

July 28, 1964

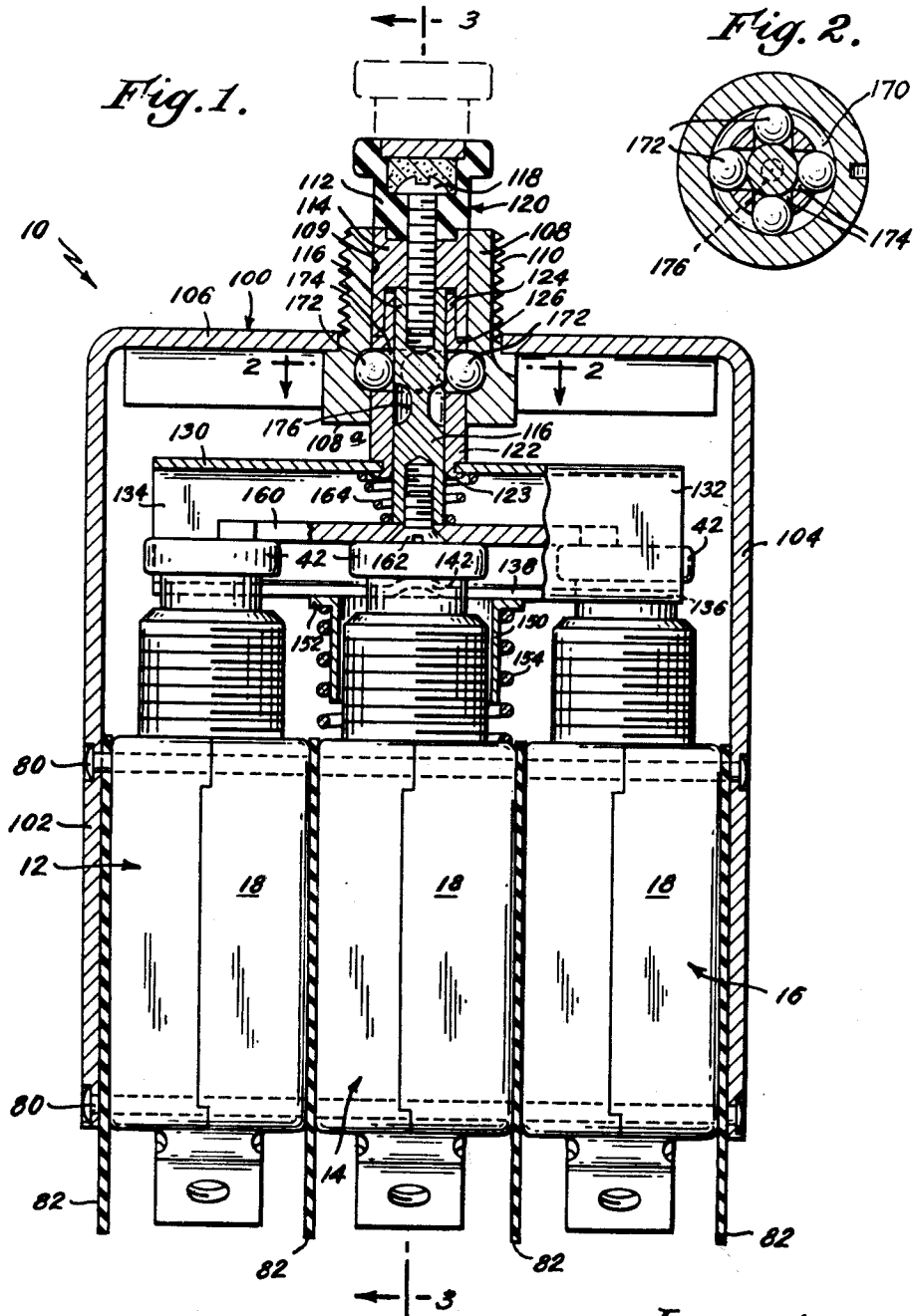
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3,142,732

GANGED MULTIPOLE CIRCUIT BREAKER

Filed Dec. 1, 1961

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

Fig. 3.

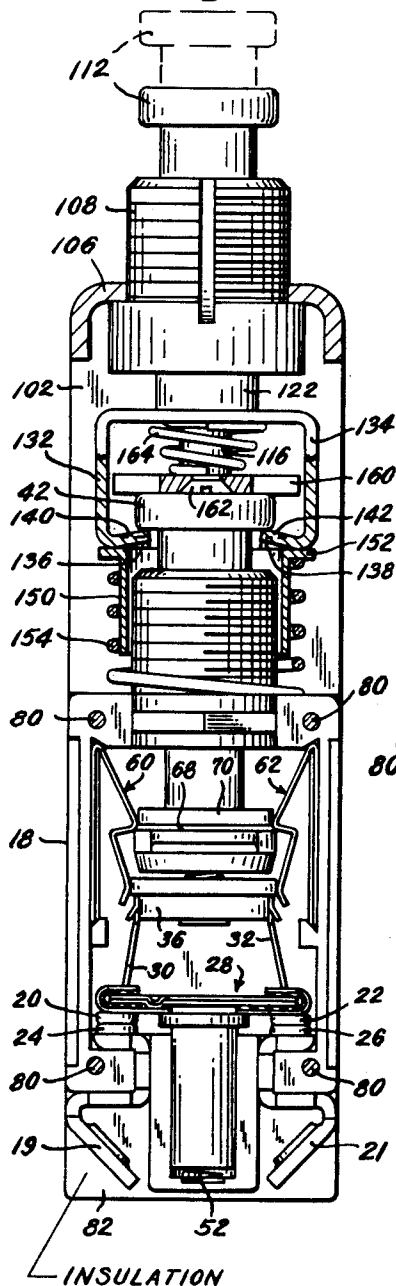


Fig. 4.

