Aug. 23, 1960 K. W. SWAIN 2,950,370

CIRCUIT INTERRUPTING BUILDING BLOCKS

Filed Dec. 10, 1956 2 Sheets-Sheet 1

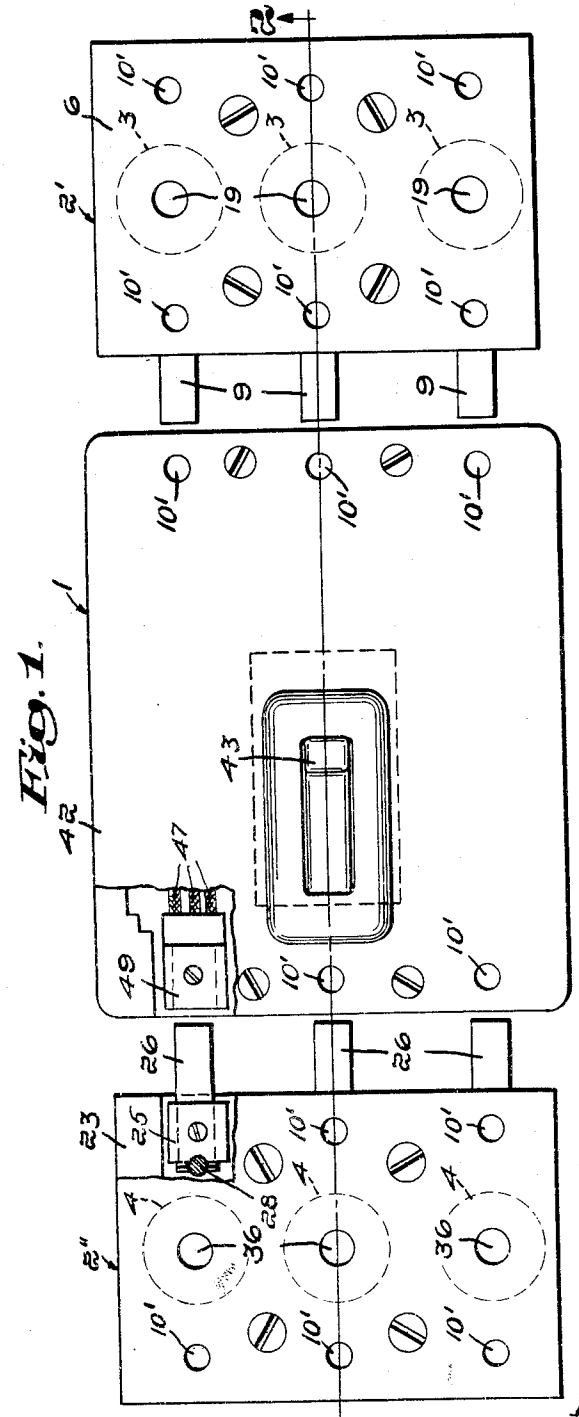


Fig. 1.

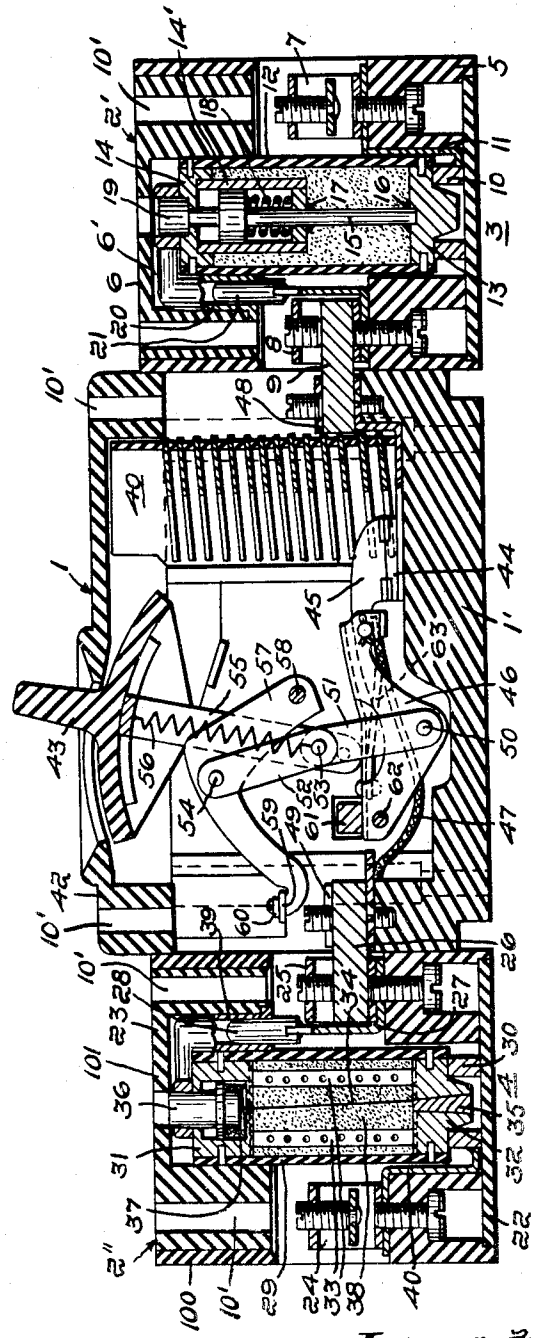
Inventor:
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Fig. 2.



