March 13, 1951 G. KILMINSTER 2,544,761

ELECTRIC SWITCH GEAR

Filed July 29, 1948 2 Sheets-Sheet 1

FIG. 1.

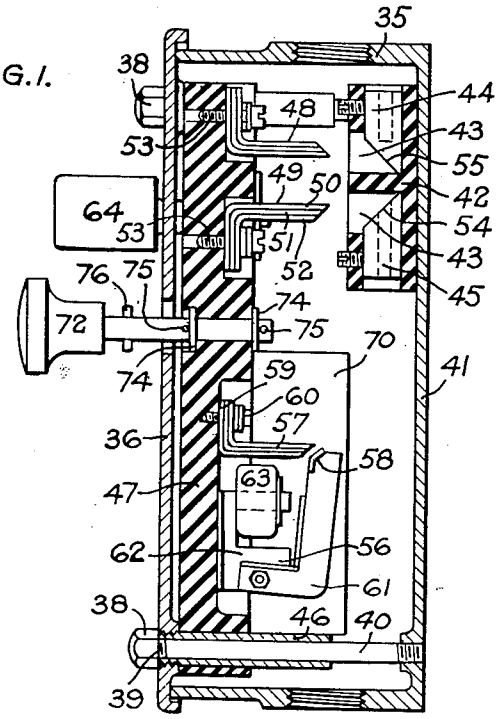

FIG. 2.

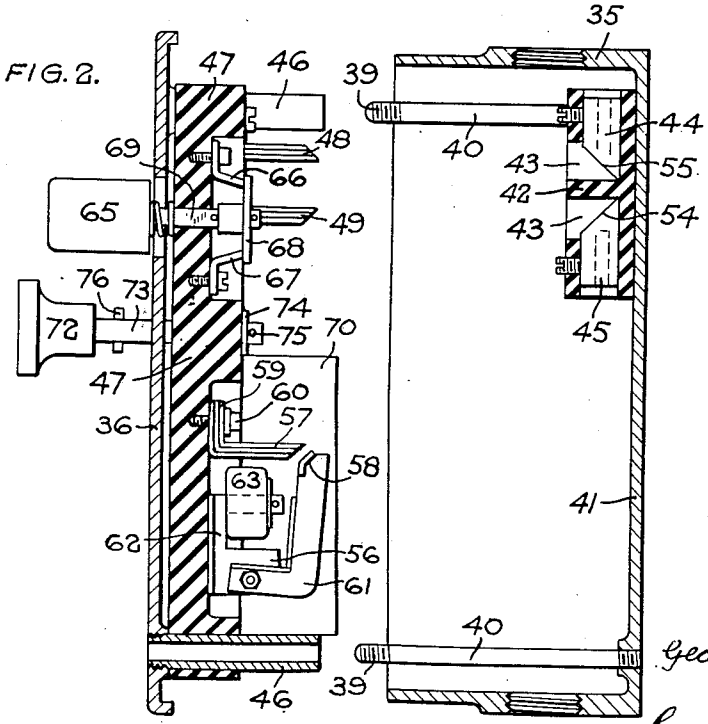

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FIG. 3.