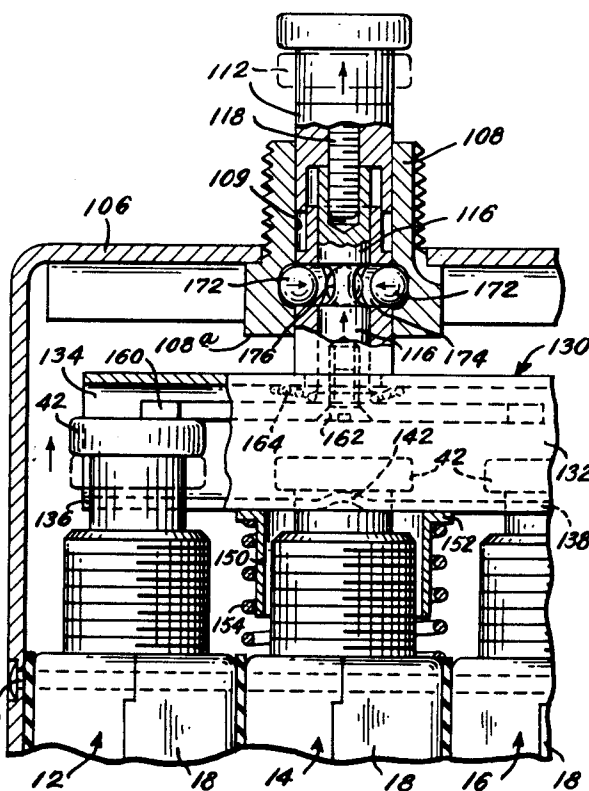
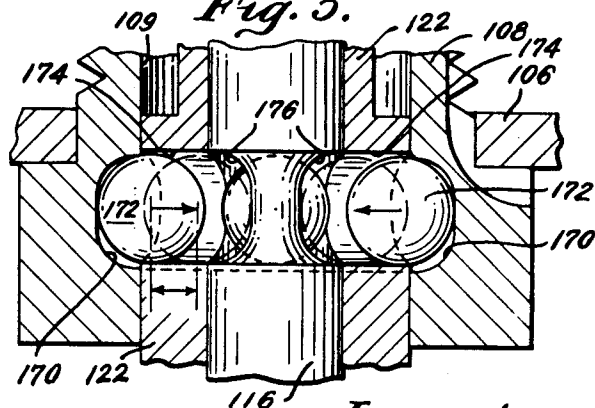


Fig. 5.



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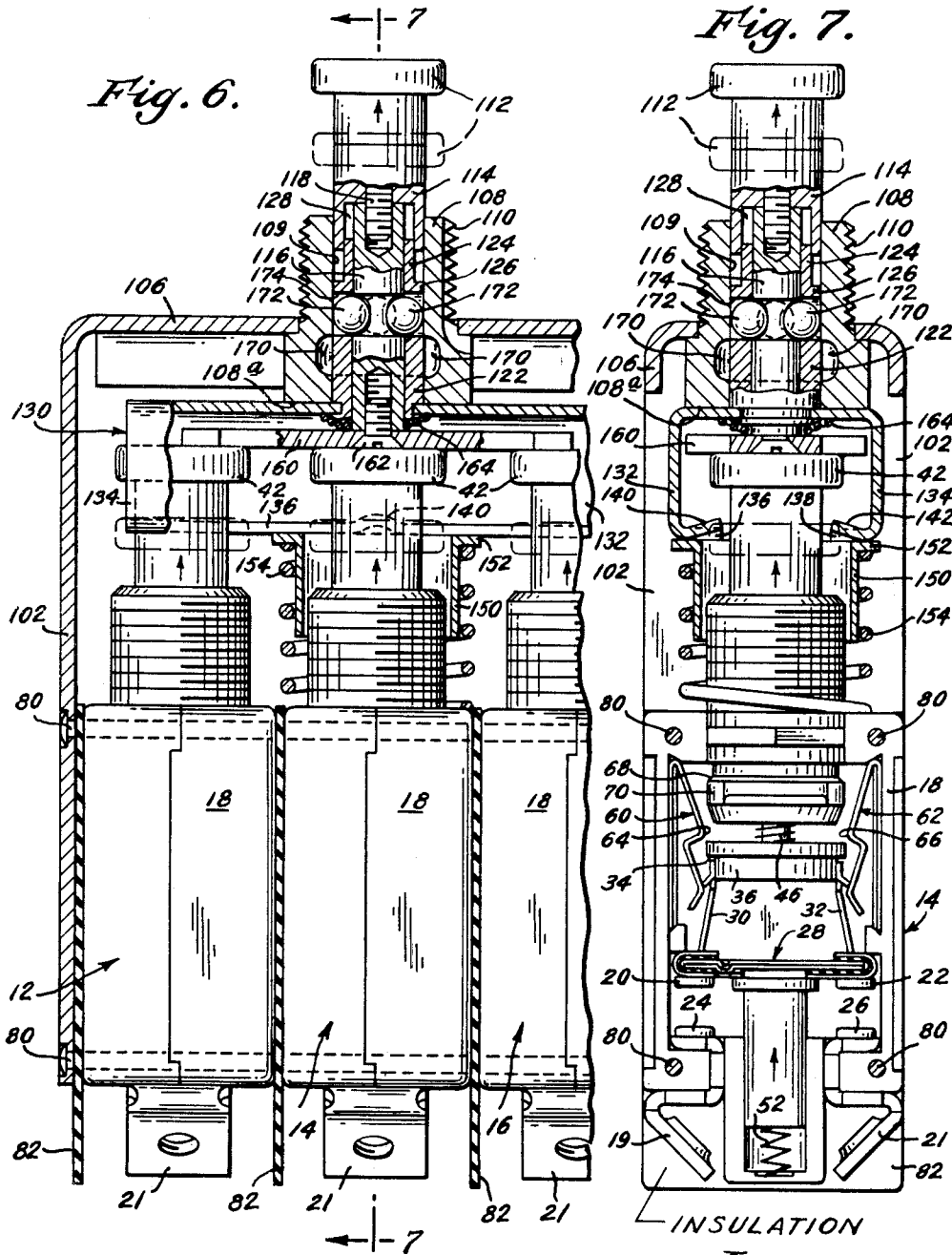
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4 Sheets-Sheet 3



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4 Sheets-Sheet 4

Fig. 8.