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CIRCUIT INTERRUPTING BUILDING BLOCKS

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Filed Dec. 10, 1956, Ser. No. 627,371

10 Claims. (Cl. 200—114)

This invention has reference to the control of power circuits, and more particularly to the control of low-voltage circuits carrying currents of less than 1000 amps., e.g. currents in the range from 25 amps. to 800 amps.

In many instances it has been found practical to protect power circuits having a circuit voltage up to 600 volts and carrying currents of less than 1000 amps. by so-called molded case circuit breakers. Such circuit breakers comprise a tumbler-operated over-center toggle switch and excess current responsive control means (tripping devices) therefor. Since available short-circuit currents are rapidly increasing with increasing power concentrations, and since the interrupting capacity of molded case circuit breakers is relatively limited, it became necessary to apply current-limiting fuses for back-up protection of molded case circuit breakers. This increases considerably the cost involved in protecting relatively small feeder and branch circuits.

To avoid the relatively high cost of molded case circuit breakers backed up by current-limiting fuses, some installations are being provided only with manually operable switching devices rather than automatically operable circuit breakers, and with current-limiting back-up fuses for back-up protection of the switching devices.

It is one object of the invention to provide protective arrangements comprising manually operable switching devices and fusible protective devices which arrangements are adapted to be readily manufactured largely from pre-existing parts, i.e. from parts normally used in manufacturing molded case circuit breakers and back-up fuses therefor.

Another object of the invention is to provide protective arrangements comprising manually operable switching devices and fusible protective devices which arrangements are considerably more compact than prior art arrangements comprising such switching devices and such protective devices of comparable ratings.

Another object of the invention is to provide composite arrangements comprising switching devices and fusible protective devices which arrangements are adapted to be readily assembled in the field by combining various sub-units having different operational characteristics.

Another object of the invention is to provide composite switching and protective arrangements adapted to be readily assembled in the field from a few basic parts in building-block-like fashion.

A further object of the invention is to provide switching and protective arrangements which lend themselves well to protection against short-circuit currents and to protection of cables against protracted overloads.

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

For a more complete understanding of the invention reference may be had to the following detailed description thereof taken in connection with the accompanying drawings wherein

Fig. 1 is a top plan view of an arrangement embodying

the invention in disconnected position of its constituent parts, and

Fig. 2 is a section along 2—2 of Fig. 1 showing the constituent parts of the arrangement in connected positions.