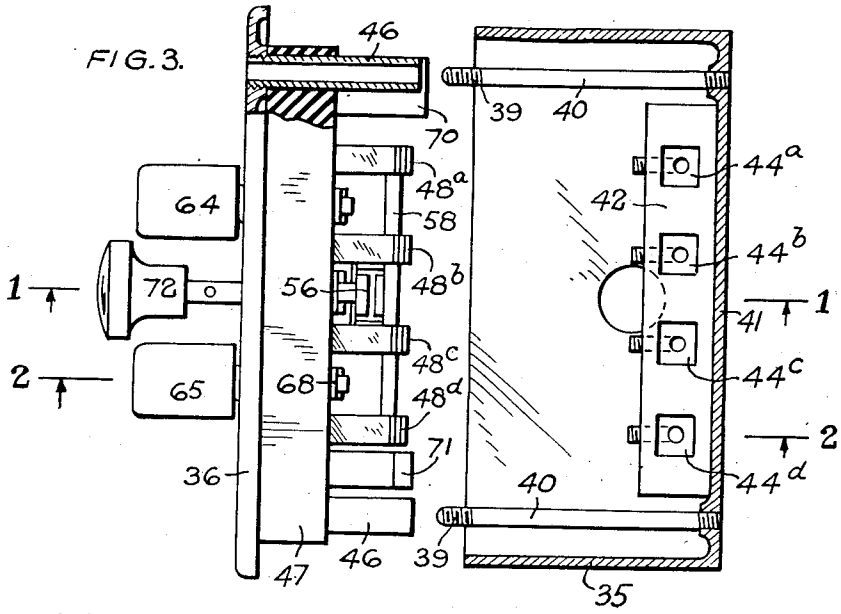
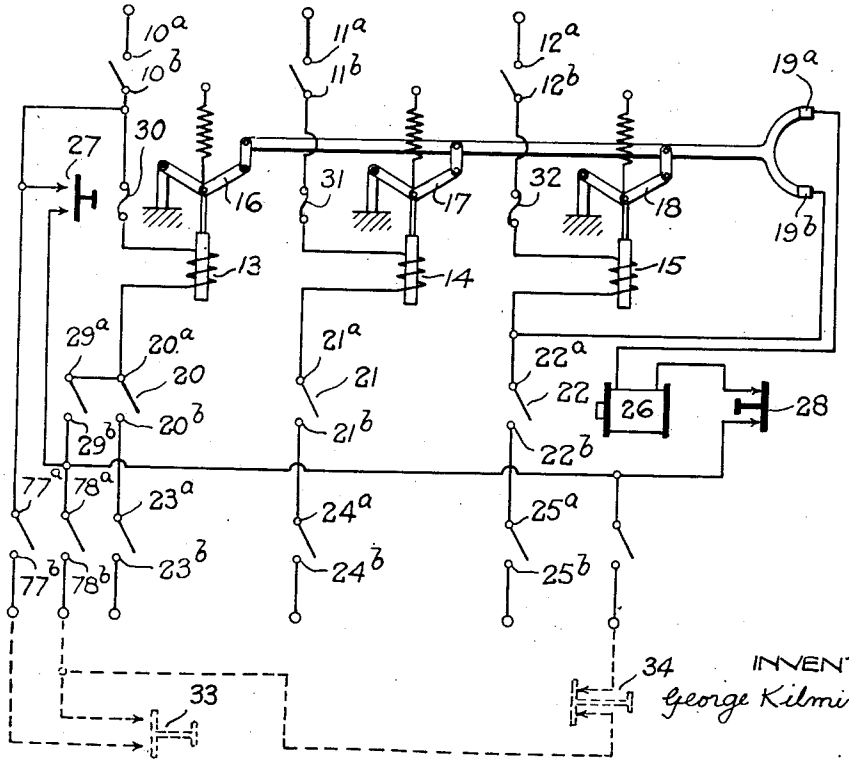


FIG. 4.



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UNITED STATES PATENT OFFICE

2,544,761

ELECTRIC SWITCHGEAR

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10 Claims. (Cl. 175—298)

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This invention relates to electric switch gear and refers to switch gear which is of low-tension type and which includes contactors comprising fixed and movable contacts. Usually the movable contacts are solenoid operated to displace them into the "on" position.

The invention is primarily applicable to switch gear individually associated with a single appliance, which appliance is usually an electric motor, although it may sometimes comprise another form of appliance, such as for example an industrial furnace.

With such devices the arcing which occurs between the contacts of the contactor results in them becoming pitted and worn, so that after an extended period of use they require attention and are liable to fail during actual operation.

As hitherto constructed the contactors and solenoid have all been mounted upon an insulating base, the whole being enclosed within a suitable box-like casing, the base carrying the terminals for both the mains and the appliance, so that in the event of failure of the switch gear it is first necessary to find and then withdraw the fuses in the mains to isolate the switch gear before any repair can be effected, and in the result the appliance may be out of action for an appreciable period.

The primary object of this invention is to provide an improved construction in which this disadvantage is avoided, and in which the contactors and the solenoid are all carried upon a common supporting member removably mounted within the casing, the supporting member carrying contact elements which have sliding engagement with fixed contact elements within the casing to which the mains and other external leads are connected, so that in the event of failure of the contactor assembly the supporting member complete with its contactors and solenoid can be slidden out of the casing as a single unit and replaced immediately by a further similar unit without the necessity of effecting isolation of the entire switch gear from the mains.