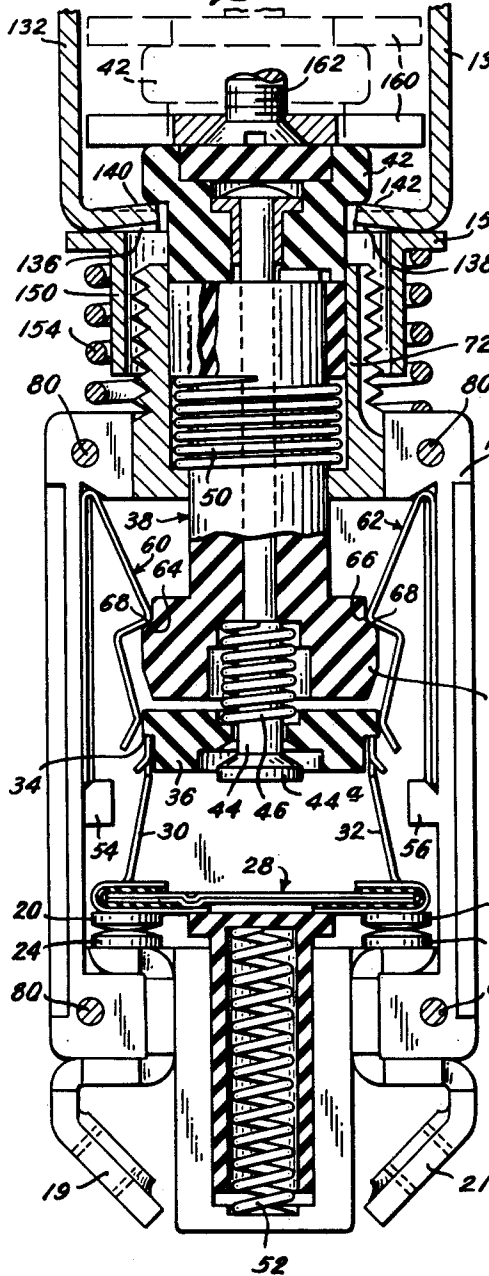
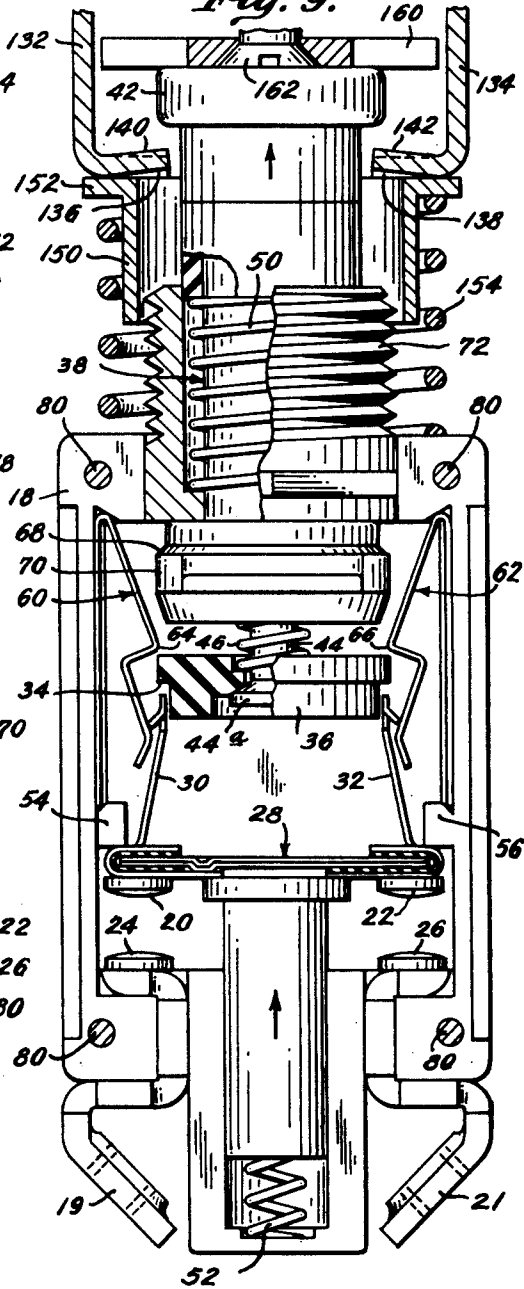


Fig. 9.



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3,142,732

GANGED MULTIPOLE CIRCUIT BREAKER

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Filed Dec. 1, 1961, Ser. No. 156,341
16 Claims. (Cl. 200—50)

This invention relates to multipole electrical switches, and more particularly, to thermally responsive, multipole switch structures.

Among the several objects of the present invention may be noted the provision of means for mechanically interconnecting or ganging a plurality of individual circuit breaker units to provide a multipole circuit breaker construction in which all of the circuit breaker units will be automatically tripped or actuated upon actuation or tripping of any one of the units; the provision of a three-phase, thermally responsive, electrical circuit breaker construction which comprises three, individual, single-phase electrical circuit breaker units mechanically interconnected together, in which all of said circuit breaker units will be automatically tripped or actuated upon tripping or actuation of any one circuit breaker unit; and the provision of multipole or three-phase electrical switch constructions of the class described, which are simple in construction, economical to manufacture and assemble, and dependable in use.

Other objects will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated:

FIG. 1 is an elevational view of a multipole or three-phase circuit breaker embodying the present invention, showing the parts thereof in a reset, contacts-closed position, with parts broken away and certain of the parts in section;

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is a view taken on line 3—3 of FIG. 1;

FIG. 4 is a fragmentary view of a portion of the circuit breaker, shown in FIG. 1, certain of the parts being shown in full lines and in broken lines at intermediate positions during operations thereof;

FIG. 5 is an enlarged, fragmentary view of a portion of the switch shown in FIGS. 1 and 4, with certain of the parts being shown in full and in broken lines indicating different positions during operation thereof;

FIG. 6 is a view similar to FIG. 1, showing the parts thereof in solid lines, in a retracted, contacts-open condition;

FIG. 7 is a sectional view taken along line 7—7 of FIG. 6;

FIG. 8 is an enlarged view similar to FIG. 3, showing the parts in a reset, contacts-closed condition; and

FIG. 9 is an enlarged view similar to FIG. 7, showing the parts thereof in a retracted, contacts-open condition.