Referring now to the drawings, numeral 1 has been applied to indicate a switch unit. Switch unit 1 comprises a base 1' of molded insulating material. A tumbler-operated over-center toggle switch to be described below in detail is mounted on base 1'. This switch is of the same type as generally used in molded case circuit breakers, and comprises a toggle mechanism adapted to effect manual closing and manual opening of an electric circuit by snap action closing and snap action opening of cooperating pairs of contacts. Base 1' is proportioned to support the aforementioned switch only, i.e. without excess current responsive means thereon. In other words, unit 1 is a molded case circuit breaker having a molded base of considerably reduced size, stripped from all automatic tripping means so as to form a manually operable switch. Reference characters 2' and 2'' have been applied to indicate two other units of which the former is adapted for protection against protracted overloads, and the latter for protection against short-circuit currents or major fault currents. Unit 2' comprises a plurality of fusible protective devices, one for each phase of a polyphase circuit. Fig. 2 shows but one of the three poles of a switching device and one of the three poles of the outer units 2' and 2''. The other poles of the outer units 2' and 2'' are identical to the poles shown in Fig. 2. Reference numeral 3 has been applied to generally indicate a fusible protective device designed to preclude damage to the insulation of cables by protracted overloads. The principle underlying the operation of device 3 is set forth in detail in United States Patent 2,645,690 to William S. Edsall et al., Thermal Protector for Conductor Insulation, issued July 14, 1953, and reference may be had to that patent for additional information regarding the theory underlying fusible protective devices 3. Reference numeral 4 has been applied to indicate one of three current limiting fuses forming an integral part of unit 2''. Each of these three current-limiting fuses 4 is adapted to be inserted into one phase of a polyphase circuit, of which switching and control means of one single phase have been shown in Fig. 2.

Protective devices 3 are mounted on a base 5 of molded insulating material closed by a cover 6. Base 5 supports the outer terminals or cable connectors 7, and the inner terminals or cable connectors 8. Each cable connector 7, 8 is made up by a short length of copper tubing, preferably square in cross-section, and each cable connector 7, 8 comprises a set screw projecting transversely across said length of copper tubing, Such cable connectors are generally used in the art, and particularly in molded case circuit breakers, and therefore need not to be described more in detail. In the structure embodying this invention the aforementioned cable connectors are applied in a novel way, i.e. as disconnect switches. To this end a square copper mandrel 9 is inserted into each of the inner cable connectors 8 on base 5. Each of the mandrels or rods 9 is also inserted into a cable connector or terminal 48 arranged on one side of base 1' in coaxial relation to one of the cable connectors 8. The connectors 48 on base 1' are identical to the connectors may be used as cable connector rather than as disconnect 8 on base 5. Each connector 48 and each connector 8 switch upon removal of mandrel 9 therefrom. Mandrels 9 are of relatively considerable mechanical strength and rigidity. Upon insertion of mandrels 9 into connectors 8 and 48 bases 1' and 5 are firmly tied together, thus forming in effect an integral or unitary base, or structural

unit. In a similar fashion base or socket 22 of unit 2'' is provided with cable connectors 24 and 25 identical to cable connectors 7 and 8. Cable connectors 25 are provided with square mandrels 26 projecting into cable connectors 49 on base 1', forming a disconnect switch for units 2'' and 1 and integrating both units 2'' and 1 into a single structural unit or composite unitary base. It will be noted that all cable connectors 7, 8; 48, 49 and 24, 25 are arranged on the same level, which is a prerequisite for readily converting the aforementioned cable connectors into disconnect switches by the mere addition of mandrels 9 and 26, respectively. Reference numeral 10 has been applied to indicate an annular base contact on base 5 of unit 2', into which base contact 13 in the shape of a truncated cone projects. Base contact 13 forms an integral part of fusible protective device 3 which comprises a tubular casing or housing 12 of insulating material arranged at right angles to the general plane of base 5, i.e. at right angles to the bottom surface thereof. The lower end of casing 12 is closed by the aforementioned contact 13, and its upper end is closed by a terminal plug 14. Piston rod 15 is biased by spring 18 in upward direction but normally restrained by two solder joints 16 and 17. Solder joint 16 conductively connects piston rod 15 to base contact 13, and solder joint 17 conductively connects piston rod 15 to a casing 14' for spring 18 forming an integral part of terminal element or plug 14. The upper end of piston rod 15 is provided with a colored indicator button 19, normally recessed in cover 6 of unit 2'. Upon softening or fusion of solder joints 16 and 17 piston rod 15 is free to be moved upwardly under the bias of spring 18, thus interrupting the circuit previously closed by protective device 3. Indicator button 19 never moves beyond the level of cover 6. This precludes manual reclosing of the circuit by tampering with button 19. Tampering with button 19, i.e. exerting pressure upon it against the bias of spring 18 would preclude proper operation of device 3. The recessed arrangement of button 19 precludes such a misuse thereof. Each terminal 8 is connected to an upstanding male contact 21 adapted to cooperatively engage a female contact 20. The latter forms an integral part of terminal element 14, i.e. it is permanently attached thereto. Each protective device 3 or casing 12 thereof is arranged in a recess 6' of cover 6, and fixedly held therein by abutment means (not fully shown) engaging female contacts 20. As a result, the protective devices 3 in all the poles of unit 2' can be removed jointly from base 5 merely by lifting cover 6 thereof. The circuit in each pole of unit 2' is completed by a connecting strap 11 of metal between annular base contact 10 and cable connector 7.

