Nov. 17, 1953 R. T. CASEY 2,659,788

CIRCUIT BREAKER SWITCH UNIT

Filed Dec. 28, 1949

2 Sheets-Sheet 1

Fig. 1.

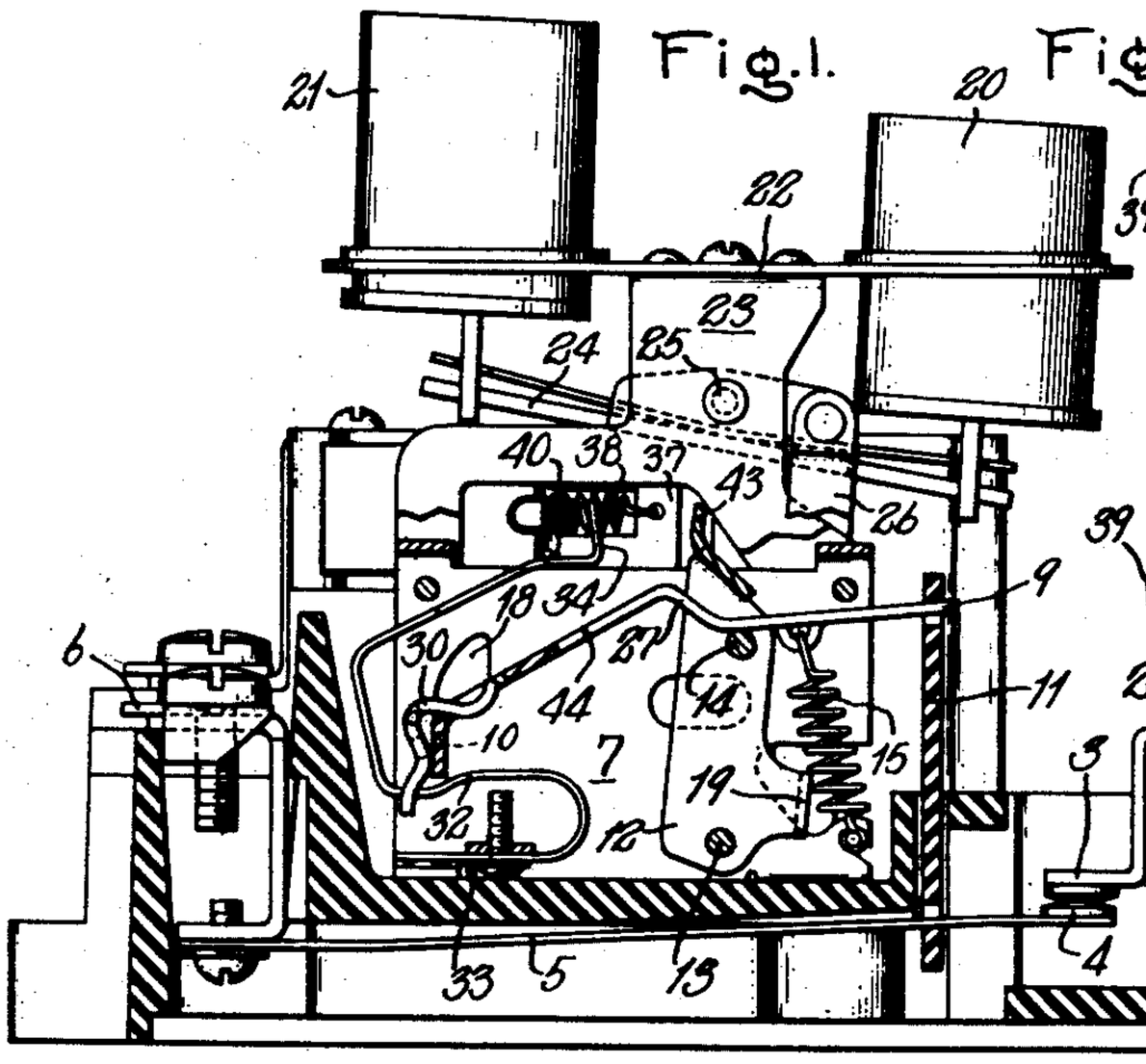

Fig. 1a.

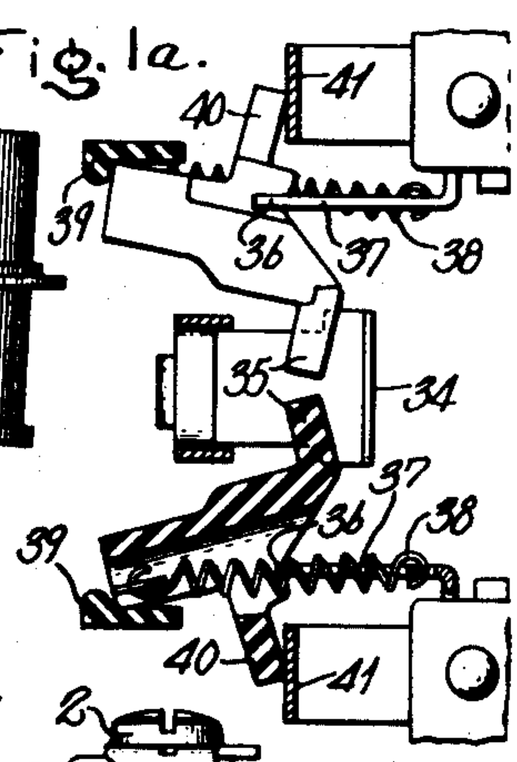

Fig. 2.