Dimensions of certain of the parts as shown in the drawings have been modified and/or exaggerated for the purposes of clarity of illustration.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Briefly, according to the present invention, means are provided for ganging or interconnecting individual standard type, single-phase circuit breaker units together into a multipole or three-phase circuit breaker, which includes

a common, manually operable actuating means for manually actuating all of the individual, single-phase circuit breaker units, and also for automatically opening all of the individual circuit breaker units when any one of them automatically trips in response to a current or thermal overload. It will be seen that by means of the present invention, a three-phase or multipole circuit breaker can easily be constructed from standard type, single-phase circuit breaker units of desired ratings, and the necessity for stocking various ratings of three-phase circuit breakers, as many times heretofore required with conventional three-phase circuit breaker constructions, is advantageously eliminated.

Referring now to the drawings, there is shown in FIG. 1, a multipole, three-phase circuit breaker 10, which comprises three, standard individual circuit breaker units 12, 14 and 16, which are disposed in a side-by-side adjacent relationship. Each of switches 12, 14 and 16 is substantially identical in construction (but may have different electrical ratings as may be required by the particular application for circuit breaker 10) and may be of any suitable construction such as, for example that disclosed and illustrated in U.S. Patent No. 2,912,546 of November 10, 1959, to R. G. Arey, entitled Electrical Switch Structures, which patent is assigned to the assignee of the instant invention. Reference to this patent may be had for details of construction of the exemplary electrical switches 12, 14 and 16, illustrated in the drawings. As will be clearly understood in reference to the aforementioned Arey patent, each of switches 12, 14 and 16 includes a hollow housing 18, made of electrically insulating material; a pair of movable contacts 20 and 22, positioned for respective mating engagement with a pair of fixed contacts 24 and 26. Contacts 20 and 22 are carried by a thermally responsive member, generally referred to by numeral 28.

Member 28, as best seen in FIGS. 8 and 9, includes a pair of arms 30 and 32 which are normally positioned for engagement with an annularly or circumferentially extending abutment 34, provided by member 36, forming part of a resetting or manually operable actuating plunger mechanism of the switch, generally referred to by numeral 38. The individually manually operable actuating or resetting means 38 of the switches 12, 14 and 16 include a push button member 42 having an enlarged, flanged portion extending exteriorly of the hollow housing 18. Member 36 is slidably carried on a stem 44, and is biased for movement toward the distal ends of arms 30 and 32 by a spring 46 disposed about stem 44. The stem 44 provides a stop 44a for engagement with a countersunk portion of the member 36 to limit downward movement thereof under the biasing action of spring 46. Compression spring 50 biases manually operable means 38 for movement in a contacts-opening direction. Spring means 52 biases thermally responsive movable contact-carrying trip member 28 for movement in a contacts-opening direction. The upward or contacts-opening movement of the member 28 (as seen in FIGS. 8 and 9) is limited by its engagement with a pair of abutments 54 and 56 provided by casing member 18, as best shown in FIGS. 7 and 9.

Switches 12, 14 and 16 also include mechanical latching means, in the form of a pair of latch spring members 60 and 62, mounted on casing 18 and which respectively have portions 64 and 66 which are normally urged toward each other into position for engagement with a circumferentially or annularly extending abutment portion 68 provided by a retaining member 70, forming a part of the means 38, as shown and more fully described in the aforementioned Arey patent.

Briefly, the operation of switches 12, 14 and 16 described above and more fully in the aforementioned Arey patent, is as follows: with the parts in the respective positions shown in FIGS. 6, 7 and 9, thermally responsive member 28 is in the retracted, contacts-open position; member 36 is in the retracted position and biased by the spring 46 against the stop 44a; member 70, along with the parts fixed with respect thereto, is biased to the retracted position by compression spring 50; and push button 42 is urged outwardly with respect to the casing 18. When push button 42 is depressed to the advanced or reset contacts-closed position, the parts take the respective positions shown in full lines in FIG. 8. As means 38 moves from the FIG. 9 to the FIG. 8 position, abutment 34 moves into engagement with the distal ends of each of arms 30 and 32 of the thermally responsive trip means or member 28. Continued movement of the push button 42 and the manually operable actuating means 38 in the contacts-closing direction results in continued compression of spring 50; outward deflection of latched spring arms 60 and 62 due to the camming action of member 70 in moving against and slidably along these arms; and movement of the thermally responsive trip means 28 against the bias of compression spring 52 to the contacts-closed position shown in full lines in FIG. 8.

When button 42 has been depressed to move the parts to the FIG. 8 contacts-closed position, portions 64 and 66 of the latch spring members 60 and 62 move under their inherent resilient bias into engagement with abutment 68 to mechanically latch and retain member 70 and the parts of manually operable actuating means 38 fixed with respect thereto, against the bias of the springs 46 and 50, tending to move these parts from the reset, contacts-closed condition of FIG. 8 to the retracted, contacts-open condition of FIG. 9. With the parts in the contacts-closed condition, member 36 retains the member 28 in the contacts-closed, advanced position under the bias exerted by a compression spring 46, and an electrically conductive path is established from terminal 19 to fixed contact 24, to movable contact 20, through the thermally responsive trip element 28 to the movable contact 22, to the fixed contact 26, to the other terminal 21. Upon the flow of current of sufficiently high values along the electrically conductive path just described, thermally responsive member 28 is heated whereupon it warps or flexes outwardly from the position shown in FIG. 8 to move the distal ends of the arms 30 and 32 out of engagement with the abutment 34, and to move spring members 60 and 62 outwardly with respect to member 70 to move portions 64 and 66 out of engagement with the annularly extending abutment 68, whereby button 42 and the remainder of the parts comprising the manually operable actuating means 38, can quickly move to the retracted position shown in FIG. 9, under the spring biasing action of spring 50.

After thermally responsive member 28 has cooled sufficiently, arms 30 and 32 will move inwardly toward each other in position for engagement by the abutment 34 for resetting of the switch upon depression of button 42. As pointed out in greater detail in the aforementioned Arey patent, circuit breakers 12, 14 and 16 are "trip free," and the thermally responsive member 28 cannot be retained in the contacts-closed position by forcibly retaining push button 42 in the advanced, depressed position, upon the occurrence of a current overload of a predetermined magnitude through the thermally responsive member 28.