The circuit through one pole of unit 2' is as follows: cable connector 7, strap 11, base contact 10, conical plug contact 13, solder joint 16, piston rod 15, solder joint 17, spring casing 14', plug contact or terminal element 14, female contact 20, male contact 21, disconnect switch 8, 9.

Protective unit 2'' is substantially the same as protective unit 2', except that either of them is fitted with protective devices 4 and 3, respectively, of a different nature. Unit 2'' is made up of a base 22 of molded insulating material and of a cover 23. Cover 23 may comprise several molded sub-assembly members such as an outer frame member 100 and an inner core member 101, as indicated. In a similar way the cover 6 of unit 2' may be made up of several parts, as indicated. Whether covers 23 and 6 are made up of one or more parts has no bearing upon this invention. Terminal 25 on base 22 receives mandrel 26 and is in physical contact with metal strap 27 supporting male contact or contact pin 28. Male contact 28 engages cooperatively the female contact 39 which forms an integral part of current-limiting fuse 4. The current-limiting fuse 4 in each pole of unit 2'' comprises a casing 29 of insulating material, preferably a synthetic-resin-glass-cloth laminate, arranged at right angles to the general plane of base 22, and more particularly to the plane of the bottom surface of base 22. The arrangement of protective devices 3 and 4 in the positions shown, i.e. with the casings thereof at right angles to the general planes of bases 5 and 22, respectively, is conducive to great compactness of the aggregate unit 2', 1, 2'' because this arrangement of parts results in units 2' and 2'' which are relatively short, and whose height is substantially equal to the height of unit 1. This, in turn, results in the best economy of the total space required for the composite structure 2', 1, 2''. Casing 29 is closed by plug type terminal members 31 and 32 of which the latter is in the shape of a truncated cone, engaging annular base contact 30 supported by base 22. Multi-perforated ribbon type fuse links preferably made of silver conductively interconnect terminal members 31 and 32. Terminal member 31 is provided with a recess accommodating an indicator button 36 biased upwardly by a helical spring 37, but normally held in position by a restraining wire 34. The upper end of restraining wire 34 is fixedly attached to indicator button 36, whereas the lower end thereof is threaded through a hole in terminal element 32 into which a wedge 35 is driven to hold restraining wire 34 firmly in taut position. Fuse links 33 and the restraining wire 34 are embedded in a pulverulent arc-quenching filler 38, preferably chemically pure quartz sand. Metal strip 40 conductively connects annular base contact 30 to cable connector 24.

The circuit through one pole of unit 2'' is as follows: cable connector 24, strip 40, annular base contact 30, terminal element 32, fuse links 33, terminal element 31, female contact 39, male contact 28, metal strap 27, clamp 25, mandrel 26.

It will be noted that the space-saving arrangement of protective devices 3 and 4 calls for such an arrangement of contacts 20, 21 and 10, 13 that the axes thereof are at right angles to the general plane of base 5 and for such an arrangement of contacts 28, 39 and of contacts 30, 32 that the axes thereof are at right angles to the general plane of base 22.