One embodiment of the present invention is illustrated in the drawings, wherein:

Figure 1 is a view in side elevation and in section substantially on the line 1—1 of Figure 3 of a low-tension electric switch constructed in accordance with the present invention;

Figure 2 is a view in side elevation and in section along the line 2—2 of Figure 1 of the same switch with the supporting member and removable cover withdrawn from the casing;

Figure 3 is a plan view of the same switch partly in section, also with the supporting member and removable cover withdrawn from the casing; and

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Figure 4 is a circuit diagram showing the electrical connections between the various contacts of the switch.

Referring first of all to Figure 4, which illustrates the circuit of the switch suitable for application to the control of a three phase motor, the circuit comprises isolator contacts seen at 10*a*, 10*b*, 11*a*, 11*b*, 12*a*, 12*b* by means of which the switch is connected to the three phases of the incoming mains; from each of the contacts 10*b*, 11*b* and 12*b*, each phase further includes the actuating windings seen respectively at 13, 14 and 15 for overload devices 16, 17 and 18 which are operative upon a single pair of overload release contacts 19*a* and 19*b*.

From each of the overload actuating windings a connection in each phase is taken to one of the contacts of contactors comprising moving and fixed contacts 20*a* and 20*b*, 21*a* and 21*b*, 22*a* and 22*b*. In each phase a further connection is taken from the other contact of the contactors (as seen in Figure 4) from contacts 20*a* and 21*b* and 22*b* to one contact 23*a*, 24*a* and 25*a* of a further set of isolator contacts, the other contact of each 23*b*, 24*b*, 25*b* is connected to the motor which it is desired to control.

For actuating the contactors 20, 21, 22 a solenoid 26 is provided, the energisation of which is controlled by a normally open push-button switch known as the "on" button 27 and a normally closed push-button switch known as the "off" button 28. These two switches are connected in series with the winding of the solenoid and in series with the overload release contacts 19*a* and 19*b* across two of the phases. An auxiliary pair of contacts 29*a* and 29*b* on the contactor serve to short circuit the normally open "on" button 27 after this has been initially pressed and the solenoid has been energised to close all the contactors.

Fuses 30, 31 and 32 are included in the leads between the incoming isolator contacts from the mains and the overload actuating windings 13, 14 and 15, respectively.

In an alternative arrangement where it is desired to provide for remote operation, a plurality of sets of remote control buttons may be provided in addition to the buttons 27 and 28, and each arranged as indicated by the dotted lines in Figure 4, wherein a single set of such buttons is indicated at 33 and 34, serving as "on" and "off" buttons respectively.

Referring now to Figure 1 of the drawings, in the embodiment shown the switch comprises an outer case 35 conveniently formed of the usual metal casting provided with a removable cover 36 which is secured on to the case by means of nuts 38 screwing on to the threaded end portion, seen at 39, of rods 40 secured at their other ends in tapped holes in the rear wall 41 of the casing, which wall is opposed to the removable cover.

The wall 41 carries an insulating mounting member 42 which has a plurality of guideways or passages, as seen at 43, communicating with cavities housing fixed contact elements 44 and 45.

One set of these fixed contacts, for example those seen at 44, are connected to the incoming mains and the other set 45 are connected to the circuit of the motor which it is required to control.

Secured in tapped holes in the removable cover 36 are tubular guide members 46. Conveniently the case and the cover are of substantially rectangular form and one tubular guide member is provided near each of the corners of the cover.

Carried upon the tubular guide members 46 is a supporting member 47 preferably formed of a plate or sheet of insulating material such as that known by the name Bakelite, in the peripheral margin of which suitable openings are provided to receive the tubular guide members 46 so that the supporting member 47 can execute sliding movement towards and away from the removable cover along the length of the guide members.

As seen in the drawings the upper part of the supporting member 47 carries a series of further contact elements 48 shown in Figure 3 at 48*a*, 48*b*, 48*c* and 48*d* respectively, a corresponding number of contact elements 49 being provided but not being visible in Figure 3 by reason of being positioned beneath corresponding contacts 48.

Each of these further contact elements comprise a prong extending rearwardly towards the fixed contact elements 44 and 45. Each prong is formed of a plurality of superposed substantially parallel resilient conducting metal strips 50, 51, 52 which are of L formation, one arm of the L forming the actual prong and the other arm being utilised to form an attachment portion by means of which the contact is secured to the supporting member by screws such as those seen at 53.

