (Fig. 8) adapted to cooperate with a corresponding opening in plate 38 is provided on the bottom surface of base 45. Base 45 is also provided at opposite ends thereof with a pair of smaller, semicircular, integrally formed projections 45b which extend downwardly a substantial distance from the plane of the top surface of the aforementioned base, said last mentioned projections each being provided with an internally threaded metal insert 46 rigidly attached thereto for accommodating a cover screw, as will hereinafter be described.

Insulating base 45 is further provided with a pair of recesses 45c, 45d, of the contour best illustrated in Fig. 7, extending downwardly a substantial distance from the top surface thereof, said recesses 45c, 45d serving as contact chambers, as will hereinafter become apparent. One side wall of each of the recesses 45c, 45d has opening into the same a smaller substantially rectangular recess 45e (Fig. 1 and Fig. 10) extending downwardly from the top surface of base 45, the rounded bottom walls of said recesses 45e each serving to support the end of a spring as will hereinafter appear.

Within each of the recesses 45c, 45d and extending upwardly from the bottom wall and outwardly from the aforementioned side wall thereof is an integrally formed shoulder 47 of the contour best illustrated in Figs. 7 and 10; said shoulders being formed to cooperate with a depending portion of a cover member to be hereinafter described to afford rather close clearance for a bridging contactor 48 as the switch is moved to the "off" position. Provision of said shoulder 47 and its aforementioned mating member reduces the size of the contact chamber and tends to confine any arc which may be present on opening or closure of the contacts as will hereinafter be described.

The upper surface of base 45 is further provided with a shallow recess 45f to accommodate the substantially rectangular flat intermediate portion 49a of a combination stationary contact and terminal lug member 49, the terminal lug portion 49b of said member being supported by a substantially rectangular integrally formed projection 45g extending upwardly a substantial distance from the bottom plane of base 45. The terminal lug illustrated is of the type disclosed in the patent to Millermaster No. 2,193,202 to which reference is made for the details of construction thereof. Said terminal lug includes a hollow metal member 50 of substantially rectangular form in transverse cross section, which member is provided with a relatively large tapped opening to accommodate the threaded shank of a screw 51. Intermediate portion 49a serving as a strip metal conductor or bus is preferably rigidly attached to base 45 as by rivets 52. An integral portion 49c of member 49 is bent downwardly at approximately a right angle to intermediate portion 49a to depend into recess 45c, the lower end of said portion 49c being provided with a suitable contact surface 49d, preferably circular, thus to serve as a stationary contact for the switch unit.

The aforementioned bridging contactor 48 comprises a flat, substantially rectangular metal bar having a pair of preferably circular contact surfaces 48a projecting forwardly therefrom at each end thereof, said contact surfaces being adapted to engage contact surface 49d and another sta-

tionary contact to be hereinafter described respectively. The back surface of contactor **43** is provided near each end thereof with a preferably circular integrally formed lug **48b**, each for insertion into the end of a helical compression spring **53** for support thereof, the opposite end of each spring being supported by the bottom walls of recesses **45e** respectively as hereinbefore described, said springs **53** thus serving to bias bridging contactor **48** to a closed position with respect to its cooperating stationary contacts.

Bridging contactor **48** is supported as a whole by the bottom wall of a rectangular notch **33b** of plunger **33**, said notch extending downwardly from the top surface of plunger **33**, and being of sufficient width to allow contactor **48** considerable play. The aforementioned bottom wall of notch **33b** is provided with an integrally formed transverse rib or ridge **33c** to interlock with a corresponding notch **48c** formed in the bottom edge of contactor **48** as best shown in Figs. 9 and 10, said interlocking preventing lateral displacement of contactor **48** relative to plunger **33**.

Plunger **33** is adapted for sliding reciprocal movement in a substantially rectangular channel **45h** extending through base **45** from side to side thereof, the bottom wall of said channel being provided with a substantially rectangular recess **45i** (Figs. 8 and 9) for accommodating a helical compression spring **54**. As best shown in Fig. 8, the bottom surface of plunger **33** is provided with an integrally formed depending lug **33d**, preferably of such dimensions as to closely fit within recess **45i** for reciprocal movement therein. Spring **54** is positioned so that one end thereof abuts the end wall of recess **45i** while the other end of said spring abuts a side edge of said lug **33d** thus tending to bias plunger **33** to the closed position of the switch.