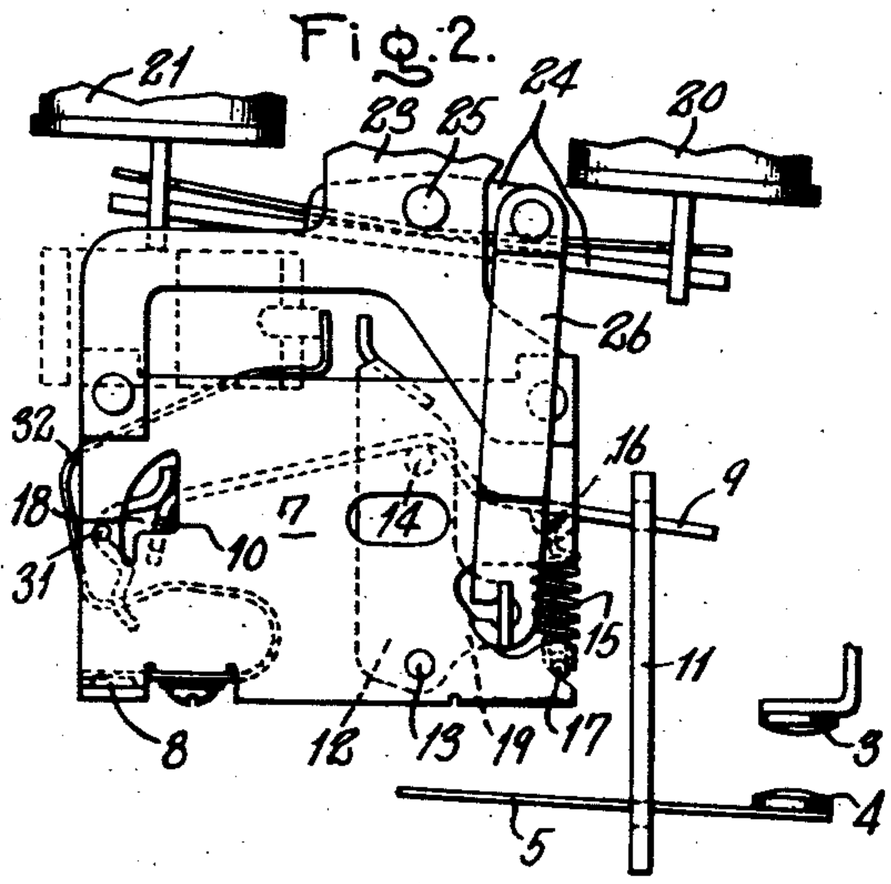

Fig. 3.

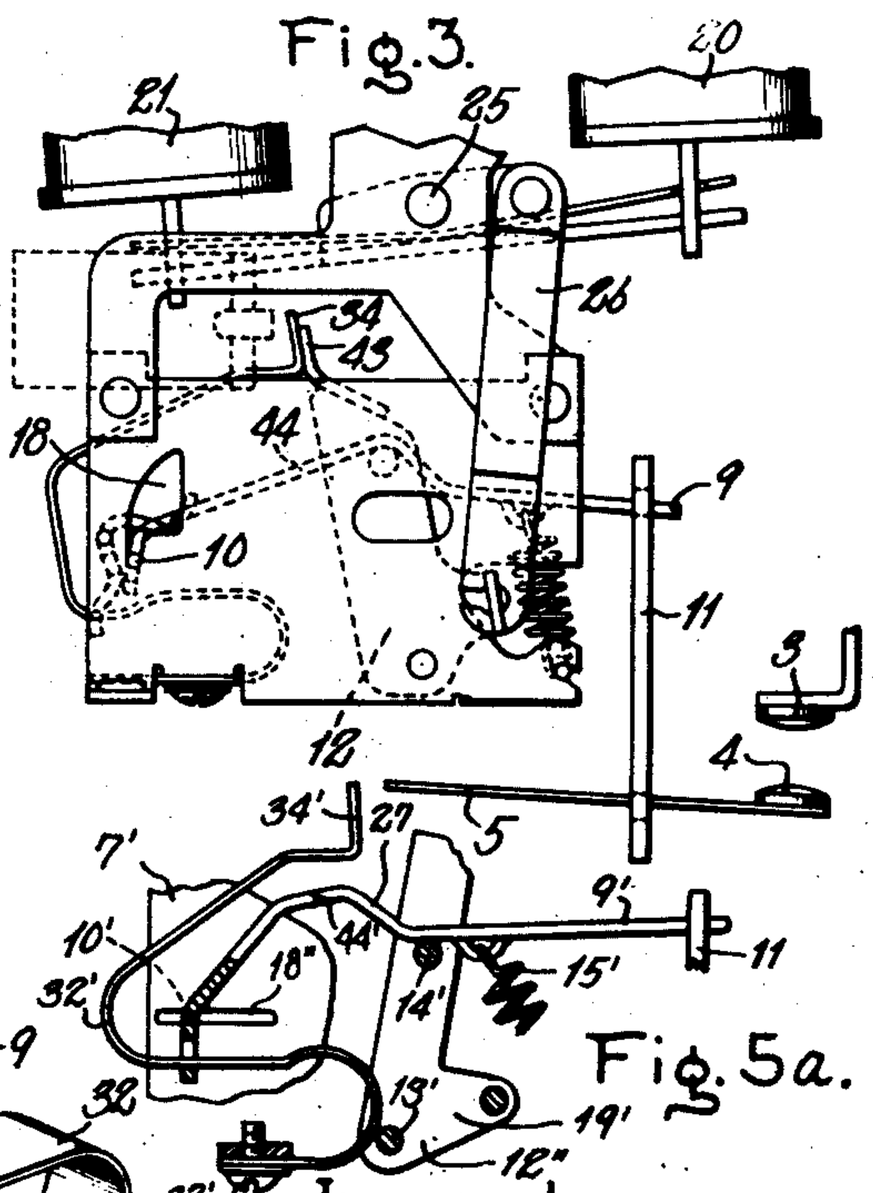

Fig. 4.

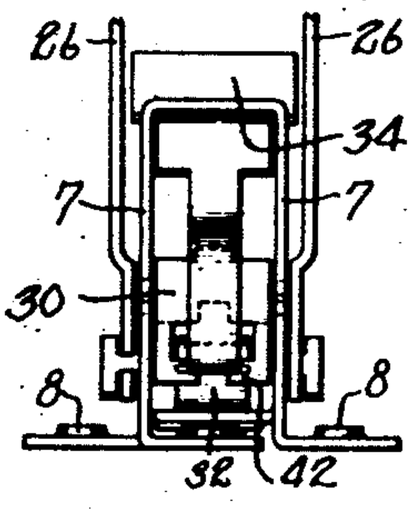

Fig. 5.