Successively positioned strips have prong portions of progressively reduced length, that is to say, the prong portion of the strip 51 is shorter than that of the strip 50 and likewise the strip 52 is shorter than that of the strip 51 so that the end face of each prong lies inclined at an angle to the direction in which the prong extends which is also the direction in which it is moved by movement of the supporting member 47 on the tubular guides 46.

The fixed contact elements 44 and 45 correspond in number to the prongs 48 and 49 and are each provided with a contact face seen at 54 and 55 which is substantially parallel to the associated end faces of the prongs.

Also carried on the supporting member 47 preferably positioned centrally thereon on the rearwardly directed face of the supporting member is a solenoid operated contactor indicated generally at 56. The contactor includes a series of fixed contacts and in each pair of contacts in the series there is a fixed contactor member such as that seen at 57 and a moving contactor member such as that seen at 58.

The fixed contactor member is of the same constructional form as the fixed contact elements 48*a*, 48*b*, 48*c* and 48*d* carried by the supporting member in that it consists of a plurality of superposed substantially parallel resilient conducting metal strips having rearwardly extending prong portions and attachment portions 59 for attachment to the supporting member by screws 60.

The moving contactor members 58 are of V shape when viewed in side elevation, one arm of each V shaped moving contactor extending at an

inclination to the length of the prong portion of the fixed contactors and lying in a plane substantially parallel to the inclined end face of the fixed contactors so as to make contact with the end face thereof.

In making such contact the moving contactor has a wiping action across the end face of the fixed contactor and at the same time displaces the component metal strips of the latter apart relatively whereby there is provided an air space between the strips to facilitate the cooling thereof.

In other respects the contactor assembly is of conventional construction and as will be seen from the drawings, includes an L shaped pivoted arm 61 carrying the moving contactor members and a stationary U shaped armature 62 carrying the solenoid winding 63, the armature and the L shaped arm both being constructed of magnetic material in laminated form.

Above the contactor assembly and positioned intermediate the contactor elements 48 are two push-button switches 64 and 65 which are indicated in the circuit diagram shown in Figure 4 by the reference numerals 27 and 28.

The push-button switch 65 seen in side elevation in Figure 2 comprises a pair of spaced fixed contacts 66 and 67 secured by screws to the supporting member 47 and a spring loaded bridging piece 68 which is operable by means of the push-button which is mounted on a stem 69 projecting through the supporting member 47 and the removable cover 36 and is thus accessible from the outside of the casing. The push-button switch 64 is of similar construction but the fixed spaced contacts corresponding to those 66 and 67 of the switch 65 are suitably modified, for example, their ends are bent over inwardly towards each other so that these end portions are of U shape, contact between the bridging piece and these ends being between the rearward face of the bridging piece instead of the forward face as seen in the case of switch 65 and the bent over end face of the strips. In this way the loading spring in the case of the switch 64 results in the switch being normally open instead of normally closed as in the case of switch 65.

Also carried upon the supporting member 47 and to one side of the contactor assembly is an overload device housed in an associated outer casing 70 and on the other side of the contactor assembly and also carried upon the supporting member 47 are a set of fuses housed in an associated casing 71. Preferably the overload device is of the type described in my co-pending application of even date.

As seen in Figure 1 the supporting member 47, the removable cover 36 and the tubular guide members 46 by means of which the supporting member 47 is carried, are shown assembled into the outer case 35 and the supporting member 47 is shown in that position in which the contact elements 48 and 49 are withdrawn out of contact with their respectively fixed contact elements 44 and 45.

For moving the supporting member along the tubular guide members 46 means are provided for sliding as a single unit the said supporting member complete with the contactors, overloads and fuses and the contact elements 48 and 49 towards the fixed contact elements 44 and 45 so that contact is established between the end faces of the contact elements 48 and 49 and the respectively associated contact faces 55 and 54 of the fixed contact elements 44 and 45.

As shown in the drawings this means takes the form of a knob 72 mounted on the outer portion of a stem 73 secured to the supporting member 47 by means of spaced washers 74 retained by associated cross pins 75, the stem projecting through an opening in the removable cover 36.

For retaining the supporting member 47 in the rearmost position with the contact elements 48 and 49 in contact with their respective fixed contact elements 44 and 45 suitable locking means are provided associated with the operating knob 72 comprising a cross pin 76 which in one position of rotation of the knob and stem can pass through a suitably shaped portion of the opening in the removable cover and upon turning the knob 72 to another position of rotation engage the inner face of the removable cover to retain the stem and the supporting member against outward movement.