Switch unit **36** is also provided with a flat cover member **55** of arc resisting insulating material, said cover member being of substantially the same size and peripheral contour as that of base **45** with which it is adapted to cooperate. Extending outwardly from each end of cover member **55** are a pair of integrally formed semi-circular extensions **55a** alined with and adapted to cooperate with the corresponding extensions **45b** of base **45**, said extensions **55a** each having a centrally located, preferably circular opening **55b** to accommodate a screw **56** for insertion therethrough and threading into the alined openings in metal inserts **46** hereinbefore described, thus to provide for removable attachment of cover member **55** to base **45**.

As best shown in Fig. 10, cover member **55** is further provided with a pair of integrally formed depending portions **55c** so proportioned and alined as to fit downwardly into recesses **45c**, **45d** each to mate with shoulders **47** hereinbefore described and each having an integral extension **55g** fitting into recess **45e** (Fig. 7) to interlock cover member **55** with base **45** and prevent upward displacement of springs **53** within recesses **45e** (Fig. 10). The bottom surface of cover member **55** is also provided with an integrally formed substantially rectangular depending portion **55d** extending the entire width thereof, said portion **55d** being so proportioned and alined with respect to base **45** as to extend downwardly into channel **45h** to form an upper wall thereof and being adapted to closely fit the upper surface of plunger **33** and prevent upward displacement of the latter. Said portion **55d** and cover member **55** are recessed as at **55e** to provide clearance for a pair of rivets **57**, the shanks of which are inserted through corresponding and alined openings in cover member **55** and a bus or conducting member **58**, said rivets being upset over the top surface of bus **58** to rigidly secure the same to the top surface of cover member **55**.

Bus or conducting member **58** is a flat metal plate of the size and shape best shown in Fig. 1, it being constructed so as to substantially cover the top surface of cover member **55**, the latter being provided with an upstanding integrally formed positioning lug **55f** for cooperation with the aforementioned rivets **57** in preventing lateral displacement of bus **58**. Formed integrally with bus **58** is a depending portion **58a** extending downwardly at substantially a right angle thereto through a corresponding opening in cover member **55** and into recess **45d** of base **45** (Figs. 1 and 9). Said portion **58a** is provided at its lower end with a preferably circular contact surface **58b** thus forming a stationary contact for cooperation with one of the contact surfaces **48a** on bridging contactor **48** as hereinbefore described (Fig. 7).

Rigidly attached to bus **58** as by means of a screw **59** is a fuse clamp **60**, cover member **55** being suitably recessed as at **55h** to provide clearance for the head of screw **59** (Fig. 9). Said fuse clamp **60** is illustrated as being of the knife blade type disclosed in the patent to Millermaster No. 2,213,284, though it is to be understood that any other suitable type of fuse clamp might be employed.

Each of the ends of bus **58** are upturned throughout the width thereof as at **58c** to prevent relative rotary movement of fuse clamp **60** and bus **58**, the upturned end **58d** being provided to perform that function should it be found desirable to position fuse clamp **60** adjacent thereto to accommodate a different size fuse.

As will be apparent from the foregoing description, the inter-relation of base **45**, cover member **55** and plunger **33** provides two substantially closed chambers as indicated by recesses **45c** and **45d** respectively, each containing a stationary contact **49d** and **58b** respectively to be bridged by bridging contactor **48** carried by plunger **33** as hereinbefore described. Each of the aforementioned contact chambers is further provided with an L-shaped metal member **61a**, **61b** respectively (Figs. 7 and 9) to serve as a blowout or means to aid extinguishing of any arc which may be developed on opening or closure of the contacts. Said blowouts are each adapted to abut the respective side walls of recesses **45c**, **45d**, respectively, and each are rigidly attached to the bottom wall of the respective recess as by means of rivets **62a**, **62b**, the bottom surface of base **45** being suitably recessed as at **63a**, **63b**, to provide access to said rivets, said recesses being subsequently filled with wax or other suitable insulating material as shown at **64a**, **64b** (Fig. 9). Base **45** is also provided with other irregularly shaped recesses extending upwardly from the bottom surface thereof, as for example at **45k** and **45l** (Figs. 9 and 10), the purpose of which is primarily to reduce the weight of base **45**.