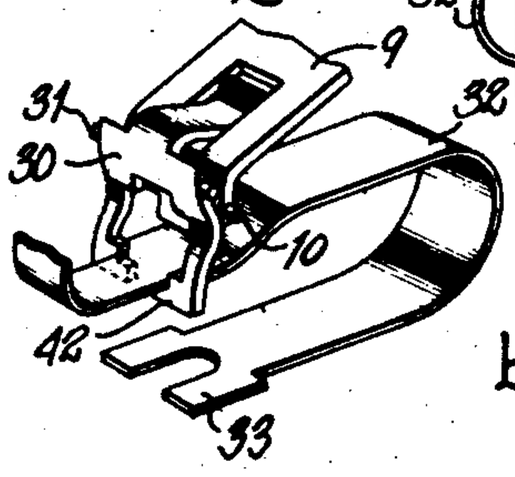

Fig. 5a.

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CIRCUIT BREAKER SWITCH UNIT

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Fig. 6.

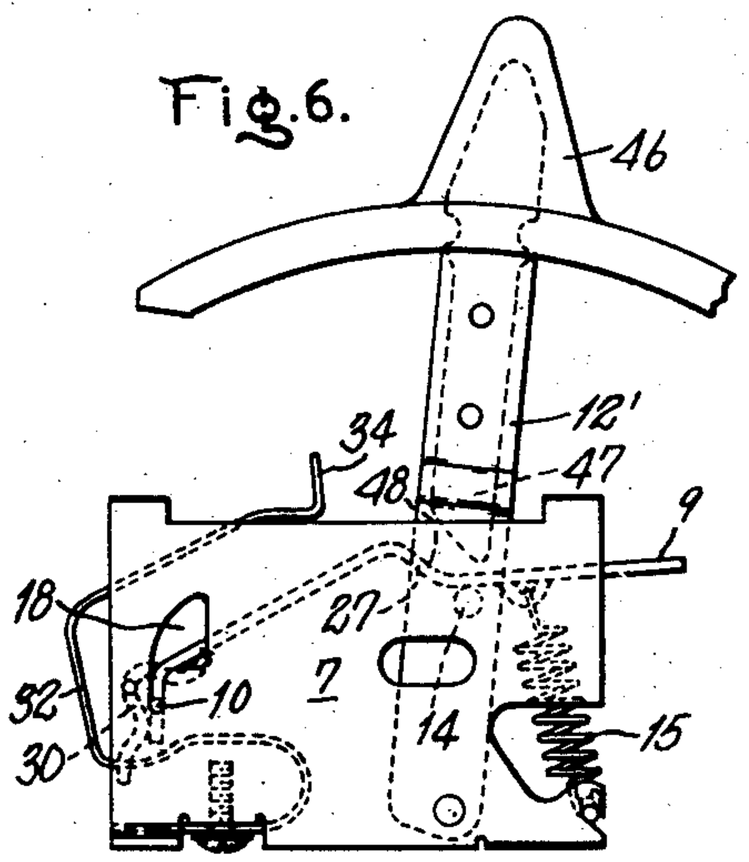


Fig. 7.

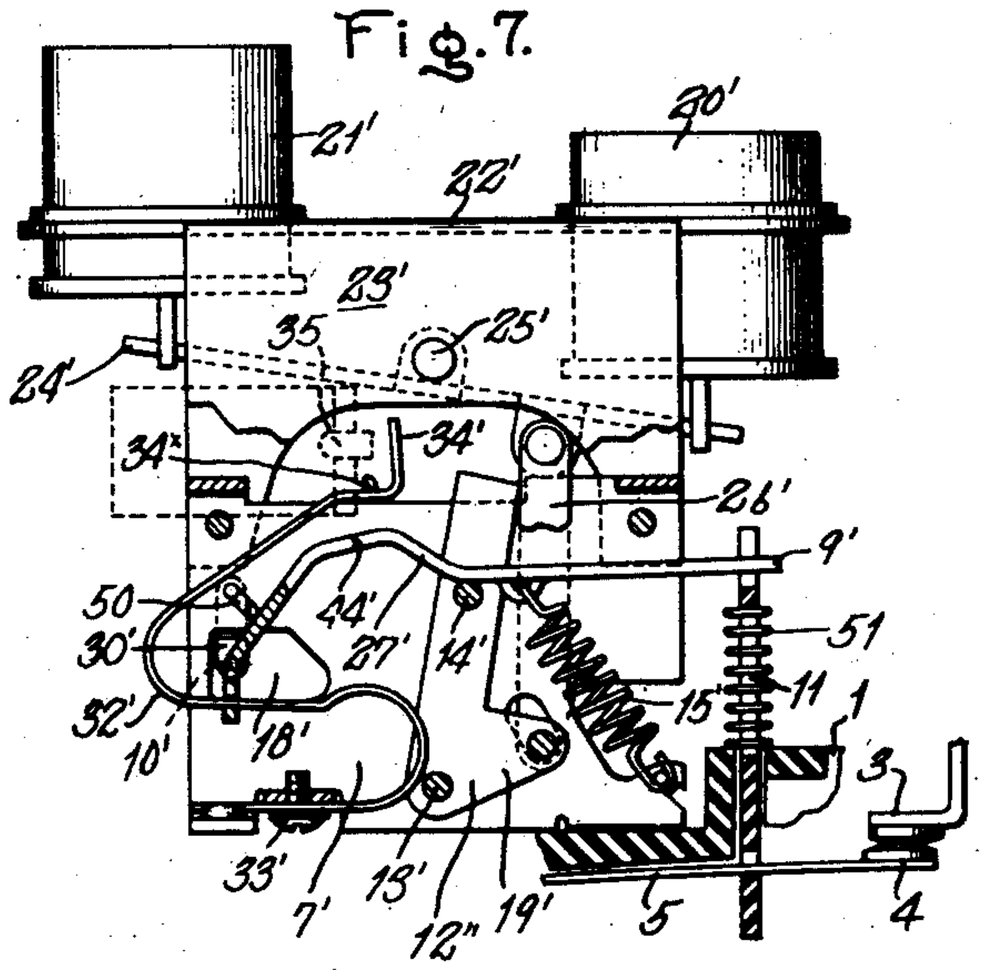


Fig. 8.