Multipole circuit breaker 10 advantageously utilizes the trip-free characteristics of each of the individual single-phase circuit breakers 12, 14 and 16.

According to the present invention, the three individual circuit breakers or electrical switches 12, 14 and 16, are secured together in side-by-side relationship by suitable fastening means, such as bolts or rivets 80, as shown. Electrical insulating members 82 are disposed intermediate

each adjacent pair of switches, and also intermediate switches 12 and 16 and the respective metallic wall portions 102 and 104 of a mechanical interconnecting or ganging device, generally referred to by numeral 100. Means 80 also secures the switches 12, 14 and 16 to members 82 and wall portions 102 and 104, as shown, to provide an integrated multipole three-phase circuit breaker 10.

Ganging means 100 includes a U-shaped housing defined by bight portion or wall 106 which interconnects wall portions 102 and 104, as clearly shown in FIG. 1. As shown in FIG. 1, each of the three circuit breaker units 12, 14 and 16 are each individually electrically connectable in a separate circuit.

Means 100 includes a bushing 108 which is carried by and fixedly secured to wall 106, and is externally threaded, as at 100, for reception of a nut (not shown) to facilitate mounting of the multipole or three-phase circuit breaker 10 on a support. Mounted for slidable movement within and along bushing 108 are a button member 112 and members 114 and 116, all forming part of a common, manually operable actuating means generally referred to by numeral 120, for the multipole or three-phase circuit breaker 10. Members 112, 114 and 116 are fixed relative to each other by means of a threaded bolt member 118, as shown. The common actuating means 120 also includes a cylindrical tubular member 122, which is mounted for slidable movement within and along the bushing 108, for movement with respect to members 112, 114 and 116. Member 122 includes, at an upper portion thereof (as seen in FIG. 1), a reduced diameter portion 124 and an annularly extending shoulder 126. Reduced diameter portion 124 is receivable within, and movable along, a correspondingly shaped recess 128 provided in member 114 (as best seen in FIGS. 6 and 7). Shoulder 126 is engageable with the underside of member 114 (as seen in FIGS. 1 and 6) to limit relative movement therebetween in one direction. A channel-shaped member 130 is fixed to and carried by the free end of member 122. Member 130 is defined at least in part, by a pair of legs 132 and 134 (as best seen in FIG. 7). The free end of legs 132 and 134 include inturned lip portions 136 and 138 extending toward each other, and disposed for gripping engagement with the underside of button 42 of each of switches 12, 14 and 16, as clearly shown in FIGS. 3 and 7.

Means 120 further includes a spring seat ring 150, having a circumferentially extending flange portion 152, for receiving and seating thereagainst one end of a compression spring 154. The other end of spring 154 is seated against the upper surface of the hollow housing 18 of switch 14, as shown in FIG. 1.

Compression spring 154 biases the flange portion of member 150 into engagement with the lips 136 and 138 of the channel-shaped member 130 to urge member 130 for movement upwardly, as seen in FIG. 1, in a contacts-opening direction into gripping engagement with the underside of the button members 42 of each of switches 12, 14 and 16, for movement to a contact-open condition, such as shown in FIGS. 7 and 9.

Means 120 further includes a plate-like resetting bar member 160, which is carried by and fixedly secured to member 116 by means of a screw 162, as shown. Tele-scoped about member 116 is a compression spring 164, one end of which engages the channel-shaped member 130, and the other end of which engages the upper surface of resetting member 160, as clearly shown in FIG. 1. Spring 164 biases member 160 for movement in a resetting, contacts-closing direction against the individually manually operable button members 42 of each of switches 12, 14 and 16, as clearly shown in FIG. 1.

Means 120 includes mechanical detent means for mechanically locking the common, manually operable actuating means 120 in a contacts-closed position. The mechanical latching means operates independently of the

thermal trip means in each of circuit breakers 12, 14 and 16, and is mechanically actuatable repeatedly without upsetting the calibration of the thermally responsive trip means in each of switch units 12, 14 and 16.

Bushing 108, adjacent its lower portion, has a detent surface 170 in the form of a circumferentially or peripherally extending groove, as clearly seen in FIGS. 1, 5 and 6. Detent groove 170 is adapted to receive a plurality of balls 172 in latching, mating engagement therewith.

Referring now to FIG. 2, ball means 172 is shown by way of example, as comprising four balls 172 circumferentially spaced about stem or member 116, and mounted for movement in a direction normal to the longitudinal axis of stem member 116. It should be understood that in the practice of the instant invention, a greater or lesser number of balls could be provided, if desired. It has been found, however, that the employment of the four balls, as illustrated, provides a stable mechanical latching arrangement.

Balls 172 are carried in suitable openings 174 provided in member 122, for movement into and out of engagement with detent surface 170, and into and out of engagement with a circumferentially or peripherally extending groove 176 provided by stem member 116, as best seen in FIG. 5. The wall thickness of cylindrical member 122, plus the depth of groove 176 or groove 170, is slightly greater than the diameter of ball members 172. The thickness of the wall member 122 is greater than the radius of ball members 172 whereby when grooves 170 and 176 are aligned with openings 174, as in the FIG. 5 intermediate position, member 122 is effective to cam or wedgingly move the ball members 172 out of engagement with detent surface 170 when member 120 moves upwardly, and to cam or wedgingly move ball members 172 out of engagement with groove 176 and into engagement with detent groove 170 when member 120 is moved downwardly, as seen in FIG. 5. Continued downward movement of stem member 116 will lock balls 172 in its detent surface 170 engaged position, through engagement of the balls 172 with the full diameter cylindrical outer surface of member 116, as shown in the FIG. 1 position of the parts.