Each pole of switch unit 1 comprises an arc chute made up of a stack of spaced plates generally indicated by reference character 40. Unit 1 may be without cover or, as an alternative, its cover 42 may be made of a clear plastic to readily enable checking of the position the switch is in. Cover 42 is provided with a slot through which one end of the operating handle 43 or tumbler projects. Each pole of switch unit 1 comprises a fixed switch contact 44 conductively connected to clamp 48 and a movable contact 45 adapted to be operated by handle 43. Movable contact 45 is mounted on a contact support 46 and connected by a flexible conductor or braid 47 to disconnect contact clamp 49. Toggle links 51, 52 form a toggle the lower end of which is pinned at 50 to contact support 46. Pin 53 joins toggle links 51, 52 whereas the upper end of toggle 51, 52 is pinned at 54 to a latching lever 57. Latching lever 57 is a bell-crank shaped lever pivotally supported at the fixed fulcrum 58. The left end of bell-crank shaped lever 57—as seen in Fig. 2—is provided with a latch surface 59 which engages the fixed latch bridge 60. Operating lever 55 is pivotally supported at the lower end thereof by base 1' and forms an integral part of handle 43. Reference numeral 56 indicates an overcenter spring of which one end is secured to pin 53, whereas the other end thereof is attached to handle 43. Contact support 46 is pivoted at 62, and the contact supports 46 of all poles of switch unit 1 are tied together for common movement or gang operation by the cross-bar 61. Each contact support 46 comprises a leaf spring 63 tending to bias movable contacts 45 downwardly, or toward contacts 44.

Operation of handle 43 in counterclockwise direction—as seen in Fig. 2—causes snap action opening of contacts 45 and 44. Return of handle 43 to the position

shown causes snap action closing of contacts **45** and **44**.

Upon occurrence of major faults links **33** fuse rapidly, interrupting the faulted circuit before the fault current can reach its dangerous available peak. Upon fusion of links **33** restraining wire **34** is caused to carry current and fuses instantly. As a result, indicator button **36** is pushed above the level of cover **23**, thus clearly indicating that the circuit has been interrupted on account of a major fault.

Upon occurrence of a protracted overload solder joints **16** and **17** fuse with an appropriate time delay, resulting in separation of current-carrying piston rod **15** from plug type terminal element **13** and interruption of the circuit. This, in turn, causes the upper end of indicator button **19** to be projected upwardly, substantially to the position wherein it lies flush with the upper surface of cover **6**. This gives a clear indication that the circuit has been interrupted as a result of a protracted overload.

Manual closing and opening of the circuit is effected by moving handle **43**. Upon interruption of the circuit by operation of handle **43** cover **6** with protective devices **3**, or cover **23** with protective devices **4**, may safely be removed for the purpose of replacement of devices **3** or **4**.

Unit **2''** may be omitted where short-circuit protection is afforded by some other means as, for instance, by current-limiting fuses placed at another point of the circuit. In a similar way, unit **2'** may be omitted if there is no need of providing overload current protective means. It thus will be apparent that units **1**, **2'** and **2''** form building blocks permitting to readily establish a number of different combinations, depending upon the specific requirements of different installations, or different applications. It is possible to combine units **2'** and **2''** with switches having different frame sizes, and/or interrupting capacity ratings, thus establishing a great variety of combinations with a minimum of elemental building blocks.

In Fig. 1 protective devices **3** and **4** have been indicated by dotted lines. The pole spacing of devices **3** and **4** is the same as the spacing of the three poles of switch unit **1**. Fig. 1 shows also clearly that the width of units **1**, **2'** and **2''** or the width of bases **1'**, **5** and **22** are substantially equal, whereas Fig. 2 shows that units **1**, **2'** and **2''** are arranged in abutting relation. This can be achieved since all set-screws are accessible through appropriate openings or holes **10'** in covers **6**, **42** and **23**.

It will be understood that I have illustrated and described herein a preferred embodiment of my invention, and that various alterations may be made in the details thereof without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. An arrangement for controlling power circuits comprising a first base of molded insulating material, a multipolar tumbler-operated over-center toggle switch supported by said first base, said first base being proportioned to support said switch only without excess current responsive control means thereon, a plurality of cable connectors arranged on opposite sides of said first base for connecting said switch into a polyphase circuit, each of said plurality of cable connectors comprising a substantially tubular clamping member and a set-screw projecting transversely across said clamping member, a second separate base of molded insulating material arranged immediately adjacent to said first base, a plurality of fusible excess current protective devices mounted on said second base, a plurality of cable connectors arranged on opposite sides of said second base for connecting said plurality of protective devices into a polyphase circuit, each of said plurality of cable connectors on said second base comprising a substantially tubular clamping member and a set-screw projecting transversely across said clamping member, said plurality of cable connectors on said second base being arranged on the same level as said plurality of cable connectors on said first base, and conductor means inserted into juxtaposed cable connectors on said first base and on said second base to serially connect each pole of said switch with one of said plurality of protective devices.