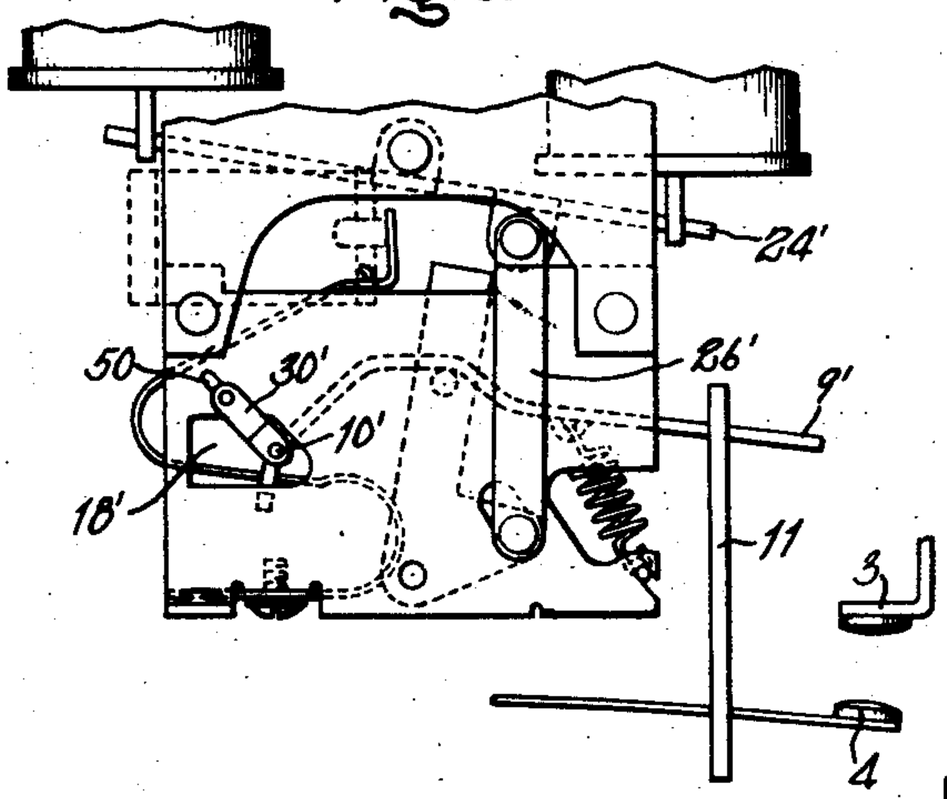


Fig. 10.

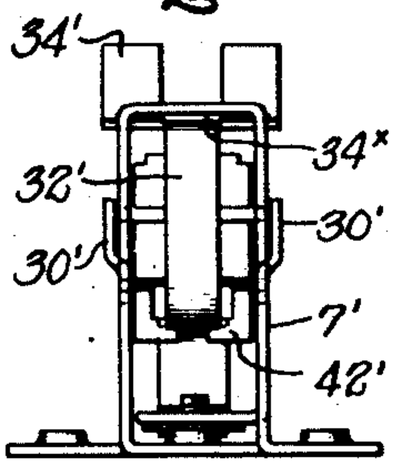


Fig. 9.

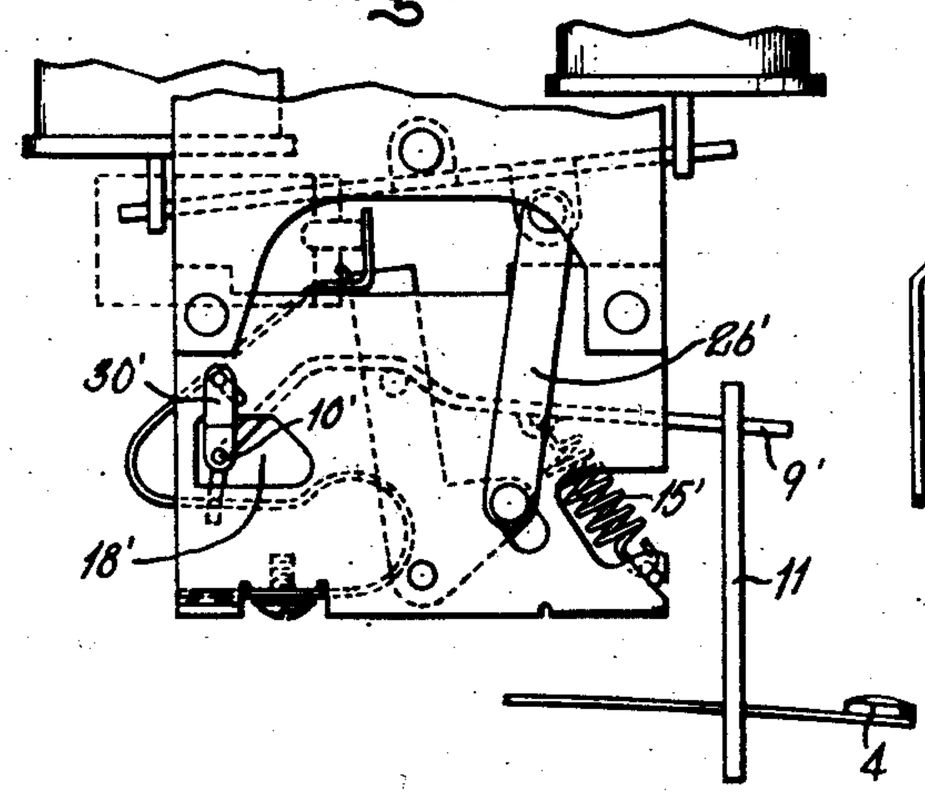
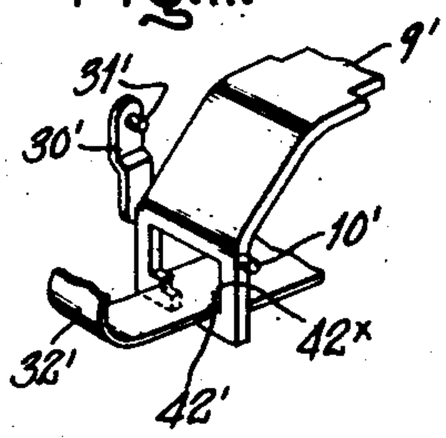


Fig. 11.