For the sake of clarity in Figures 1, 2 and 3 the connecting leads corresponding to the connections shown in the circuit diagram in Figure 4 have been omitted but with the following explanation the functions of the various parts shown in Figures 1, 2 and 3 will readily be understood. The contact elements 48 carried on the supporting member correspond to contacts 10*b*, 11*b* and 12*b* on the circuit diagram and the fixed contacts 44 in Figure 1 are represented in the circuit diagram by contacts 10*a*, 11*a* and 12*a*, these being connected to the mains supply in the particular application described.

The contact elements 49 seen in Figure 2 are shown in the circuit diagram as contacts 23*a*, 24*a* and 25*a* and fixed contacts 45 as contacts 23*b*, 24*b* and 25*b*, these latter being connected to the motor which it is desired to control. As seen in Figure 3 there are four contacts in series 48*a*, 48*b*, 48*c* and 48*d* and four in the corresponding series 49*a*, 49*b*, 49*c* and 49*d* which is not seen in the drawings. The fourth contact in each of these series for example 48*d* and 49*d* corresponds with contacts 77*a* and 78*a* on the circuit diagram used when control by remote push-buttons is required and there are corresponding fixed contacts as for example that seen at 44*d* which are shown in the circuit diagram at 77*b* and 78*b*.

The moving contacts of the contactor indicated at 58 in Figure 2 are shown in the circuit diagram at 29*a*, 20*a*, 21*a*, and 22*a*, these being connected to the overload actuating windings by means of flexible conductors and the fixed contacts 57 of the contactor are shown at 29*b*, 20*b*, 21*b* and 22*b* in the circuit diagram.

The overload release contacts 19*a* and 19*b* seen in the circuit diagram are not shown in Figures 1, 2 and 3 since they are enclosed within the casing 70 but it will be apparent from the circuit diagram that an overload carried in any one of the three phases serves to open these contacts and de-energise the operating solenoid of the contactor.

In the event of failure of the switch occurring during use the knob 72 is first rotated to a suitable position and pulled out so as to withdraw the slidable isolating contacts 48 and 49 from their respectively associated fixed contacts 44 and 45, after which the nuts 38 are removed and the cover 36 complete with the supporting member and associated parts of the switch is withdrawn as a single unit and can be replaced immediately by a further similar unit whilst the original withdrawn assembly is being repaired.

Since as soon as the contacts of the switch are withdrawn as above described they are necessarily completely isolated from the electrical supply there is no necessity to remove any isolating fuse external to the switch before repair can be effected, all that is required being to operate the isolator of the switch by moving the knob 72 and remove the cover 36 as described.

Thus in event of failure of the switch, assuming that a spare unit is available, the motor or other appliance is out of use for the minimum period of time.

What I claim then is:

1. In a low tension electric switch having an outer case with fixed contact elements carried by an insulating mounting member therein, a removable and replaceable assembly comprising a cover for the outer case, a supporting member mounted slidably within said outer case, said supporting member carrying fixed and moving contactor members and further contact elements connected electrically with said contactor members, said further contact element being adapted to engage with said fixed contact elements, and means accessible externally of said cover for sliding said supporting member towards and away from the cover, respectively to effect isolation and establish contact between said fixed contact elements and said further contact elements.

2. In a low tension electric switch having an outer case with fixed contact elements carried by an insulating mounting member therein, a removable and replaceable assembly comprising a cover for the outer case, guide means on said cover projecting inwardly in relation to said outer case, a supporting member mounted slidably on said guide means, said supporting member carrying fixed and moving contactor members and further contact elements connected electrically with said contactor members, said further contact elements being adapted to engage with said fixed contact elements and means accessible externally of said cover for sliding, said supporting member towards and away from the cover respectively to effect isolation and establish contact between said fixed contact elements and said further contact elements.

3. In a low tension electric switch having an outer case with fixed contact elements carried by an insulating mounting member therein, a removable and replaceable assembly comprising a cover for the outer case, guide means in the form of a plurality of tubes projecting inwardly in relation to said outer case from the edge portions of said cover and in register with outwardly projecting support rods in said outer case, a supporting member mounted slidably on said tubes, said supporting member carrying fixed and moving contactor members and further contact elements connected electrically with said contactor members, said further contact elements being adapted to engage with said fixed contact elements and means accessible externally of said cover for sliding said supporting member towards and away from the cover, respectively to effect isolation and establish contact between said fixed contact elements and said further contact elements.

