March 17, 1970 L. W. BRACKETT, SR 3,501,729

TRIP FREE RECIPROCATING CIRCUIT BREAKER

Filed May 3, 1968

4 Sheets-Sheet 1

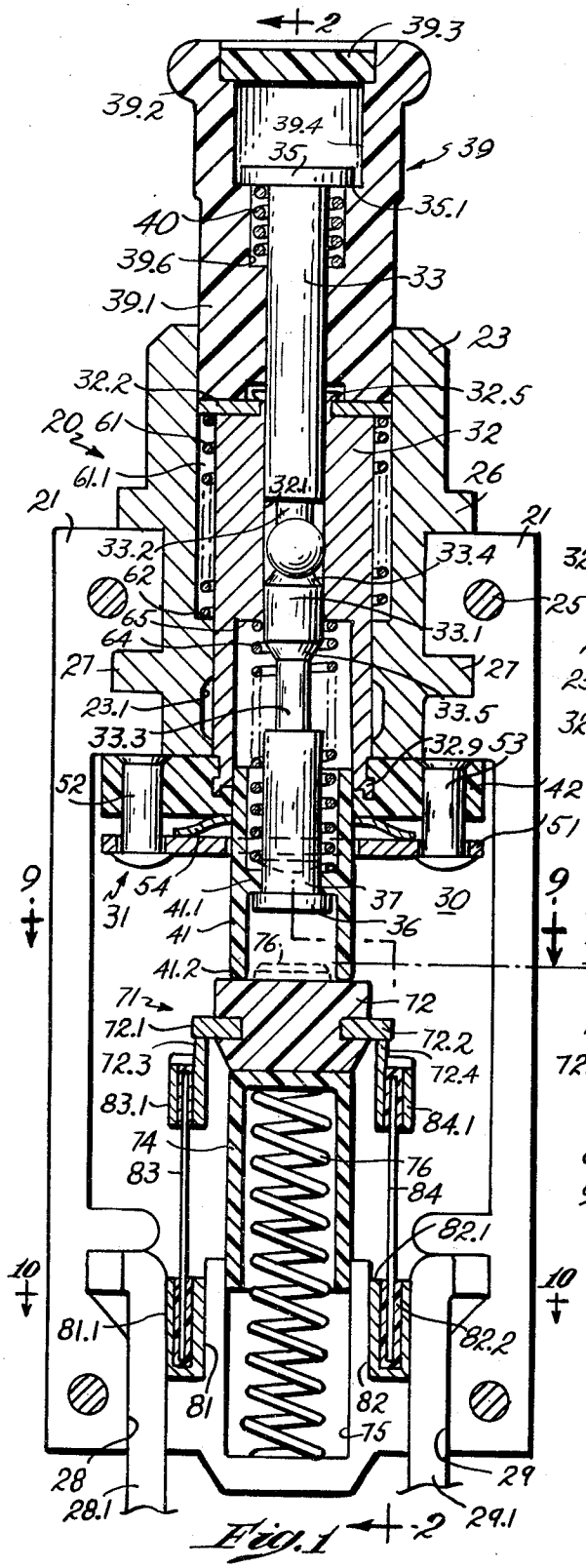


Fig. 1

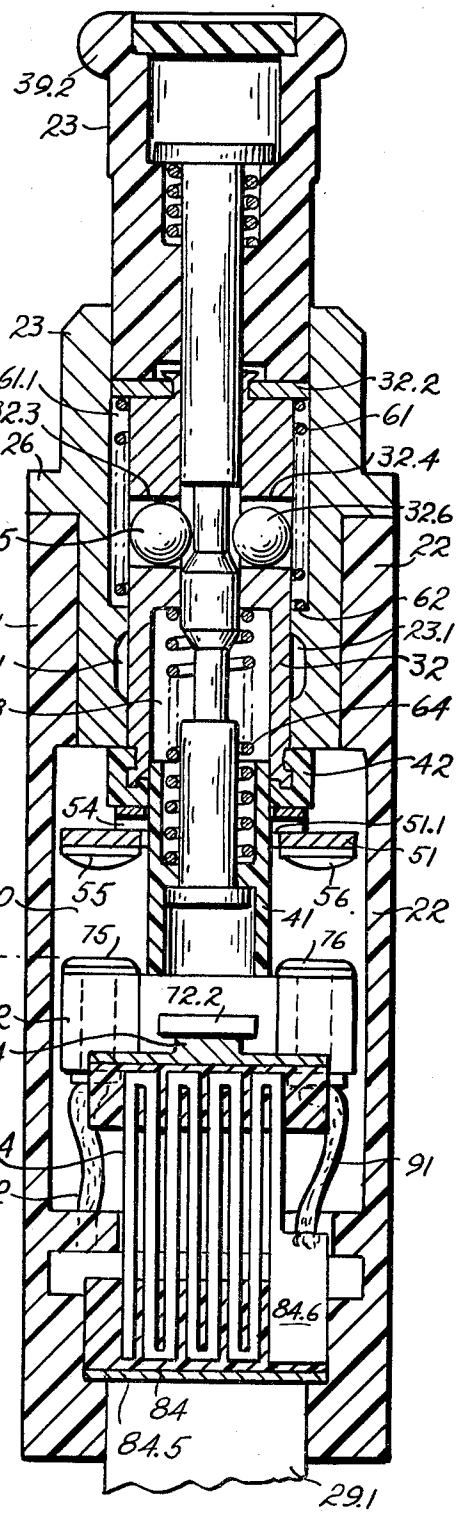


Fig. 2

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TRIP FREE RECIPROCATING CIRCUIT BREAKER