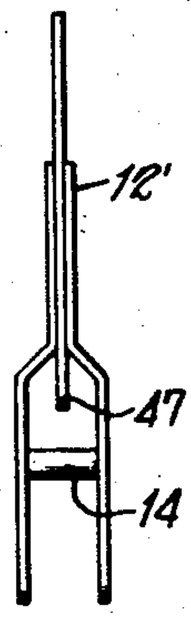


Fig. 6a.

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Patented Nov. 17, 1953

2,659,788

UNITED STATES PATENT OFFICE

2,659,788

CIRCUIT BREAKER SWITCH UNIT

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Application December 28, 1949, Serial No. 135,376

11 Claims. (Cl. 200—116)

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My invention relates to electric switch mechanism which is operable manually and particularly to a mechanism which can be installed as a unit to be associated with an overload release of an automatic circuit breaker.

Such circuit breakers are provided with circuit making and breaking elements which are operable by means of push buttons or levers and are also adapted to open a circuit or circuits automatically in case of an overload and are usually so constructed that they can be reset manually.

One object of the present invention is to provide a simple, inexpensive and reliable mechanism for use in a circuit breaker by which the circuit or circuits may be opened and closed manually and by which the circuits will open automatically in case the overload release of the circuit breaker is actuated.

Another object is to provide for the manual resetting of the circuit breaker after an automatic breaking of the circuit.

Another object is to provide a switch unit which is sensitive in operation and yet free from danger of release due to shock.

Another object is to provide a switch unit which can be adapted for use in either a push button or lever-actuated type of circuit breaker.

Another object is to provide a switch unit whose operating means will assume a distinct position upon automatic opening of the contacts, to furnish an indication of such automatic opening.

Another object is to provide a circuit breaker which is sensitive to automatic action but reliable.

Fig. 1 is a fragmentary longitudinal sectional view and side elevation showing a push-button-actuated type switch with the parts of the switch in the closed circuit position.

Fig. 1*a* is a fragmentary plan view showing the relation of the improved mechanism to a circuit breaker.

Fig. 2 is a fragmentary side view showing parts in the automatically tripped position.

Fig. 3 is a similar fragmentary side view showing the parts in the manually opened position.

Fig. 4 is an end view of a fragment of the operating mechanism, omitting the push button operators.

Fig. 5 is a fragmentary perspective view showing the latching device and coacting parts.

Fig. 5*a* shows a modified detail of construction.

Fig. 6 is a fragmentary side view showing a lever-actuated type of mechanism with parts in the normal "on" position.

Fig. 6*a* is an edge view of the actuating lever of Fig. 6.

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Fig. 7 is a side view and partial section showing modified details of a push button actuated type switch showing the parts in the closed circuit position.

Fig. 8 is a fragmentary side view of the parts shown in Fig. 7 but showing the parts in the automatically tripped position.

Fig. 9 is a view similar to Fig. 8 showing the parts in the manually open circuit position.

Fig. 10 is a fragmentary end view of parts of the mechanism of Figs. 7 to 9, inclusive, omitting the push button operators.

Fig. 11 is a fragmentary perspective view of the latching means of Figs. 7 to 10, inclusive.

In the form shown in Fig. 1, the base 1 of the circuit breaker is formed of insulating material and mounts the circuit terminals and switch contact elements and the switch actuating unit. The terminal 2 is connected to a stationary switch contact 3 and the movable switch contact 4 is carried by a spring arm 5 which is supported by the terminal 6.

The switch actuating unit has a frame 7 whose side plates have feet 8, 8 secured to the base in any suitable manner. The operating arm or lever 9 has pivot pins 10 forming a pivot supported and guided in openings 18 in the side plates and is connected by an insulating link 11 to the switch contact arm 5.

A lever 12 is pivoted at 13 between the side plates and has a projecting pin or roller 14 against which the arm 9 is pulled by spring 15 which connects the eye 16 of the arm 9 to a pin 17 supported in the frame 7.

Lever 12 has an extension 19 to which the actuating push buttons 20 and 21 are connected. These push buttons are guided in openings in a face plate member 22 which is supported by a frame 23 connected to frame 7 in any suitable manner. The rocker 24 pivoted at 25 in frame 23 has its opposite ends connected to the push buttons in any suitable manner and is connected by links 26 to the extensions 19 of lever 12.

It will be seen that the spring 15 exerts a diagonal pull on the arm 9, one component biasing the arm vertically downward against the roller or projection 14 on lever 12 and the other component biasing the arm horizontally (as viewed in the drawing). When button 21 is depressed, it tilts rocker 24, raises link 26 and turns lever 12 anticlockwise with movement of the projection 14 longitudinally of the arm 9 toward the left. Thereupon the spring 15 pulls the arm 9 so that the projection 14 slides along the inclined cam portion 27 of arm 9 from the position of Fig. 1 to that of Fig. 3, thus opening the circuit. It

will be seen that the cam portion 27 intermediate the ends of the arm 9 is offset transversely with respect to the pivot 10. Depression of button 20 reverses the action and closes the circuit.

As shown in the drawing, the projection 14 is held by the arm 9 and spring 15 in each of the positions of Figs. 1 and 3. In Fig. 1 the projection 14 has been moved to a position past the outside or right-hand bend in the arm 9 so that the force of the spring 15 is applied to the projection 14 along a line passing substantially to the right of the pivot 13 for the lever 12. In Fig. 3 the projection 14 is held by being seated in the inside or left-hand bend in the arm 9.

A latch 30 is pivoted at 31 in the frame and normally engages the end of arm 9. Strip spring 32 resiliently holds the latch and the pivoted end of arm 9 in the positions of Figs. 1 and 3. This spring 32 is of approximately S-shape and has one end 33 fixed to the frame and its remote end 34 arranged in the path of movement of a part of the overload release member 35. This latter member is of insulating material and is hinged at 36 to a stationary support 37 carried by the base. A spring 38 in the operating condition pulls the release member against the stationary shoulder 39 of the base with its finger 40 close to the bimetal overload current-responsive strip 41.