2. An arrangement as specified in claim 1 wherein said conductor means are formed by relatively heavy metal bars integrating said second base and said first base into a self-supporting structural unit, and wherein said second base and said first base are each provided with a cover normally precluding access to said metal bars.

3. An arrangement for controlling power circuits comprising a first base of molded insulating material, a multipolar tumbler-operated over-center toggle switch mounted on said first base, said first base being proportioned to support said switch only excluding excess current responsive control means thereon, a plurality of cable connectors arranged on opposite sides of said first base for connecting said switch into a polyphase circuit, each of said plurality of cable connectors comprising a substantially tubular clamping member and a set-screw projecting transversely across said clamping member, a second separate base of molded insulating material arranged immediately adjacent said first base, a plurality of fusible excess current protective devices mounted on said second base, each of said plurality of protective devices comprising a casing arranged at right angles to the general plane of said second base, a plurality of cable connectors arranged on opposite sides of said second base on the same level as said plurality of cable connectors on said first base, each of said plurality of cable connectors on said second base comprising a substantially tubular clamping member and a set-screw projecting transversely across said clamping member, a plurality of pairs of plug-type disconnects arranged with the axes thereof at right angles to the general plane of said second base to connect each of said plurality of protective devices to one pair of said plurality of cable connectors on said second base, and conductor means inserted into juxtaposed cable connectors on said first base and on said second base to serially connect each pole of said switch to one of said plurality of protective devices.

4. An arrangement for controlling power circuits comprising a first base of molded insulating material, a first excess current protective device mounted on said first base, said first protective device comprising a solder joint adapted to carry current and spring means biasing said solder joint to a separated position thereof, a second base of molded insulating material arranged in spaced relation from said first base, a second excess current protective device mounted on said second base, said second protective device comprising a fusible metal ribbon adapted to carry current, a third base of molded insulating material arranged in the space between said first base and said second base, a tumbler-operated over-center toggle switch mounted on said third base, said third base being proportioned to support said switch only excluding excess current responsive control means thereon, cooperating disconnect contact means on juxtaposed sides of said first base and said third base adapted to serially connect said first protective device and said switch, and cooperating disconnect contact means on juxtaposed sides of said second base and said third base adapted to serially connect said second protective device and said switch.

5. An arrangement for controlling power circuits comprising a first base of molded insulating material, a first excess current protective device mounted on said first base, said first protective device comprising a solder joint adapted to carry current and spring means biasing said solder joint to a separated position thereof, a second base of molded insulating material, a second excess current protective device mounted on said second base, said second protective device comprising a fusible metal ribbon adapted to carry current, a third base of insulating

material, a tumbler-operated over-center toggle switch mounted on said third base, said third base being proportioned to support said switch only without any excess current responsive control means thereon, said first base, said second base and said third base being substantially equal in width and arranged with sides thereof of substantially equal width in substantially abutting relation, and cooperating disconnect contact means on said first base, on said second base and on said third base for serially connecting said first protective device, said second protective device and said switch.

6. An arrangement for controlling power circuits comprising a first base of molded insulating material, a first excess current protective device mounted on said first base, said first protective device comprising a substantially tubular casing arranged at right angles to the general plane of said first base and a spring-biased solder joint inside said casing adapted to carry current, a second base of molded insulating material arranged in spaced relation from said first base, a second excess current protective device mounted on said second base, said second protective device comprising a substantially tubular casing arranged at right angles to the general plane of said second base and a fusible metal ribbon adapted to carry current inside said casing; a third base of molded insulating material arranged in the space between said first base and said second base, a tumbler-operated over-center toggle switch mounted on said third base, said third base being proportioned to support said switch only without excess current responsive control means thereon, cooperating disconnect contact means on juxtaposed sides of said first base and said third base adapted to serially connect said first protective device and said switch, cooperating disconnect contact means on juxtaposed sides of said second base and said third base adapted to serially connect said second protective device and said switch, said cooperating disconnect contact means comprising pairs of coaxial substantially tubular clamping members, a metal mandrel in each of said pairs of clamping members, and set-screws firmly holding said mandrel in position inside each of said pairs of clamping members.