The operation of the switch units **36** is as follows: Assuming the parts to be in the closed position as shown in Fig. 7, electrical conductivity is afforded from terminal lug **50** and conducting strip **49** to stationary contact portion **49d**, thence through bridging contactor **48** to stationary con-

tact 58b, bus 58 to fuse clamp 60. In this position springs 53 hold bridging contactor 48 firmly against its cooperating stationary contact while spring 54 urges plunger 33 to its extreme right position. As hereinbefore described rotary movement of cam member 30 results in reciprocal linear movement of plunger 33; that is, to the left from the assumed position, against the bias afforded by spring 54. Movement of plunger 33 to the left, after a certain amount of lost motion afforded by the play in the connection between bridging contactor 48 and plunger 33 due to the width of notch 33b, results in movement of bridging contactor 48 to the left against the bias of springs 53, thus breaking the circuit at two points i. e., where contact surfaces 48a contact stationary surfaces 49d and 58b respectively. Closure of the switch is accomplished in substantially the reverse manner, rotary movement of cam member 30 permitting plunger 33 to slide to the right in response to the bias afforded by springs 53 and 54, while contactor 48, due to the bias of springs 53, bridges the aforementioned stationary contacts, thus completing the circuit.

As previously mentioned, the construction of each of the switch units 36 is identical except as to the reciprocating plunger, which in the unit adjacent to the snap action mechanism takes the form of plunger 33 to cooperate with cam member 30. In each of the other switch units the plunger takes the form best illustrated in Fig. 1 at 133. Plunger 133 is similar in construction to plunger 33 except that one end thereof instead of being provided with a roller is reduced in size as at 133a to abut the beveled end of the plunger of the next adjacent switch unit, this relationship being best shown in Fig. 7. Said reduced portion 133a is provided with a plurality of radially extending fins 133b, the purpose of which is to increase the over-surface electrical clearance between live parts of adjacent switch units. It will be apparent from the foregoing that the operation of each of the switch units is similar, and further that the switch units are operated jointly by the snap action mechanism hereinbefore described by virtue of the interconnection of the individual switch units through the alined and substantially abutting end to end relation of their respective plungers. It will also be apparent that since each of the switch units is individually removably attached to mounting plate 38 and may be added or removed without disturbance of the other units, a high degree of flexibility in the number of poles provided in the switch is afforded. Moreover, it will be observed from the aforedescribed structure that the bridging contactors 48 and/or their associated plungers may, upon removal of the cover member 55 of the particular switch unit, be removed and/or replaced without disturbing adjacent switch units, the end to end abutting relationship of the respective plungers and the aforedescribed removable attachment of such bridging contactor with its associated plunger permitting removal of such contactors and/or such plungers while nevertheless rendering the aforedescribed snap action mechanism common to all of the switch units utilized.

As hereinbefore indicated, each of the switch units 36 has associated therewith a complementary fuse clamp assembly designated generally by the reference numeral 37. Said assembly includes an open bottom insulating shell or base 65 (Fig. 9) of the contour best illustrated in plan view in Fig. 1. Said base 65 has at opposite ends thereof a pair of integrally formed extensions 65a, 65b extending upwardly a substantial distance from the bottom plane thereof, said extensions each having a countersunk opening therein for accommodating screws 39 for removable attachment of the assembly to mounting plate 38.

Adapted to overlie base 65 and rigidly attached to the upper surface thereof as by means of screws 66, is a bus or conducting member 67 similar to conducting member 58 on cover member 55 of switch unit 36. Said bus member 67 is a flat metal member of substantially rectangular contour as best shown in Fig. 1. Said bus member 67 has a portion 67a at one end thereof serving as the base for a terminal lug 50a which is similar to the terminal lug shown on the switch units 36 and is likewise provided with a screw 51a.

