Nov. 19, 1957 A. F. KOLB ET AL 2,813,951

CIRCUIT BREAKER

Filed Oct. 16, 1953 4 Sheets-Sheet 1

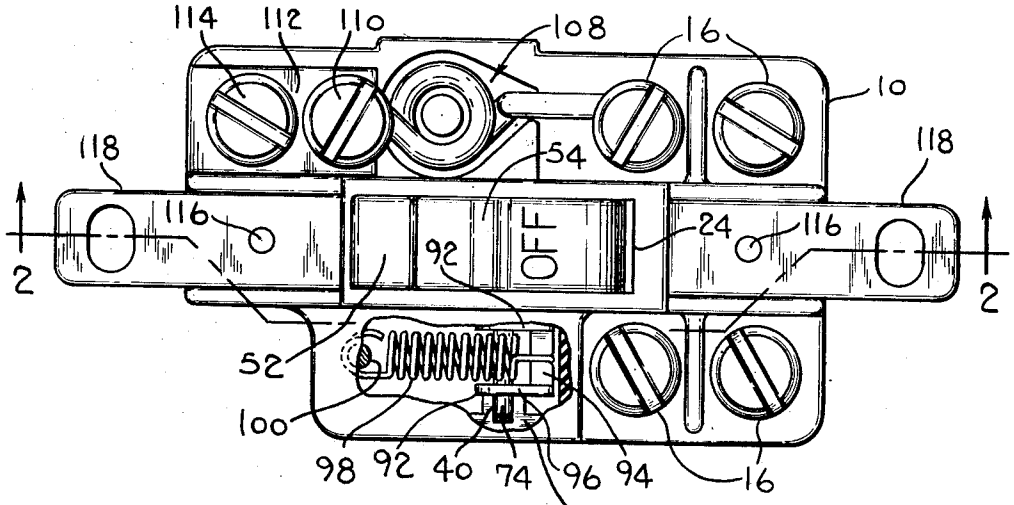


FIG. 1

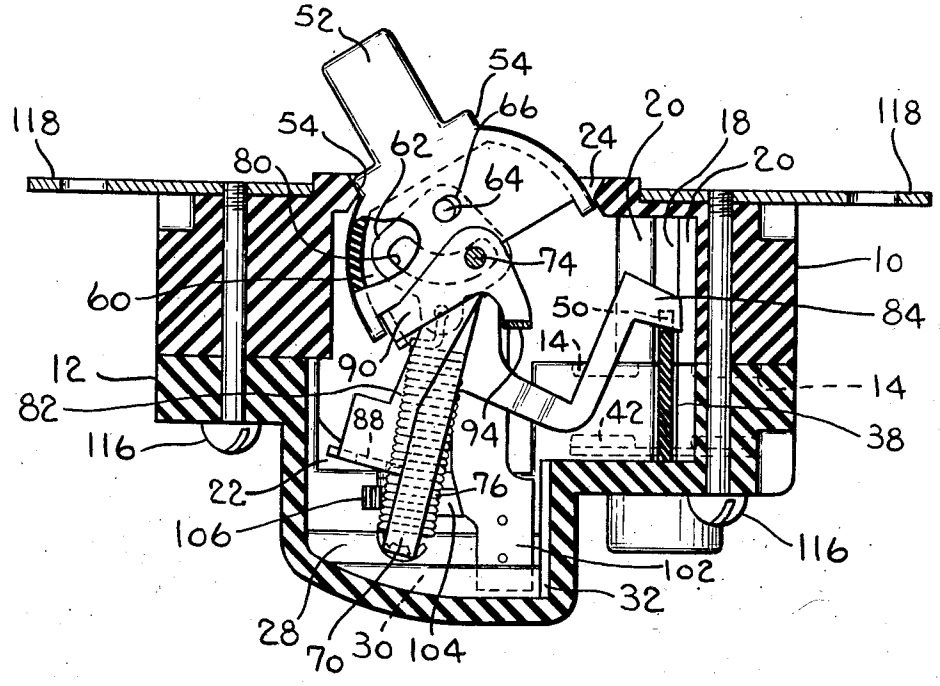


FIG. 2

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CIRCUIT BREAKER