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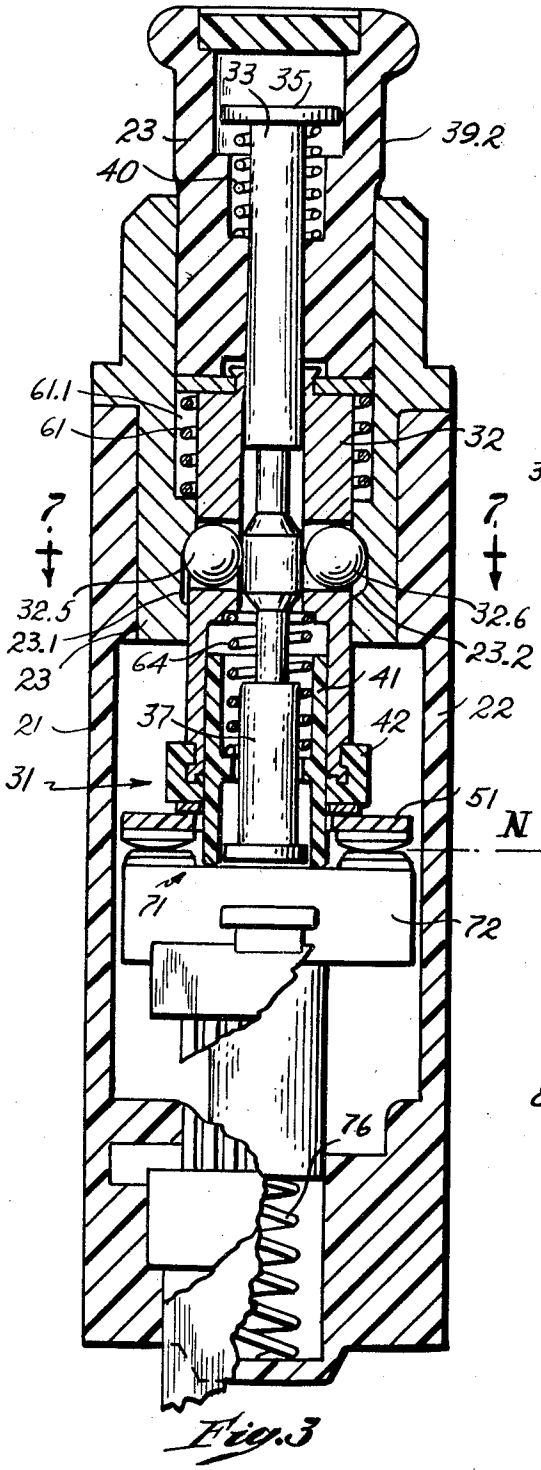