With the parts in the respective positions shown in full lines in FIGS. 6 and 9, the thermally responsive element 28 of each of units 12, 14 and 16 is in the retracted, contacts-open position (shown in FIG. 9); and button members 42 are each biased upwardly by each of spring members 50 against plate member 160, which in turn biases stem member 116 upwardly to the contacts-open position. In the contacts-open position shown in FIGS. 6 and 9, apertures 174 of the sleeve 122 are in register with the circumferentially extending groove 176 of the stem 116. The engagement of balls 172 with groove 176 interlocks and latches sleeve member 122 and member 116 together as a unit for movement upwardly to the contacts-open position under the biasing action of compression spring 154. Balls 172 are confined in latched, interlocking engagement with the groove 176 of the stem member 116 in the FIG. 6 condition, by the interior side-walls 109 of the bushing 108. When the push button member 112 is moved downwardly from the contacts-open condition shown in solid lines in FIG. 6 and in dashed lines in FIG. 1, toward the contacts-closed condition shown in dashed lines in FIG. 6 and in solid lines in FIG. 1, the parts will take the respective positions shown in full lines in FIGS. 1 and 8. As movement of the push button 112 from the position shown in FIG. 6 to that shown in FIG. 1 ensues, spring 154 will be compressed and stem 116 and sleeve 122 will move together as an interlocked unit until the intermediate position shown in FIGS. 4 and 5 is reached, wherein openings 174 are aligned and register with detent groove 170 provided by the sleeve 108. Thereafter, on continued downward movement of push button 112, ball members 172

will be cammed out of engagement with groove 176 on the stem 116 (shown in dashed lines in FIG. 5) and into latching engagement with detent surface 170 (shown in solid lines in FIG. 5).

Thereafter, downward movement of the push button results in relative movement between stem member 116 and sleeve 122, whereby the upper full diameter, circumferential surface portion of the stem 116 moves into engagement with balls 176 to maintain them in a latched condition with respect to detent surface 170. Push button 112, in moving from the FIG. 6 to the FIG. 1 condition, moves plate member 160 against buttons 42 of each of switches 12, 14 and 16 to simultaneously depress the latter and simultaneously reset units 12, 14 and 16 to the contacts-closed FIG. 8 condition.

The operation of the multipole, three-phase circuit breaker 10 will now be described. When the parts are in the respective full line, contacts-closed positions shown in FIGS. 1 and 8, spring member 164 biases plate 160 into engagement with the button members 42 of each of units 12, 14 and 16, which are each in the depressed, contacts-closed position.

When the thermally responsive member 28 in any of switches 12, 14 and 16 (for example, switch 12 as shown in FIG. 4) trips from the contacts-closed FIG. 8 position to the contacts-open, FIG. 9 position, button member 42 will move outwardly against plate member 160, to move the latter against the spring bias of spring 164 from the solid-line FIG. 8 position to the solid-line FIG. 9 position. Such movement of plate 160 is effective to also move stem member 116 (which is fixed with respect to plate 160) upwardly to an intermediate position, as shown in FIGS. 4 and 5, wherein the ball-receiving groove 176 in the stem 116 is in register with apertures 174 of the sleeve member 122. Thereafter, sleeve 122 which is urged for movement upwardly under the bias of spring 154 will cam and move balls 172 inwardly out of engagement with the detent surface 170 and into engagement with groove 176 of the stem 116. The edges of sleeve 122 adjacent the ball-receiving openings 174 co-operate with the groove 170 to cam the balls inwardly in the direction of the arrows shown in FIGS. 4 and 5, to move the balls from the solid to the dashed line positions shown in FIG. 5. After the balls have moved into interlocking engagement with groove 176, sleeve 122 and stem 116 are locked together as a unit for movement upwardly relative to bushing 108 under the biasing action of spring 154.

Channel member 130 (which is fixed to sleeve 122) will also move upwardly (as seen in FIG. 4) under the bias of spring 154 to bring lips 136 and 138 and/or raised lip portions 140 and 142 into gripping engagement with the underside of the button members 42 of the remainder of the untripped circuit breakers (which, in the FIG. 4 example are units 14 and 16) to quickly pull the individual manually operable actuating means 38 of each of the untripped circuit breakers outwardly to a contacts-open position, as shown in FIG. 9. The spring force exerted by spring 154 is greater than the cumulative pull-out force required to manually open at least two of the three (but not necessarily all three) circuit breakers units 12, 14 and 16, by pulling button members 42 from the contacts-closed reset to the contacts-open retracted position. This has the advantage of minimizing the forces required for manually actuating the common actuating means 120.

As best seen in FIG. 6, stem 116, sleeve 122 and channel member 130, which are interlocked for movement together as a unit (after tripping of units 12, 14 and 16) will continue to move upwardly under the bias exerted by spring 154 until the upper portion of channel member 130 moves into engagement with the lower surface 108a of the bushing 108 to limit further upward movement of the common manually operable actuating means 120.

Thereafter, if it is desired to reset the circuit breakers

12, 14 and 16 from the FIG. 6 condition to the FIG. 1 condition, it is merely necessary to depress button 112, which will cause plate member 160 to simultaneously depress buttons 42 to reset each of units 12, 14 and 16 to a contacts-closed condition.

Multipole three-phase circuit breaker 10 is further capable of being manually actuated for use as an on-off electrical switch. In this regard, with the parts in the advanced, reset, contacts-closed positions, as shown in FIG. 1, push button member 112 may be grasped and forcibly pulled outwardly to the retracted position to manually open units 12, 14 and 16. The inturned lip portions 136 and 138 of member 130, adjacent the button member 42 of the centrally located switch 14, include upturned portions 140 and 142 for the purpose of effecting contact-opening actuation of the center unit 14 momentarily, prior to simultaneous actuation of the other two units 12 and 16, which minimizes the grasping force required for pulling the button 112 outwardly to manually open multipole circuit breaker 10. Upturned lip portions 140 and 142 also permit use of a spring 154 having the spring force described above.

Common actuating means 120, when forcibly manually moved toward the retracted position, will first move raised lip portions 140 and 142 into gripping engagement with button 42 of unit 14 to open unit 14, and will thereafter move lips 136 and 138 into engagement with buttons 42 of units 12 and 16 to simultaneously open units 12 and 16.