7. An arrangement for controlling power circuits comprising a first base of molded insulating material, a first excess current protective device mounted on said first base, said first protective device comprising a substantially tubular casing arranged at right angles to the general plane of said first base and a spring-biased solder joint inside said casing adapted to carry current, a second base of molded insulating material, a second excess current protective device mounted on said second base, said second protective device comprising a substantially tubular casing arranged at right angles to the general plane of said second base and a fusible metal ribbon adapted to carry current inside said casing, a third base of molded insulating material, a tumbler-operated over-center toggle switch mounted on said third base, said third base being proportioned to support said switch only without any excess current responsive control means thereon, said first base, said second base and said third base being substantially equal in width and arranged with sides thereof having substantially equal width in substantially abutting relation, and cooperating disconnect contact means on said first base, on said scond base and on said third base for serially connecting said first protective device, and said second protective device and said switch, said cooperating disconnect contact means comprising pairs of coaxial substantially tubular clamping members, a metal mandrel in each of said pairs of clamping members, and set-screws firmly holding said mandrel in position inside each of said pairs of clamping members.

8. An arrangement for controlling power circuits comprising a first base of molded insulating material, a tumbler-operated over-center toggle switch mounted on said first base, said first base being proportioned to support said switch only without excess current responsive tripping means thereon, a second separate base of molded insulating material arranged immediately adjacent said first base, a current-limiting fuse mounted on said second base, said current-limiting fuse comprising a substantially tubular casing arranged at right angles to the general plane of said second base, cooperating plug-in disconnect contact means on the end of said current-limiting fuse immediately adjacent said second base and on said second base arranged coaxially with respect to said casing, cooperating plug-in disconnect contact means on the end of said current-limiting fuse remote from said second base and on said second base arranged with the axis thereof parallel to the axis of said casing, and additional cooperating disconnect contact means adapted to serially connect said switch and said current-limiting fuse, said additional disconnect contact means comprising coaxial substantially tubular clamping members arranged on the same level on said first base and on said second base, a metal mandrel in said clamping members, and set-screws firmly securing said mandrel in the position thereof.

9. An arrangement for controlling power circuits comprising a first base of molded insulating material, a tumbler operated over-center toggle switch mounted on said first base, said first base being proportioned to support said switch only without excess current responsive tripping means thereon, a second separate base of molded insulating material arranged immediately adjacent to said first base, a fusible excess current protective device mounted on said second base, cable connector means arranged in alignment at the same level on juxtaposed sides of said first base and said second base, and a short length of conductor clamped into said cable connector means to serially connect said switch and said fusible protective device, said short length of conductor being sufficiently rigid to integrate said first base and said second base into a self-supporting structural unit.

10. An arrangement for controlling power circuits comprising a first base of molded insulating material, a multipolar tumbler-operated over-center toggle switch supported by said first base, said first base being proportioned to support said switch only without excess current responsive control means thereon, terminal elements arranged on opposite sides of said first base for connecting said switch into an electric circuit, a second separate base of molded insulating material arranged immediately adjacent said first base, a plurality of fusible excess current protective devices mounted on said second base, terminal elements arranged on opposite sides of said second base at the same level as said terminal elements on said first base, and conductors in form of relatively rigid metal rods extending substantially parallel to the general plane of said first base and the general plane of said second base conductively interconnecting juxtaposed terminal elements on said first base and on said second base and integrating said first base and said second base into a self-supporting structural unit.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,950,370 August 23, 1960

Kenneth W. Swain

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 66, strike out "8 on base 5. Each connector 48 and each connector 8" and insert the same after "connectors", second occurrence, in line 64, same column.

Signed and sealed this 31st day of January 1961.

(SEAL)
Attest:
KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents

UNITED STATES PATENT OFFICE

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