Fig. 3

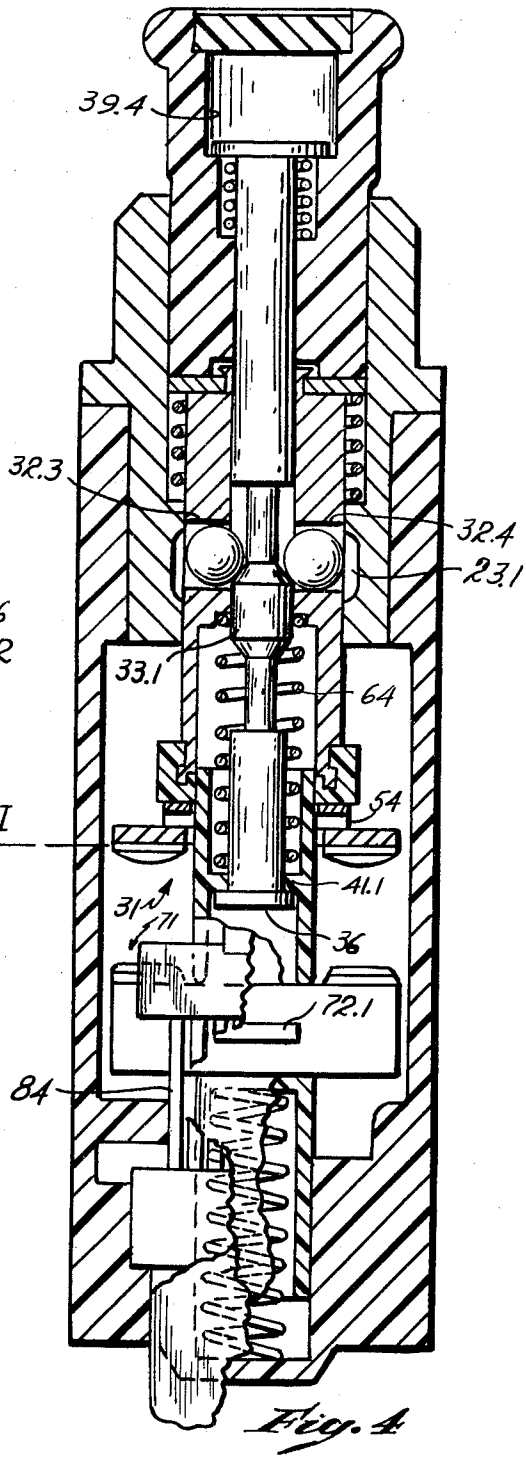


Fig. 4

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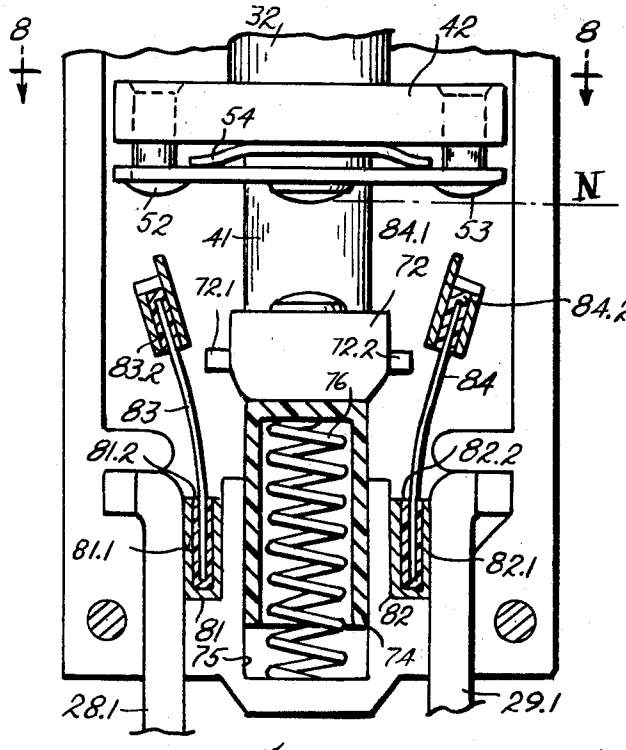