The present invention provides advantages over the type of ganged single-pole circuit breaker constructions in which the manually operable buttons are mechanically and rigidly interconnected by a bar, for example, such as the single-pole, series connected pair of circuit breakers shown in the Ingwersen U.S. Patent No. 2,968,709. In the bar connected constructions, the force exerted by each circuit breaker button on the bar in tripping must be great enough to trip the other breakers which are linked to the bar. In contrast, in applicants' construction, the channel member 130 and tripping plate 160 (which are movable relative to buttons 42) co-operate with spring 154 to quickly, automatically open the other breakers once any one breaker has tripped. The force exerted by the button 42 (e.g. of switch 12 in FIG. 4) in tripping to a contacts-open position against bar 160 is amplified by means 100. In applicants' construction, the force exerted by button 42 in tripping against plate 160, is not required to be great enough to open the other switches, or to be greater than the force ordinarily available in the standard, single-phase breaker, when used separately.

Another advantage of the present invention is that standard available individual circuit breaker units can be utilized with very little, if any, modification for incorporation into the multipole or three-phase circuit breaker construction of this invention.

Another advantage of the present invention is that one circuit breaker unit cannot be opened without opening the other two circuit breaker units of the multipole circuit breaker 10.

The invention affords a low-cost and economical means of quickly making multipole three-phase circuit breakers from three, standard individual, single-phase, already calibrated circuit breaker units. The multipole three-stability, and provides a stable latching arrangement tending to minimize the dangers of accidental or unintentional phase circuit breaker arrangement of the invention also provides a construction which affords increased vibration latch release.

It will be apparent that thermal actuators and electrical circuit breakers of types other than illustrated and described above, could be employed within the purview of this invention without departing from the scope of this invention.

In view of the above, it will be seen that the several

objects of the invention are achieved, and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense, and it is also intended that the appended claims shall cover all such equivalent variations as come within the true spirit and scope of the invention.

We claim:

1. A multipole circuit breaker comprising a plurality of individual electric circuit breaker units secured together in an adjacent relationship; each of said circuit breaker units including a housing; relatively movable contact means in each housing for opening and closing a circuit through its respective unit; trip means in each housing for automatically opening said contact means at predetermined conditions to de-energize the circuit through said unit; each of said units being electrically connectable in a separate circuit; each of said individual units having a manually operable actuating member extending externally thereof for manual actuation of the contact means of its respective unit; common manually operable actuating means on said multipole circuit breaker including a first member movable relative to and against each of said individual manually operable actuating members for movement thereof in a contacts-closing direction to close the contact means of each of said individual circuit breaker units; said common actuating means including a second member movable relative to and against each of said individual manually operable actuating members, said second member having portions for gripping engagement with each of said individual manually operable actuating members for movement thereof in a contacts-opening direction to automatically open the contact means in all of said individual circuit breaker units when any one of said circuit breaker units is tripped to a contacts-open condition.

2. The multipole circuit breaker as set forth in claim 1 and wherein said contacts-opening and -closing directions are opposite to each other.

3. The multipole circuit breaker as set forth in claim 2 and including spring means biasing said second member for movement in said contacts-opening direction.

4. The multipole circuit breaker as set forth in claim 3 and including second spring means biasing said first member for movement against said individual manually operable members in said contacts-closing direction.

5. The multipole circuit breaker as set forth in claim 3 and including mechanical latching means for latching said common manually operable actuating means in a contacts-closed position when said first movable member has moved said individual manually operable actuating members to a contacts-closed condition.

6. The multipole circuit breaker set forth in claim 1 and wherein each of said individual circuit breaker units is trip-free.

7. The multipole circuit breaker as set forth in claim 1 wherein said multipole circuit breaker unit comprises a three-phase circuit breaker and said plurality of individual circuit breaker units comprises three separate individual single-phase circuit breaker units.

8. A three-phase circuit breaker comprising three individual single-phase electric circuit breaker units secured together in an adjacent relationship; each of said single-phase circuit breaker units including a housing; relatively movable contact means in each housing for opening and closing a circuit through its respective unit; thermally responsive trip means in each housing for automatically opening said contact means at predetermined temperature and current conditions to de-energize the circuit through said unit; each of said units being electrically connectable in a separate circuit; each of said individual circuit breaker units having a manually oper-

able actuating member extending externally thereof for manual actuation of the contact means of its respective unit; common manually operable actuating means on said three-phase circuit breaker including a first member movable relative to and against each of said individual manually operable actuating members for movement thereof in a contacts-closing direction to close the contact means of each of said individual units; said common actuating means further including a second member movable in a contacts-opening direction relative to and against each of said individual manually operable members, said second member having portions for gripping engagement with each of said individual manually operable actuating members for movement thereof in a contacts-opening direction to automatically open the contact means in all of said single-phase circuit breaker units when any one of said individual circuit breaker units is tripped to a contacts-open condition.

9. The three-phase circuit breaker as set forth in claim 8 and wherein said first member comprises a plate member and including spring means biasing said plate member for movement in said contacts-closing direction.

10. A three-phase circuit breaker comprising three individual single-phase electric circuit breaker units secured together in an adjacent relationship; each of said single-phase circuit breaker units including a housing; relatively movable contact means in each housing for opening and closing a circuit through its respective unit; thermally responsive trip means in each housing for automatically opening said contact means at predetermined temperature and current conditions to de-energize the circuit through said unit; means electrically insulating adjacent units from each other; each of said units being electrically connectable in a separate circuit; each of said individual circuit breaker units having a manually operable actuating member extending externally thereof for manual actuation of the contact means of its respective unit; common manually operable actuating means including a first member movable relative to and against each of said individual manually operable actuating members for movement thereof in a contacts-closing direction to close the contact means of each of said individual units; said common actuating means further including a second member movable in a contacts-opening direction relative to and against each of said individual manually operable members for movement thereof in a contacts-opening direction to automatically open the contact means in all of said single-phase circuit breaker units when any one of said individual circuit breaker units is tripped to a contacts-open condition, said first member comprising a plate member, spring means biasing said plate member for movement in said contacts-closing direction; said second member comprising a channel shaped member disposed about and having portions for gripping engagement with each of said individual manually operable actuating members and compressive spring means biasing said channel member for movement in said contacts-opening direction against said individual manually operable members.