Said bus member 67 has rigidly attached thereto as by means of a screw 59a a fuse clamp 60a similar to fuse clamp 60 attached to bus member 58. Base 65 has an opening 65c in the upper surface thereof for clearance of said screw 59a. Bus member 67 is also preferably provided with upturned portions 67b, 67c at each end thereof and extending the width of said member 67. Portion 67a in cooperation with an upstanding integrally formed positioning lug 67d is adapted to prevent rotary displacement of fuse clamp 60a when in assembled relation as shown in Fig. 9. Portion 67c at the opposite end of member 67 is provided in the event that it is desired to attach fuse clamp 60a at the opposite ends of member 67 to accommodate a different sized fuse.

As is apparent from the foregoing description, fuse clamps 60 and 60a are adapted to accommodate a fuse 68 (Fig. 1), said fuse providing electrical conductivity from fuse clamp 60 to fuse clamp 60a, thence through conducting member 67 to terminal lug 50a. As will also be apparent, in addition to the flexibility of positioning of the fuse clamps 60, 60a on their respective conducting members to accommodate different sizes of fuses, a still greater flexibility resides in the fact that casing 10 and mounting plate 38 might, if desired, be elongated to permit further spacing of the fuse clamp assemblies 37 from the switch units 36 to accommodate still larger fuses, the arrangement of the fuse 68 above the switch unit 36 nevertheless affording greater compactness, hence saving of space.

I claim:

1. A compact switch comprising in combination, at least one individual switch unit having an enclosed arcing chamber and having a rectilinearly movable contact actuator, operating means for said switch unit separate therefrom and comprising a cam movable transversely of said contact actuator, said actuator being biased into cam following engagement with said cam, and said switch operating means further comprising snap acting means for oscillating said cam to impart lateral rectilinear movements to said contact actuator against its aforementioned bias.

2. A compact switch affording flexibility in number of poles, comprising in combination, individual switch units in number depending upon the number of poles desired in the switch, each individual unit having a rectilinearly movable contact actuator and means for individually biasing said actuators in a given direction, an operating mechanism for said switch units separate therefrom and comprising a cam movable transversely of the contact actuator of one of said units, the contact actuator of said one unit having cam following engagement with said cam under its

aforementioned bias, the other of said individual switch units being arranged in tandem relation to said one unit with their actuators in longitudinal alinement and operatively connected to render said operating mechanism common to all of said individual switch units, said operating mechanism further comprising snap acting means for oscillating said cam to impart lateral rectilinear movements to said contact actuators conjointly against their aforementioned bias.

3. A compact switch affording flexibility in number of poles comprising in combination, individual switch units in number depending upon the number of poles desired in the switch, each individual unit having an enclosed arcing chamber and having a rectilinearly movable contact actuator biased in a given direction, an operating mechanism for said switch units separate therefrom and comprising a floating cam movable transversely of the contact actuator of one of said units, the contact actuator of said one unit having cam following engagement with said cam under its aforementioned bias, the other of said individual units being arranged in tandem relation to said one unit with their actuators in longitudinal alinement in end to end engagement under their aforementioned bias to render said operating mechanism common to all of said switch units, said operating mechanism further comprising a pivoted handle and snap lost motion connections between said handle and said floating cam for movement of the latter in reverse directions selectively as a function of reverse movements of said handle to impart lateral rectilinear movements to said contact actuators conjointly against their aforementioned bias.

4. A compact switch whose size varies directly with the fusing capacity afforded, comprising in combination, at least one individual switch unit having an enclosed arcing chamber and having a rectilinearly movable contact actuator biased in a given direction, fuse holding means carried on the top of said switch unit, a separate complementary fuse holding assembly in alinement with said switch unit and spaced therefrom according to the size of fuse utilized, an operating mechanism for said switch unit separate therefrom and comprising a cam movable transversely of said contact actuator, said contact actuator being biased into cam following engagement with said cam, and said operating mechanism further comprising means for oscillating said cam to impart lateral rectilinear movements to said contact actuator against its aforementioned bias.