4. In a low tension electric switch having an outer case with fixed contact elements carried by an insulating mounting member therein, a removable and replaceable assembly comprising a cover for the outer case, a supporting member mounted slidably within said outer case, and manually operable means accessible externally of said cover movable between a visible isolating

position and a visible operative position for sliding said supporting member towards and away from the cover, respectively to effect isolation and establish contact between said fixed contact elements and said further contact elements, whereby an operator is informed of the condition of the switch.

5. In a low tension electric switch having an outer case with fixed contact elements carried by an insulating mounting member therein, a removable and replaceable assembly comprising a cover for the outer case, guide means in the form of a plurality of tubes projecting inwardly in relation to said outer case from the edge portions of said cover and in register with outwardly projecting support rods in said outer case, a supporting member mounted slidably on said tubes, said supporting member carrying fixed and moving contactor members and further contact elements connected electrically with said contactor members, said further contact elements being adapted to engage with said fixed contact elements and a stem fixed to said supporting member substantially centrally in relation to said tubes and projecting outwardly through an opening in said cover manual handling means on said stem portion positioned externally of said cover whereby endwise movement can be imparted to said stem for sliding said supporting member towards and away from the cover, respectively to effect isolation and establish contact between said fixed contact elements and said further contact elements.

6. In a low tension electric switch having an outer case with fixed contact elements carried by an insulating mounting member therein, a removable and replaceable assembly comprising a cover for the outer case, guide means in the form of a plurality of tubes projecting inwardly in relation to said outer case from the edge portions of said cover and in register with outwardly projecting support rods in said outer case, a supporting member mounted slidably on said tubes, said supporting member carrying fixed and moving contactor members and further contact elements connected electrically with said contactor members, means on said cover for locating it in relation to said outer case independently of said guide tubes and means accessible externally of said cover for sliding said supporting member towards and away from the cover, respectively to effect isolation and establish contact between said fixed contact elements and said further contact elements.

7. In a low tension electric switch having an outer case with fixed contact elements carried by an insulating mounting member therein, a removable and replaceable assembly comprising a cover for the outer case, a supporting member mounted slidably within said outer case and having relatively to the depth thereof a relatively short travel, said supporting member carrying fixed and moving contactor members and further contact elements connected electrically with said contactor members, said further contact elements being adapted to engage with said fixed contact elements and means accessible externally of said cover for sliding said supporting member towards and away from the cover, respectively to effect isolation and establish contact between said fixed contact elements and said further contact elements.

8. In a low tension electric switch having a removable and replaceable assembly carrying fixed and moving contactor elements and further contact elements in the form of prongs, means for establishing connection between said prongs and conductors of an external circuit in which the switch is required to operate, comprising fixed contact elements in said switch supported by insulating supporting means, having cavities for housing said fixed contact elements and guideways communicating with said cavities and adapted to receive said prongs, whereby on removal of said assembly live fixed contact elements are not exposed to accidental handling.

9. In a low tension electric switch having an outer case with fixed contact elements carried by an insulating mounting member therein, and a removable and replaceable assembly carrying fixed and moving contactor members and further contact elements connected electrically with said contactor members, said further contact elements are in the form of prongs formed each of a plurality of superposed parallel resilient conducting metal strips, successively positioned strips having a prong portion of progressively reduced length to provide an end face for each prong which lies inclined at an angle to the direction in which the prong extends, for co-operation with said fixed contact elements in said outer case which have contact faces which are substantially parallel to respectively associated end faces of said contact elements.

10. In a low tension electric switch having an outer case with fixed contact elements carried by an insulating mounting member therein, a removable and replaceable assembly comprising a cover for the outer case, guide means on said cover projecting inwardly in relation to said outer case, a supporting member mounted slidably on said guide means, said supporting member carrying fixed and moving contactor members and further contact elements connected electrically with said contactor members, said further contact elements, being adapted to engage with said fixed contact elements a stem fixed to said supporting member and projecting outwardly through an opening in said cover, manual handling means on said stem positioned externally of said cover whereby endwise movement can be imparted to said stem for sliding said supporting member towards and away from the cover respectively to effect isolation and establish contact between said fixed contact elements and said further contact elements, and, a retaining member on said stem co-acting with said cover to latch the supporting member in the position in which the fixed and further contact elements are respectively engaged with each other.

GEORGE KILMINSTER.

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