Fig. 5

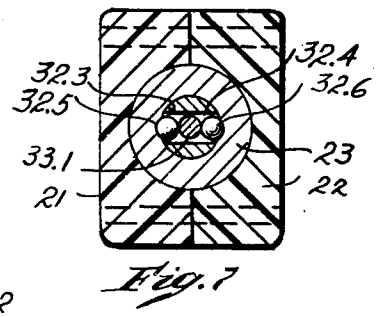


Fig. 7

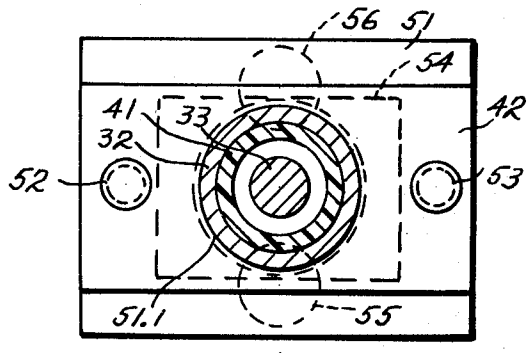


Fig. 8

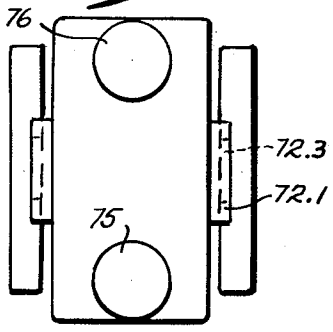


Fig. 9

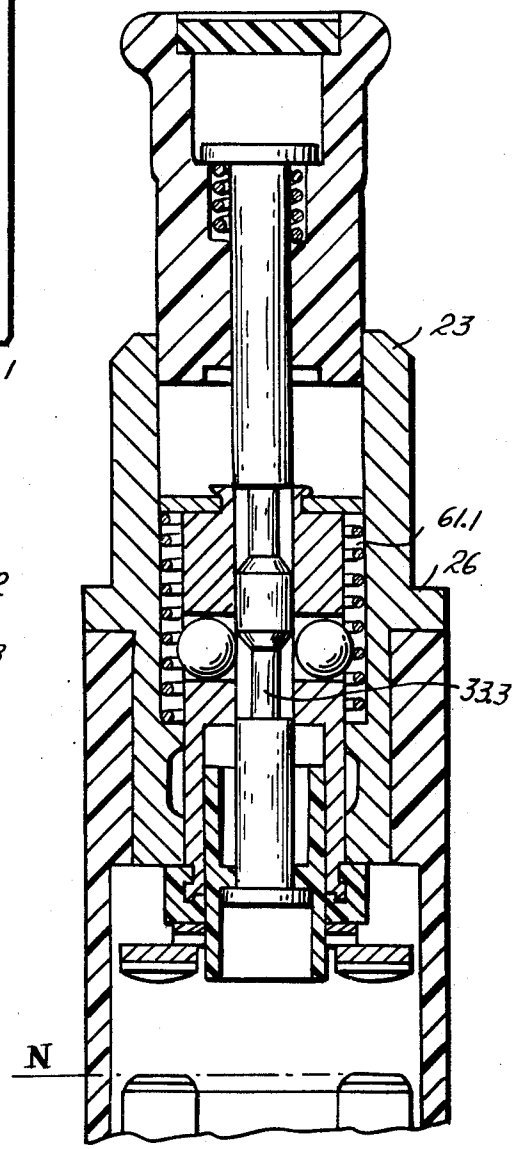


Fig. 6

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TRIP FREE RECIPROCATING CIRCUIT BREAKER

Filed May 3, 1968 4 Sheets-Sheet 4

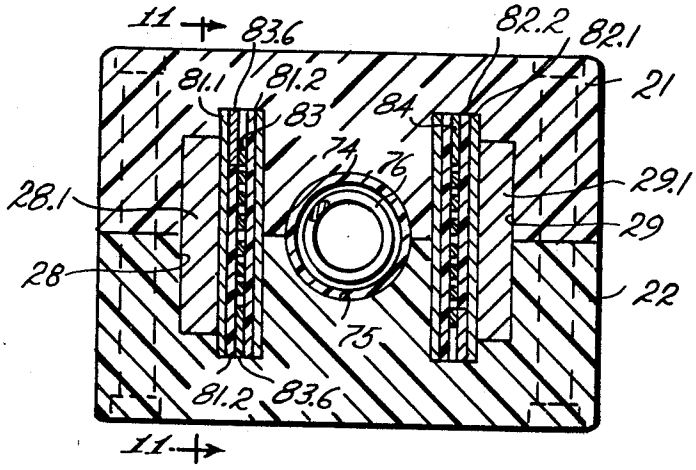


Fig. 10

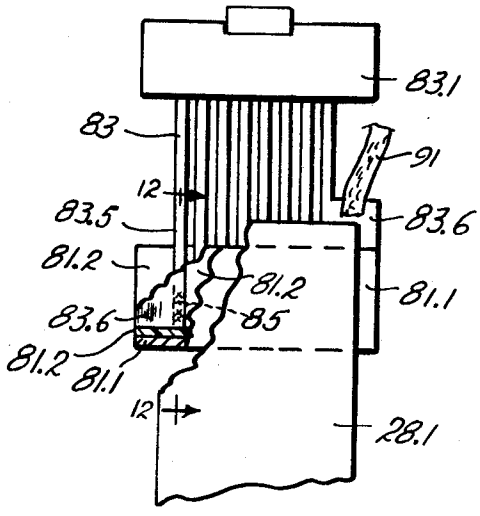


Fig. 11

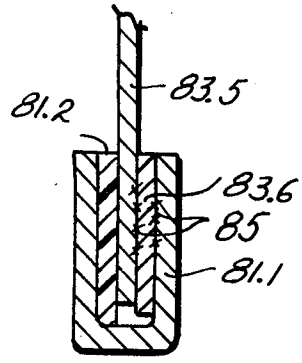


Fig. 12

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United States Patent Office 3,501,729 Patented Mar. 17, 1970

3,501,729

TRIP FREE RECIPROCATING CIRCUIT BREAKER

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Filed May 3, 1968, Ser. No. 726,338
Int. Cl. H01h 71/16
U.S. Cl. 337—66 10 Claims

ABSTRACT OF THE DISCLOSURE

A trip free circuit breaker has two movable contact actuators both reciprocating within a housing. The first actuator has a push pull operator, bridged contacts, holding and tripping springs, and a cam operated detent mechanism for retaining it in operator controlled, closed or normally open, positions relatively to the housing. The second actuator has terminal connected contacts and is normally held, by springs of both units, for normal circuit making and breaking by the first unit. Upon occurrence of an abnormal load condition the second actuator is by a bimetallic catch released from the first actuator and during abnormal condition held in tripped position by a spring of the first actuator which actuator remains in normally closing position. Upon returning the first operator to normally opening position, the second actuator is returned to normal position by a restoring spring.

BACKGROUND OF THE INVENTION

The field of the invention is that of circuit makers and breakers responsive to thermally effective current by way of a latch trip.

Description of the prior art

Circuit breakers of this general type are for example described in Patents Nos. 2,912,546, 3,042,776 and 3,210,501. The prior art constructions are comparatively complicated as to manufacture, assembly and operation. The present invention departs from the prior art by completely separating the normal and overload tripping operations, allotting them to different contact actuators respectively; its simple and compact locking and actuating mechanisms are particularly suited for this circuit breaking arrangement.