When the overload actuated member 41 is brought into play by an overload or predetermined high current in the circuit, it engages the finger 40 of the release member and tilts it about its pivot 36 and the spring 38 snaps it over so that the member 35 strikes the end 34 of the release spring.

As the end 34 of the release spring 32 is pressed by the member 35, and moved toward the right-hand as seen in Figs. 1 to 3, the spring itself is distorted so that its intermediate portion passing through jaws 42 of the latch 30 is caused to move upwardly so as to release the latch, which in turn releases the end of arm 9 so that the spring 15 can tilt the arm 9 about the roller 14 and move the parts to the tripped position of Fig. 2 intermediate the normal "on" and "off" position.

To reset the parts from the automatically tripped position of Fig. 2, button 21 is depressed so that the end 43 of lever 12 presses against the tip 34 of the spring latching member and an edge of lever 12 engages the shoulder 44 on arm 9. The arm 9 is thus shifted until the pivot pins 10 are returned to the bottom of the slots 18 as shown in Fig. 3, the latch 30 being turned clockwise somewhat to its latched position on the spring 32 by the lower left-hand end of the arm 9. The button 20 may then be depressed to close the circuit.

Referring to the preferred form, it will be seen that in moving from the open circuit position of Fig. 3 to the closed circuit position of Fig. 1, operating arm 9 first pulls switch arm 5 upwardly by means of insulating slide 11, until movable contact 4 engages staitonary contact 3.

Arm 9 continues its upward movement for a very short distance after the contacts are closed, thereby bending switch arm 5 slightly as shown in Fig. 1, thereby insuring the maintenance of good contact pressure, switch arm 5 being made of resilient material.

In order to operate properly, the arm 9 and the latch 30 are relatively rigid but the latch operating member 32 is formed of spring material.

It will be noted that the upper end of spring member 32 has considerable freedom of motion

which permits the proper coaction with the latch member and also permits the resetting of the release member 35 when the operating arm 9 is reset.

The opening 18 has a narrow slot-like portion extending vertically with respect to the horizontally movable arm 9 so as to normally guide the pivot pins 10 and oppose longitudinal movement of the arm 9 by the pull of the spring 15 (see Figs. 1 and 3). The upper part of this opening 18 is enlarged so as to permit the floatingly mounted arm to move longitudinally toward the right-hand (see Fig. 2) when the latch 30 releases the end of the arm 9, when the spring release member 32 is retracted by the pressure of member 35.

It will be observed that in moving from the closed position of Fig. 1 to the tripped position of Fig. 2, the arm 9 when released is first pivoted clockwise by the spring 15 about the roller 14 to move the pins 10 upward out of the narrow vertical slot portions in the lower ends of the openings 18, at which point the arm 9 is moved longitudinally toward the right both by the normal longitudinal component of the spring 15 and the increase in this component effected by the clockwise pivoting of the arm on the projection 14. Thereafter the cam portion 27 slides over the projection 14 thereby still further increasing the longitudinal force on the arm 9 toward the right to give more positive longitudinal movement of the arm, the arm pivoting clockwise about the pins 10, and at the same time applying an oppositely directed force to the roller 14, i. e., a counter-clockwise force to the lever 12 about the pivot 13. The arm 9 comes to rest longitudinally when the pins 10 engage the right-hand wall of the upper enlarged part of opening 18 and the lever 12 comes to rest in the intermediate tripped indicating position of Fig. 2 by the seating of the roller 14 in the inside bend in the arm. In the event that the lever 12 is held in the position of Fig. 1 by continued pressure on the button 20, the arm 9 is pivoted by the spring 15 about the projection 14 until the pins 10 engage the upper end of the opening 18 thereby to provide for substantially complete open circuit separation of the contacts.

Fig. 6 shows the invention as applied to a lever-actuated type of switch mechanism. In this form, the frame 7 supports an operating arm 9, a spring 15, a latch 30 and a spring release member 32 which are similar to the corresponding parts just described. I have also shown a lever 12' which corresponds with lever 12 previously described. This lever 12' extends from the frame and is provided with a handle or finger piece 46 by which the switch is manually actuated and reset in the same manner as by the push buttons.

Figs. 6 and 6*a* show an arm 47 formed as a part of lever 12' which serves to engage the upper inclined edge 48 of arm 9 and force the arm 9 to an open circuit position when the lever 12' is moved to the "off" position.

In the form shown in Figs. 7 to 11, inclusive, I have shown the switch mechanism substantially the same as that shown in Figs. 1 to 5, inclusive, with the exception of the method of hinging the actuating arm. The hinge pins 10' in this case are supported by links 30' which are hinged at 31' in the opposite side plates of the frame 7'.

The lever 12'' is hinged at 13' and carries the projecting pin or roller 14' which supports the arm 9' adjacent the cam portion 27'. The spring 15' biases the arm 9' downwardly and toward

the right as shown in Figs. 7 to 9, inclusive. The push buttons 20' and 21' are guided in the face plate 22' of the frame 23' and actuate a rocker 24' pivoted at 25' to the link 26' which is connected to the extension 19' of the actuating lever. The elongated substantially S-shaped spring strip 32' is anchored at 33' and has the terminal ears 34' adapted to be engaged by the release member 35 in case of an overload as previously described. The horizontal arm of the spring 32' is notched at 42x to receive the jaws 42' of the operating arm 9' as shown in Fig. 11. This interlock holds the left hand end of operating arm 9' in a manner similar to the action previously described so that the opening and closing movements of the arm 9' is effected manually in the same manner as that of Figs. 1 to 3, inclusive. In this case, the release spring is provided with an upturned lug 34x which is engaged by the edge of the actuating lever 12'' in resetting the switch after automatic trip.

The automatic trip takes place when the release member 35 engages one of the ears 34' and releases the spring 32' from the interlock. This permits the spring 15' to move the arm 9' which slides over the projection 14' and causes the left hand end of the arm 9' to move longitudinally forward from the position of Fig. 7 to that of Fig. 8 at which time the hinge pivots 31' of the links 30' slide downwardly in the inclined slots 50, the links acting as a latch to normally hold the arm 9' in position for manual operation.