5. A compact switch affording flexibility in number of poles and fusing capacity, comprising in combination, individual switch units in number depending upon the number of poles desired in the switch, each individual unit having an enclosed arcing chamber and having a rectilinearly movable contact actuator biased in a given direction, fuse holding means carried on the top of each of said switch units, individual complementary fuse holding assemblies for each of said switch units and variably spaceable therefrom according to the size of fuses utilized, and an operating mechanism for said switch units separate therefrom and comprising a cam movable transversely of the contact actuator of one of said units, the contact actuator of said one unit having a cam following engagement with said cam under its aforementioned bias, the other of said individual switch units being arranged in tandem relation to said one unit with their actuators in longitudinal alinement in end to end engagement under their aforementioned bias to render said operating mechanism common to all of said switch units, said operating mechanism further comprising means for oscillating said cam to impart lateral rectilinear movements to said contact actuators conjointly against their aforementioned bias.

6. A compact switch whose size varies directly with the fusing capacity afforded, comprising in combination, individual switch units in number corresponding to the number of switch poles desired and spaced as closely as their fusing permits, each individual switch unit having an enclosed arcing chamber and having a rectilinearly movable contact actuator biased in a given direction, said actuators being in longitudinal alinement and in end to end engagement under their aforementioned bias, an operating mechanism for said switch units separate therefrom but in engagement with the contact actuator of the end one of said switch units to impart to all of said units conjointly lateral rectilinear movements against their aforementioned bias, fuse holding means carried on top of each of said switch units, and individual complementary fuse holding assemblies for each of said switch units and variably spaceable therefrom according to the size of fuses utilized, said complementary assemblies being in alinement with their respective switch units and spaced from each other as closely as the size of fuses utilized permits, the space required by said switch units and their respective fuse holding assemblies therefore in aggregate corresponding substantially to the space requirements of the switch fusing.

7. A compact switch having an enclosure, comprising in combination, at least one individual switch unit having a rectilinearly movable contact actuator biased in a given direction, fuse holding means carried on top of said unit, a complementary fuse holding assembly for said unit, a switch operating mechanism carried by said enclosure and comprising a cam movable transversely of said contact actuator to impart lateral rectilinear movements to said actuator, the latter under its aforementioned bias having cam following engagement with said cam, and a plate carrying said switch unit and its complementary fuse holding assembly, the latter being spaced from said switch unit according to the size of fuse utilized, and said plate therefore being of dimensions corresponding to the fuse size, said plate also having removable connection with said enclosure to afford joint removal of said switch unit and its complementary fuse holding assembly as a unit leaving said operating mechanism undisturbed.

8. A compact switch having an enclosure, comprising in combination, individual switch units in number corresponding to the number of switch poles desired, each individual switch unit having an enclosed arcing chamber and having a rectilinearly movable contact actuator biased in a given direction, fuse holding means carried on top of each of said switch units, an individual complementary fuse holding assembly for each of said switch units, a plate upon which said switch units and their respective complementary fuse assemblies are carried, said switch units being spaced on said plate as closely as their fusing permits with their actuators in longitudinal alinement and in end to end engagement under their aforementioned bias, said complementary fuse holding assemblies being in alinement with their respective switch units and spaced there-

from on said plate according to the size of fusing utilized, the dimensions of said plate therefore corresponding to the size of the switch fusing, and an operating mechanism carried by said enclosure in engagement with the end one of said switch units to impart lateral rectilinear movements to all of said units conjointly against their aforementioned bias, said plate having removable connection with said enclosure to afford removal of said switch units and their complementary fuse assemblies as a unit leaving said operating mechanism undisturbed.

9. A compact switch affording flexibility in number of poles comprising in combination, individual switch units in number corresponding to the number of switch poles desired, each individual switch unit having a rectilinearly movable contact actuator biased in a given direction, an operating mechanism for said switch units separate therefrom comprising a floating cam movable transversely of the contact actuator of one of said units, the contact actuator of said one unit having cam following engagement with said cam under its aforementioned bias, the other of said individual switch units being arranged in tandem relation to said one unit with their actuators in longitudinal alinement and closely adjacent end to end to render said operating mechanism common to all, and said individual switch units being individually removable from the switch leaving the other of said units and said operating mechanism undisturbed.

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