SUMMARY OF THE INVENTION

According to the invention, a first contact actuator can be reciprocated by operator means within confining means such as a housing and held in closing or opening positions of its contacts under the control of detent latch and catch means arranged on actuator and housing and controlled by reciprocating cam means of the actuator. A second contact actuator likewise reciprocates, with its contacts in register with those of the first actuator and is normally retained against elastic contact moving means by a load responsive catch device. When overload occurs the second actuator is released and opened by the spring of the first actuator which is retained in closing position by the detent means.

In a specific aspect, the first actuator has an operator controlled stem with a detent cam, and a contact sleeve with two bridged contacts and guide holes for detent catch means such as balls, which can be moved by the reciprocating detent cam into catch recesses such as detent grooves of the contact sleeve.

In another specific aspect, the second actuator has a contact slide carrying two terminal connected contacts and a restoring spring. The slide is maintained in normal position by the holding and tripping spring of the first actuator, bearing against two bimetal elements one on each side of the slide and the restoring spring.

Objects attained by the above, and other characteristic aspects of the present invention are among others, to provide a rugged completely reliable, trip free, high amperage circuit breaker which is very compact, which utilizes uncomplicated and standard elements throughout including its latching mechanism, and which is especially economical in manufacture and assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal section of the circuit breaker in open position, taken intermediate the pairs of contacts at the housing split;

FIG. 2 is a longitudinal section on lines **2—2** of FIG. 1, with the contacts in open position;

FIG. 3 is a section similar to that of FIG. 2, with the contacts in normally closed position;

FIG. 4 is a longitudinal section similar to that of FIG. 3 with the contacts in trip free open position;

FIG. 5 is an elevation of the contact portion with the guide tube and the bimetal elements in section, the second contact actuator being in tripped position as in FIG. 4;

FIG. 6 is a section similar to that of FIG. 2, showing the circuit breaker during manual opening of the contacts;

FIG. 7 is a cross section on lines **7—7** of FIG. 3;

FIG. 8 is a cross section on lines **8—8** of FIG. 5;

FIG. 9 is a cross section on lines **9—9** of FIG 1;

FIG. 10 is a cross section on lines **10—10** of Fig. 1;

FIG. 11 is a cross section on lines **11—11** of FIG. 10; and

FIG. 12 is a detail cross section on **12** of FIG. 11.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to the figures, **20** denotes a split housing with shells **21, 22** molded from synthetic resin and an operator guiding metal insert **23**. The shells **21, 22** are held together by screws such as indicated at **25** in FIG. 1. The insert **23**, which carries the first contact actuator assembly, is held in the shells by means of an outer flange **26** and internal wings **27** (FIG. 1). The shells have registering terminal grooves which together form terminal passages **28, 29** (FIGS. 1 and 10), for confining the terminal bars to be described below. While the insert **23** has circular internal walls, the shells **21, 22** form a rectangular cavity **30** for guiding the essentially rectangular contact actuators.

The circuit breaker proper incorporates a first contact actuator **31** and a second contact **71**.

The first contact actuator **31** has a contact metal sleeve **32** and a metal stem **33** slidable relatively to each other and to the housing. The stem has a detent control collar **33.1** with sliding fit within the bore **32.1** of the contact sleeve, an upper detent neck **33.2**, a lower detent neck **33.3**, and upper and lower detent cam portions **33.4** and **33.5** respectively. At its outer end the stem **33** has an operator flange **35** and at its lower end it has a lift flange **36**. The lower end of the stem with the lift flange **36** forms a stem guide portion **37** in sliding fit with the contact distancing tube **41** to be described below. A washer **32.3** is fastened to the contact sleeve **32** with suitable means such as an annular rivet **32.5** which slides on the stem **33**.

On the washer **32.2** normally rests the operator body **39** with sleeve portion **39.1**, button portion **39.2**, and cover plate **39.3** of plastic material to which may be applied a coding color or legend. The button portion **39.2** has a recess **39.4** containing the operator flange **35** of the stem. A further, narrower, recess **39.6** contains an operator spring **40** tending to lift the stem **33** by way of the oper-

ator flange. The stem then slides within the operator sleeve portion 39.1 and the contact sleeve 32. Within the contact sleeve 32 also slides a contact distancing tube 41 of synthetic material which has an interiorly annular ridge 41.1 for guiding the stem portion 37 as mentioned above. By means of this ridge, the stem flange 36 can lift the tube 41.