It will be seen that the links 30' are mounted on the outside of the frame plates and have offset portions which pass through the openings 18' to engage the hinge pins 10' of the arm 9'.

A supplemental spring 51 may be provided to bias the connecting slide 11 upwardly as shown in Fig. 7 so that the operating arm 9' only engages the slide when the switch is thrown "off," when it will push the slide downwardly to open circuit position against the bias of this supplemental spring. This method allows the arm 9 or 9' to be free of any contact pressure loading and reduces friction against horizontal movement of the actuating arm in tripping since the vertical component of the spring 15 or 15' is the only force causing such friction and it acts very close to the pivot point 14.

It is the horizontal component of the pull of the spring 15' which serves to slide the arm 9' forward on automatic tripping and the vertical component moves the arm downwardly to open the circuit. It is therefore possible to provide for the proper distribution of the force of spring 15' between these two functions merely by suitably arranging the angle of pull of the spring with respect to the horizontal line of movement of arm 9'. It is thus possible to minimize the pressure of the arm 9' on the spring 32' at its latching connection. For this purpose the horizontal component of the tension of spring 15' is arranged to be just sufficient to overcome the latching engagement and overcome the friction of the parts and cause movement of the arm at the proper time. This is possible regardless of the vertical forces required to ensure positive separation of the switch contacts in opening the circuit.

Fig. 5a shows a simplified method of supporting the arm 9' adjacent the connection with the latching member 32'.

Here the links 30' have been omitted and the pivot pins or bearings 10' are guided in horizontal slots 18'' adjacent the latching connection between arms 9' and the releasing spring 32'.

The S-shaped latching and release spring being resilient throughout its length and being light in weight absorbs the effects of shocks and vibrations so that it is very difficult to cause accidental tripping by reason of shocks or vibrations.

When the switch is tripped automatically the operating member takes up a position intermediate the "on" and "off" position and thus serves as an indication of the condition of the circuit.

I claim:

1. In a circuit breaker having a stationary switch contact and a movable switch contact and an overload actuated member, a unit for actuating said movable switch contact comprising a U-shaped frame having opposed openings in its side walls, an actuating lever hinged to and between the side walls of the frame, an operating arm floatingly connected with said lever and at one end with the edges of the openings, the other end of the arm being operatively connected to the movable switch contact, a spring normally urging movement of the operating arm, a latch hinged between the side walls of the frame and interlocked with the other end of the arm for holding the arm against movement by said spring, manually operable means extending externally of the frame for actuating said lever and for permitting the spring to move the arm and means associated with said latch for shifting said interlock upon an overload including a spring member interlocked with said latch and having a free end to be engaged by an overload actuated member.

2. A circuit breaker comprising a fixed contact and a movable contact, a manually movable member for controlling movement of said contacts into and out of engagement, a floating actuating lever between said manual member and said movable contact and having a pivotal engagement with said manual member, spring means always biasing said floating lever for engagement with said manual member, a member movable in response to the effect of an abnormal current to release said floating lever, said release member acting as a support for said floating lever whereby said floating lever pivots about its point of engagement with said releasable member during manual engagement and disengagement of said contacts, said floating lever rotating about said point of pivotal engagement with said manually operable member upon release of said release member, and means for guiding said floating lever in its movements, so as to permit said member to move to its automatically tripped position, but to prevent it from returning to its original position thereafter without a positive manual resetting operation, said floating lever having oppositely disposed projections adjacent the end thereof about which it normally pivots, and means for guiding said floating lever in its movements, said means including side walls on either side of said floating lever and generally arcuate slots in said side walls, said projections being guided in said slots, said slots having an enlarged portion adapted to trap said projections therein upon automatic release of said circuit breaker whereby the movement of said parts is arrested so as to cause said manually movable member to assume a position intermediate its "on" and "off" positions for the purpose of indicating its automatically tripped condition.

3. A circuit breaker comprising cooperating switch contacts, an arm having one end connected to move one of said contacts and formed with a transverse cam portion intermediate its ends, means for pivotally supporting the other

end of said arm and providing for longitudinal movement of said arm in a predetermined direction, current-responsive latching means for securing said pivoted end in a predetermined pivoted position, an operating projection mounted for movement longitudinally of said arm, and a spring connected to said arm for biasing said arm about said pivoted end against said projection to an open circuit position so that movement of said projection in said predetermined direction over said cam portion moves said arm about said pivoted end to a closed circuit position and release of said pivoted end by said current-responsive latching means effects movement of said cam portion over said projection with longitudinal movement of said arm by said spring in said predetermined direction to an open circuit position.

4. A circuit breaker comprising cooperating switch contacts, an arm having one end connected to move one of said contacts and formed with a transverse cam portion intermediate its ends, means for pivotally supporting the other end of said arm and providing for transverse movement of said arm and for longitudinal movement of said arm in a predetermined direction, current-responsive latching means for securing said pivoted end in a predetermined pivoted position, an operating lever having a projection, and a spring connected to said arm for biasing said arm about said pivoted end against said projection to an open circuit position so that movement of said projection in a predetermined direction over said cam portion moves said arm about said pivoted end to a closed circuit position and release of said pivoted end by said current-responsive latching means effects movement of said cam portion over said projection with longitudinal movement of said arm by said spring in said predetermined direction to an open circuit position.

5. A circuit breaker comprising cooperating stationary and movable switch contacts, an arm provided with a pivot at one end and having an intermediate cam portion offset transversely of said pivot, an operating connection between the other end of said arm and said movable contact, means supporting said pivot for movement of said pivot and said arm both transversely and longitudinally of said arm from one position to another, means for securing said pivot in one of said positions, an operating member intermediate the ends of said arm mounted for movement longitudinally of said arm, a spring for biasing said arm about said pivot against said operating member to an open circuit position so that movement of said operating member over said cam portion moves said arm about said pivot to a closed circuit position and continued movement of said operating member to a position past said cam portion secures said arm in said closed position, and means responsive to the current in said contacts for releasing said pivot for movement to its other position upon the occurrence of a predetermined high current to effect movement of said cam portion over said operating member with pivotal and longitudinal movement of said arm by said spring to an open circuit position.