11. A three-phase circuit breaker comprising three individual single-phase electric circuit breaker units secured together in an adjacent relationship; each of said single-phase circuit breaker units including a housing; relatively movable contact means in each housing for opening and closing a circuit through its respective unit; thermally responsive trip means in each housing for automatically opening said contact means at predetermined temperature and current conditions to de-energize the circuit through said unit; each of said units being electrically connectable in a separate circuit; each of said individual circuit breaker units having a manually operable actuating member extending externally thereof for manual actuation of the contact means of its respective unit; common manually operable actuating means on said three-phase circuit breaker including a first member

movable relative to and against each of said individual manually operable actuating members for movement thereof in a contacts-closing direction to close the contact means of each of said individual units; said common actuating means further including a second member movable in a contacts-opening direction relative to and against each of said individual manually operable members said second member having portions for gripping engagement with each of said individual manually operable actuating members for movement thereof in a contacts-opening direction to automatically open the contact means in all of said single-phase circuit breaker units when any one of said individual circuit breaker units is tripped to a contacts-open condition; and mechanical latching means for latching said common manually operable actuating means in a contacts-closed position when said first member has moved to a contacts-closed position.

12. The three-phase circuit breaker as set forth in claim 11 and wherein said mechanical latching means comprises fixed detent surfaces on said three-phase circuit breaker; detent means supported on said common manually operable actuating means for movement into and out of engagement with said detent surfaces; and means for releasably maintaining said detent means in latching engagement with said detent surfaces.

13. The three-phase circuit breaker as set forth in claim 12 and wherein said detent means comprises a plurality of balls which are movable relative to said detent surfaces and into and out of register with said detent surfaces.

14. The three-phase circuit breaker set forth in claim 8 and wherein each of said single-phase electric circuit breaker units is trip-free.

15. A mechanical latching mechanism comprising a first cylindrical member and a second cylindrical member having a cylindrical opening therein telescopically receiving said first cylindrical member for relative sliding movement therewithin, a third member having a cylindrical opening therein receiving said second cylindrical member for relative sliding movement therewithin, said first member having a detent surface comprising a circumferentially extending latching groove adapted to receive a plurality of latching balls in latching-mating engagement therewith to latch said first member to said second member and prevent relative movement therebetween, said third member having a circumferentially extending latching groove communicating with the cylindrical opening therein for receiving said plurality of latching balls in latching-mating engagement therewith to latch said third member to said second cylindrical member to prevent relative movement therebetween and permit said first member to move relative to said latched second and third members; said second member having recesses therein mounting respective ones of each of said latching balls therein for movement relative to each of said latching grooves in said first and third members; said recesses communicating with said latching groove in said third member when the latter is disposed in registry therewith to permit said balls to move into engagement with said latching groove in said third member to latch said second and third members together; said recesses also communicating with said latching groove in said first member when the latter is disposed in registry therewith to permit said balls to move out of engagement with said latching groove in said third member and into engagement with said latching groove in said first member to unlatch said second and third members and to latch said first and second members together, each of said latching grooves in said first and third members being shaped so as to cam said ball members out of engagement with said latching grooves when a predetermined force is applied to said balls and said latching grooves in said first and third members and said recesses in said second member are all in registry, the

sides of said first cylindrical member being effective to maintain said balls within said recesses in said second member and in engagement with said latching groove in said third member when said recesses and said latching groove in said third member are in registry with each other, and out of registry with said latching groove in said first member, the sides of said third member forming said cylindrical opening therein being effective to maintain said balls within said recesses and in latching engagement with the latching groove in said first member when said recesses and latching groove in said first member are in registry with each other and out of registry with said latching groove in said third member.

16. A multipole circuit breaker comprising a plurality of individual electric circuit breaker units secured together in an adjacent relationship; each of said circuit breakers including a housing; relatively movable contact means in each housing for opening and closing a circuit through its respective individual circuit breaker unit; trip means in each housing for automatically opening said contact means at predetermined conditions to de-energize the circuit through said unit; means electrically insulating adjacent units from each other; each of said units being electrically connectable in a separate circuit; each of said individual circuit breaker units having a manually operable actuating member extending externally of said unit for manual actuation of the contact means of its respective unit; means mechanically interlocking said individual breaker units and having common manually operable actuating means including a first member movable relative to and against each of said manually operable actuating members to move the latter in a contacts closing direction, and further including a second member movable in a contacts opening direction relative to and against each of said individual manually operable member to move the latter in a contacts opening direction to automatically open the contact means in all of said circuit breaker units when any one of said circuit breaker units is tripped to a contacts-open condition; mechanical latching means for latching

said common manually operable actuating means in a contacts-closed position when said first member has moved to a contacts-closed position, said latching means comprising a stationary member forming part of said mechanical interlocking means and having a cylindrical opening therethrough receiving a first cylindrical member for slidable movement therewithin, said first cylindrical member being fixed to said second member for movement therewith and including a cylindrical opening therethrough receiving a second cylindrical member for slidable movement therewithin, said second cylindrical member being fixed with said first member for movement therewith; first spring means urging said second member and first cylindrical member for movement in a contacts opening direction, second spring means urging said first member and second cylindrical member for movement in a contacts-closing direction, a plurality of latching balls carried in recesses provided by said first cylindrical member for alternate engagement with latching grooves provided by said stationary member and said second cylindrical member to respectively latch said first cylindrical member to said stationary member when said recesses in said first cylindrical member are in registry with the latching groove in said stationary member and out of registry with the latching groove in said second cylindrical member and to latch said first and second cylindrical members together as a unit for movement relative to said stationary member when said latching groove in said second cylindrical member is in registry with the recesses in said first cylindrical member and out of registry with the latching groove in said stationary member.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,142,732

July 28, 1964

David E. Clarke et al.

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

Column 1, line 50, for "operations" read -- operation --;
column 4, line 59, for "contact-open" read -- contacts-open --;
line 70, for "operably" read -- operable --; column 7, lines
65 and 66, strike out "stability, and provides a stable
latching arrangement tending to minimize the dangers of
accidental or unintentional" and insert the same after
"vibration" in line 68, same column 7; column 10, line 45, for
"engageemnt" read -- engagement --.

Signed and sealed this 3rd day of December 1968.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents

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