A rectangular contact yoke 42 (FIGS. 1, 2, 8) is suitably fastened to the contact sleeve 32, such as by means of molding the bridge, made from synthetic insulating material, to the locking lip 32.9 of the recess 32.8 of the contact sleeve 32. A rectangular metallic contact bridge 51 is fastened to the insulating contact yoke 42 by means of rivets 52, 53 which are pressed into 42 and slide loosely in 51. A contact spring washer 54 between yoke and bridge provides contact pressure equalization. The contacts 55, 56 are in conventional manner such as by welding, fastened to the contact bridge 51. This bridge constitutes an electric connection between the two contacts and is wholly insulated from the contact actuator mechanism by the contact yoke 42. As shown in FIGS. 1, 2 and 8, the bridge 51 clears the distancing sleeve 41 at 51.1.

The contact sleeve 32 has (FIGS. 4 and 7) two circular guide holes 32.3, 33.4 wherein slide two balls 32.5, 32.6 constituting detent latches. The housing insert 23 has an annular detent catch groove 23.1 in the periphery of its inside wall, in the region of the contact sleeve holes and balls as shown in the figures. The lateral movement of the balls within their guide holes is controlled by the axial movement of stem 33 with collar 33.1, relatively to the axial movement of contact sleeve 32 with detent spring 61, as will be described below.

The actuator unit 31 incorporates, in addition to operator spring 40 and contact spring washer 54, further springs as follows. An opening and detent holding spring 61 is placed in the space 61.1 between the housing insert 23 and the contact sleeve 32, confined between washer 32.2 and a shoulder 62 of the housing insert 23. A contact holding and tripping spring 64 is placed around the stem guide portion 37. It rests at one end against the interior ridge 41.1 of the distancing tube 41 and at the other end against the recess shoulder 65 of the contact sleeve 32. For reasons which will appear hereinbelow, the operator spring 40 is weaker than the holding spring 64, and 64 is stronger than the restoring spring 76 of the second actuator unit now to be described.

The second contact actuator 71 (FIGS. 1, 2, 5 and 9) has a contact holder 72 of insulating material to which are fastened two metal latch bars 72.1 and 72.2. The contact holder 72 is suitably fastened to a guide tube 74 of synthetic resin which slides in the recess 75 of the housing shells and contains the above-mentioned restoring spring 76 tending to press it towards the first contact actuator 31. The contacts 75 and 76 are pressed into the contact holder 72.

As mentioned above, each housing shell has a pair of corresponding terminal grooves leading to the shell cavity 30. These form terminal passages 28, 29 (FIGS. 1, 10) for terminals 28.1, 29.1. Between the terminal passages and the recess 75 for the guide tube 74 are corresponding pairs of grooves which together form the bimetal mounting sockets 81, 82 (FIGS. 5, 10 to 12). These mounting sockets hold conventional folded bimetal elements 83 and 84, by way of interposed metal clips 81.1, 82.1 and insulating liners 81.2 and 82.2. The opposite ends of elements 83 and 84, carry catch sockets 83.1 and 84.1 with insulating liners 83.2 and 84.2. Clips 81.1, 82.1 are provided with latch rests 72.3 and 72.4 such as by severing portions of the top faces of the sockets 83.1, 84.1 on three sides and bending them up on one side, as shown in FIGS. 4, 5, and 11. Under normal operating conditions, the latch rests 72.3 and 72.4 of the sockets 83.1, 84.1 support the latch bars 72.1 and 72.2 of the contact holder 72. The restoring spring 76 tends to lift the contact yoke 72 but can normally not overcome the force of spring 64.

As shown in FIGS. 2, 5 and 10 to 12, the bimetal elements 83 and 84 are electrically connected as follows. Referring to element 83, at its end 83.5 (FIGS. 11, 12), the insulating liner 81.2 is replaced by a metal plate 83.6 and both clip 81.1 and plate 83.6 are at 85 welded to the terminal 28.1 in the passage 28. At the other end the element 83 has an ear 83.6 to which is welded one end of a flexible conductor strand 91. The other end of 91 is conductively fastened to the free end of contact 75. The connection of the other bimetal element 84 is similar. The terminal 28.2 is joined to an end of 84 at a welding point opposite to the ear 83.6 and the ear of 84 is opposite the weld 85 of terminal end 83.5. A strand 92 flexibly connects the ear of 84 to the contact 75.

The operation of the above-described circuit breaker will now be described, beginning with its circuit-making position as shown in FIG. 3. The trip free opening operation will then be described with reference to FIGS. 4 and 5, and finally the operation leading from closed (or tripped) to normally open position will be explained with reference to FIGS. 3, 4, 6, 1 and 2. The lines marked N, applied to certain figures, indicate normally closed contact position. It will be helpful to relate the various operations to these lines.