6. A circuit breaker comprising cooperating switch contacts, an arm having one end connected to move one of said contacts and formed with a transverse cam portion intermediate its ends with inside and outside bends at the respective ends of said cam portion, means for pivotally supporting the other end of said arm and providing for movement of said pivot for transverse and longitudinal movement of said arm, current-responsive latching means for securing said pivoted end in a predetermined pivoted position, an operating projection mounted for movement longitudinally of said arm and a spring connected to said arm for biasing said arm about said pivoted end against said projection to an open circuit position so that movement of said projection over said cam portion moves said arm about said pivoted end between closed and open circuit positions with said projection seated in said inside bend in said closed position and release of said pivoted end by said current-responsive latching means effects movement of said cam portion over said projection with pivotal and longitudinal movement of said arm by said spring to an open circuit position and movement of said projection back to an intermediate position in which said projection is seated in said inside bend.

7. A circuit breaker comprising cooperating stationary and movable switch contacts, an arm provided with a pivot at one end and having an intermediate cam portion offset transversely of said pivot with inside and outside bends at the respective ends of said cam portion, an operating connection between the other end of said arm and said movable contact, means supporting said pivot for movement of said pivot and said arm both transversely and longitudinally of said arm from one position to another, means for holding said pivot in one of said positions, a spring for biasing said arm about said pivot to an open circuit position, an operating member engaged by said arm mounted for movement longitudinally of said arm over said cam portion to move said arm about said pivot between open and closed circuit positions, said operating member seated in said inside bend to hold said arm in said open circuit position and moved to a position past said outside bend to hold said arm in said closed circuit position, and means responsive to the current in said contacts for releasing said pivot for movement to its other position upon the occurrence of a predetermined high current to effect movement of said cam portion over said operating member with pivotal and longitudinal movement of said arm by said spring to an open circuit position and movement of said operating member back to an intermediate position with said operating member seated in said inside bend.

8. A circuit breaker comprising cooperating stationary and movable switch contacts, an arm provided with a pivot at one end and having an intermediate cam portion offset transversely of said pivot with inside and outside bends at the respective ends of said cam portion, an operating connection between the other end of said arm and said movable contact, supporting members on opposite sides of said arm having enlarged openings for the ends of said pivot to provide for movement of said pivot and said arm both transversely and longitudinally of said arm from one position to another, latching means for holding said pivot in one of said positions, a spring for biasing said arm about said pivot to an open circuit position, an operating member engaged by said arm pivotally mounted intermediate the length of said arm for movement longitudinally of said arm over said cam portion to effect movement of said arm about said pivot between open and closed circuit positions with said operating member seated in said inside bend when said arm is in said open circuit position and moved to a position past said outside bend to hold said arm in

said closed circuit position, and means responsive to the current in said contacts for operating said latching means to release said pivot for movement to its other position upon the occurrence of a predetermined high current to effect movement of said cam portion over said operating member with pivotal and longitudinal movement of said arm by said spring to an open circuit position and movement of said operating member back to an intermediate position with said operating member seated in said inside bend.

9. A circuit breaker comprising a fixed contact, a resiliently mounted movable contact, an arm having a movable end connected to move said movable contact and an intermediate transverse cam portion, means for pivotally supporting the opposite end of said arm and providing for longitudinal movement of said arm in a predetermined direction from said pivoted end toward said movable end, latching means for holding said end in a predetermined position, an operating lever having one end pivotally mounted at a point intermediate the length of said arm, a projection on said operating lever, a spring biasing said arm about its pivot against said projection so that movement of said operating lever moves said projection over said cam portion thereby to move said arm about said pivot between closed and open circuit positions, said spring being arranged to apply a component of force to said arm biasing said arm longitudinally in said predetermined direction, current-responsive means for operating said latching means to release said pivot upon the occurrence of a predetermined high current whereupon said arm is moved longitudinally by said spring to effect movement of said cam portion over said projection with pivotal movement of said arm to an open circuit position, and a projection on said arm engaged by said operating lever to move said arm longitudinally in an opposite direction to return said pivoted end to said predetermined position.

10. A circuit breaker comprising a fixed contact, a resiliently mounted movable contact, an arm having a movable end connected to move said movable contact and an intermediate transverse cam portion, means for pivotally supporting the opposite end of said arm and providing for transverse and longitudinal movement of said arm, latching means for holding said end in a predetermined position, an operating member having one end pivotally mounted at a point intermediate the length of said arm, a projection on said operating member, a spring biasing said arm about its pivot against said projection so that movement of said operating lever moves said projection over said cam portion thereby to move said arm about said pivot between closed and open circuit positions, said spring being arranged to

apply a component of force to said arm biasing said arm longitudinally in a direction from said pivoted end toward said movable end, current-responsive means for operating said latching means to release said pivot upon the occurrence of a predetermined high current whereupon said arm is first pivoted by said spring about said projection and then moved longitudinally by said spring to effect movement of said cam portion over said projection with pivotal movement of said arm to an open circuit position.

11. A circuit breaker comprising a fixed contact, a resiliently mounted movable contact, a pair of substantially parallel supporting plates provided with oppositely disposed openings in adjacent ends including each a transverse slot portion and a communicating longitudinal portion extending toward the opposite ends of said plates, an arm having a movable end connected to move said movable contact and an intermediate transverse cam portion, a pivot on the opposite end of said arm extending into said openings for slidable and pivotal movement with respect to said supporting plates, latching means for holding said pivot in said slot portions, an operating lever having one end pivotally mounted on said supporting plates at a point intermediate the length of said arm, a projection on said operating lever, a spring biasing said arm about its pivot against said projection so that movement of said operating lever moves said projection over said cam portion thereby to move said arm about its pivot between closed and open circuit positions, said spring being arranged to apply a component of force to said arm biasing said arm longitudinally in a direction from said pivot toward said movable end, current-responsive means for operating said latching means to release said pivot upon the occurrence of a predetermined high current whereupon said arm is first pivoted by said spring about said projection to move said pivot out of said transverse slot portions into said longitudinal portions after which said arm is moved longitudinally by said spring to effect movement of said cam portion over said projection with pivotal movement of said arm to its open circuit position, and a projection on said arm engaged by said operating lever to move said arm longitudinally in an opposite direction to return said pivot to said slot portions.

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