In circuit making position (FIG. 3) the second contact actuator 71 is held in normal position by the bimetal elements 83, 84, with the latch rests 72.3, 73.4 on the latch bars 72.1, 72.2, respectively. The operator push button 39.2 of the first contact assembly having been pressed down, the sleeve 32 with yoke 42 is urged downwardly by the spring 64 which is stronger than the spring 76 of the second actuator. It will be noted that springs 64 and 76 together constitute the previously mentioned contact moving means. The detent latch balls 32.5 and 32.6 are retained in the detent catch groove 23.1 by the detent collar 33.1. The spring 64 presses the distancing tube 41 against the contact holder 72. The weak spring 40 moves the stem 33 upwardly and holds it in the detent locking position. The stronger spring 64 does not come into action at this stage of the operation. The button can be safely released once this position is established. It will be noted that the operator flange 35 of the stem 33 is halfway up within the operator recess 39.4 and that the lift flange 36 approaches the contact holder 72 of the second actuator. It will also be noted that the contact spring washer 54, in addition to providing equalized contact pressure, takes up over travel between the first actuator 31 and the housing upon the operator being pushed down. In this circuit making position, the current path leads from one terminal such as 28.1 (FIGS. 1, 2, 5) to the bimetal element 83 by way of the weld point 85 (FIGS. 11, 12) where the insulating liner is removed as described above, from there through the ear 83.6 and the tail 91 to contacts 75 and 55, then via bridge 51 to contacts 56 and 76, from there through the other tail 92 to the tail ear of the bimetal element 84, and from there through the weld point of bimetal element 84 to terminal 29.1.

As pointed out above, in normally closed position the springs 64 and 76 are compressed and the distancing tube 41 rests on the contact holder 72 of the second contact actuator 71. Upon occurrence of an overload, the bimetal elements 83, 84 heat up in the above outlined series circuit and bend outwardly as shown in FIG. 5. The first actuator unit 31 retains the contacts 55, 56 in normal position "N" by means of the detent device, but the distancing tube 41 is advanced by the spring 64 which, being stronger than 76, moves the contact holder 72 and the contacts 75, 76 down away from contacts 55, 56. The stem 33 is moved downwardly by flange 36 being engaged by the ridge 41.1. Initially, the flange 35 moves upwardly within the cavity 39.4, but then moves down into the position of FIG. 4, due to the above described relative strength of the spring.

The flange **36** contacts the interior ridge **41.1** of the distancing tube **41** which keeps moving down as indicated in FIG. 4. The bimetal element returning to normal shape will lean against the latch bars **72.1, 72.2.** It is impossible to close the circuit breaker after tripping due to a faulty load, since the first actuator **31** is then already in the ultimate (normally closed) position "N" and can only be moved oppositely into open position away from "N." On such opening movement from tripped position, with tube **41** moving up, the second actuator **71** is moved toward "N" by the spring **76,** and stopped at "N" by **41** having come to rest. The circuit breaker is then in normally open position. Since this opening operation (which will be described with reference to FIG. 6) involves movement of tube **41** away from contact holder **72,** the cooling bimetal elements can then move inwardly below the latch bars **72.1, 72.2.**

To open the circuit breaker from the normally closed position according to FIG. 3, the operator button **39.2** is pulled outwardly which moves the flange **35** of the stem **33** towards contact with the shoulder **35.1** of the operator recess **39.4.** The operator sleeve **39.1** separates from the contact sleeve **32,** and the lift flange **36** of the stem contacts the ridge **41.1** of the distancing tube **41** which is now also lifted. The detent collar **33.1** of the stem moves upwardly with the detent latch balls **32.5, 32.6** therebelow and within the guide holes **32.3, 32.4** but dislodged inwardly into the lower detent neck **33.3.** With the stem moving up further, the balls are able to move around the collar by deviating into the space **61.1** provided for the detent holding spring **61** between parts **23** and **32** as above described. This intermediate position is shown in FIG. 6. With the operator fully pulled out as shown in that figure, the spring **61** moves the sleeve **32** towards the sleeve portion **39.1** o fthe opeartor body until the contacts are fully open. The flange **35** still rests on the shoulder **35.1** of the operator recess **39.4,** and the operator body **39** remains separated from the contact sleeve **32.** Upon releasing the operator button **39.2,** the strong spring **64** pulls the stem **33** down by way of the tube **41** with ridge **41.1,** and flange **35** on shoulder **35.1.** As the stem moves down the balls deviate into the above referred to space **61.1** so that they are now again above the detent collar **33.1.** The operator sleeve portion **39.1** now contacts the sleeve and the distancing tube **41** sits on the contact holder **72** of the second contact actuator **71.** The normally open position as shown in FIGS. 1 and 2 is thus established.

I claim:

1. A trip free circuit breaker of the type having detent means for positioning contact means relatively to a housing wherein they reciprocate, comprising

first reciprocating contact actuating means slidingly guided in the housing, and including operator means, first contact means, and detent means for engagement with the housing;

second reciprocating contact actuating means slidingly guided in the housing collinearly with the first contact actuating means, and including second contact means registering with said first contact means;

contact moving means for elastically forcing the first and second actuating means towards each other; and

load responsive means for normally holding the second contact actuating means in position for making or breaking circuit with the first contact means, and for releasing the second contact actuating means for withdrawal from the first contact actuating means in closing position upon occurrence of an abnormal load condition;

whereby, with the second contact actuating means in normally held position, the first contact means can be opened and closed with the operator means, and under abnormal load conditions the second contact means is withdrawn from the first contact means.

2. Circuit breaker according to claim **1,**

wherein said operator means and said first contact means are mounted at opposite ends of the first contact actuating means, and

wherein said detent means include latch means with detent control and actuating means intermediate the operator means and the first contact means, and resilient means interposed between the operator means and the detent means.

3. Circuit breaker according to claim **1,**

wherein said contact moving means include holding spring means between the operator means and the first contact actuating means and restoring spring means between the housing and the second contact actuating means.

4. Circuit breaker according to claim **3** wherein said holding spring means is stronger than said restoring spring means.

5. Circuit breaker according to claim **1** wherein the housing has an interiorly peripheral catch groove, and wherein said first contact actuating means includes:

a stem sliding within said operator means, and having in the region of said catch groove a detent collar leading on each side with respective detent cams to upper and lower detent necks, respectively,

a contact sleeve surrounding said stem carrying said first contact means, and having radial detent perforations loosely containing latch body means capable of contacting said detent collar for moving them into said catch groove of the housing and for alternately being released from the catch groove towards one of said necks, and

opening spring means interposed between housing and contact sleeve and tending to move the contact sleeve towards the operator means.

6. Circuit breaker according to claim **1** wherein said first contact actuating means includes:

a stem having at one end a flange within a recess of the operator means and an operator spring tending to move the flange away from the contact means and having at the other end a lift flange,

a contact sleeve surrounding said stem, contacting at one end said operator means and carrying at the other end said first contact means,

opening spring means interposed between housing and contact sleeve and tending to move the contact sleeve towards the operator means,

a distancing tube slidable within said other end of the contact sleeve for projection therefrom and engagement with said second contact actuating means, and having an interior peripheral projection confining said lift flange at the side facing the second actuating means, for retrieval of the distancing tube by said lift flange, and

contact holding spring means interposed between and tending to separate said contact sleeve and said distancing tube.

7. Circuit breaker according to claim **1,** wherein said detent means includes an interiorly peripheral groove on the housing and wherein said first contact actuating means includes:

a stem sliding within said operator having at one end a flange within a recess of the operator means and an operator spring tending to move the flange away from the contact means, having at the other end a lift flange, and having intermediate the two flanges in the region of said catch groove a detent collar leading on each side with respective detent cams to upper and lower detent necks, respectively,

a contact sleeve surrounding said stem, contacting at one end said operator means, carrying at the other end said first contact means, and having radial detent perforations loosely containing latch body means capable of contacting said detent collar for moving them into said catch groove of the housing and for

alternately being released from the catch groove towards one of said necks,

opening spring means interposed between housing and contact sleeve and tending to move the contact sleeve towards the operator means,

a distancing tube slidable within said other end of the contact sleeve for projection therefrom and engagement with said second contact actuating means, and having an interior peripheral projection confining said lift flange at the side facing the second actuating means, for retrieval of the distancing tube by said lift flange, and

contact holding spring means interposed between and tending to separate said contact sleeve and said distancing tube.

8. Circuit breaker according to claim 1 wherein said operator means extends from said first contact actuating means at one end of the housing, and wherein said second contact actuating means includes:

a contact slide guided in said housing at the other end thereof opopsite the operator means,

a contact holder fastened to said slide, carrying said second contact means and having latch means, and

thermoresponsive catch means fastened to the housing at said other end and normally engaging said latch means and under abnormal load conditions tending to release the contact holder which is by said contact moving means moved away from the first contact actuating means which is held in normally closed position by the detent means.

9. Circuit breaker according to claim 1, wherein said housing has a recess opposite said second contact actuating means aligned with said operator means, and terminal openings adjacent the recess, wherein said contact moving means includes restoring spring means urging the second contact actuating means towards the first contact actuating means, and wherein said second contact actuating means includes:

a contact slide guided in said recess,

a contact holder fastened to said slide, carrying said second contact means and having latch means,

terminals leading through said openings into said housing, and

thermoresponsive catch means fastened to the housing electrically interposed between respective terminals and said second contact means and normally engaging said latch means, and under abnormal load conditions tending to release the contact holder which is by said contact moving means moved away from the first contact actuating means which is held in normally closed position by said detent means, said restoring spring means urging said contact holder towards said first contact actuating means.

10. Circuit breaker according to claim 9 wherein said latch means include two latch bars protruding on opposite sides of the contact holder, and wherein said thermoresponsive catch means include two bimetal structures at either side of the contact slide, each fastened with one respective end to the housing, and having at the respective opposite ends latch rests normally resting on the latch bars and supporting the contact holder against the force of the contact moving means.

References Cited

UNITED STATES PATENTS

2,912,546	11/1959	Arey	337—62
3,042,776	7/1962	Arey et al.	337—62
3,210,501	10/1965	Clarke	337—62

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R. L. COHRS, Assistant Examiner

U.S. Cl. X.R.

337—62