Filed Oct. 16, 1953 4 Sheets-Sheet 2

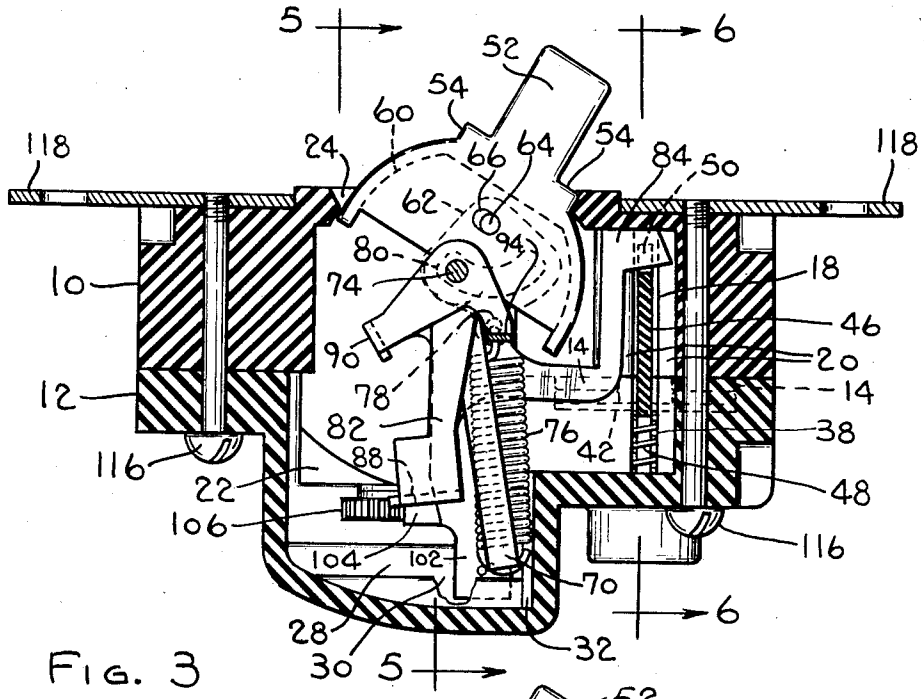


FIG. 3

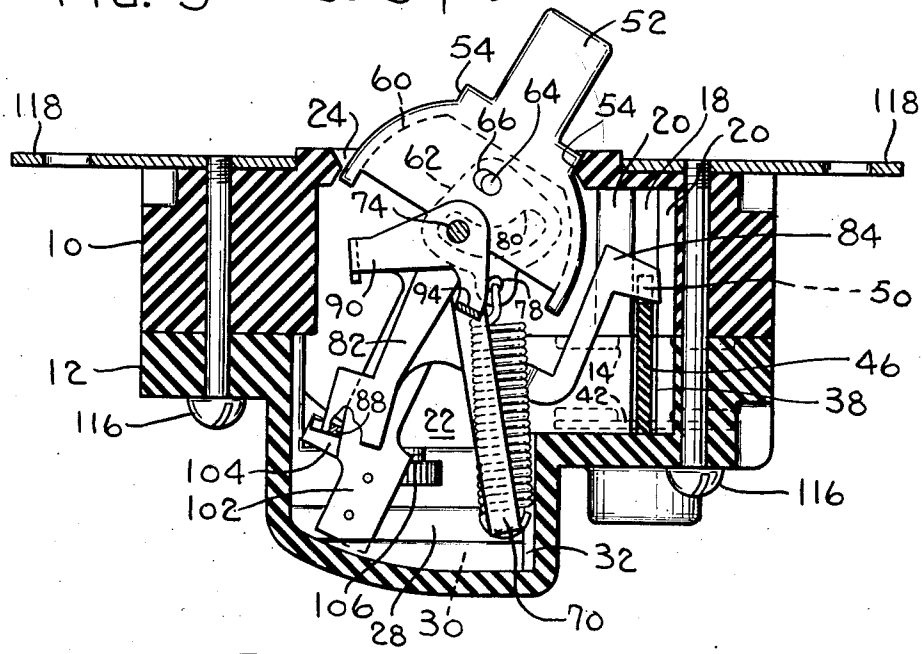


FIG. 4

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CIRCUIT BREAKER

Filed Oct. 16, 1953 4 Sheets-Sheet 3

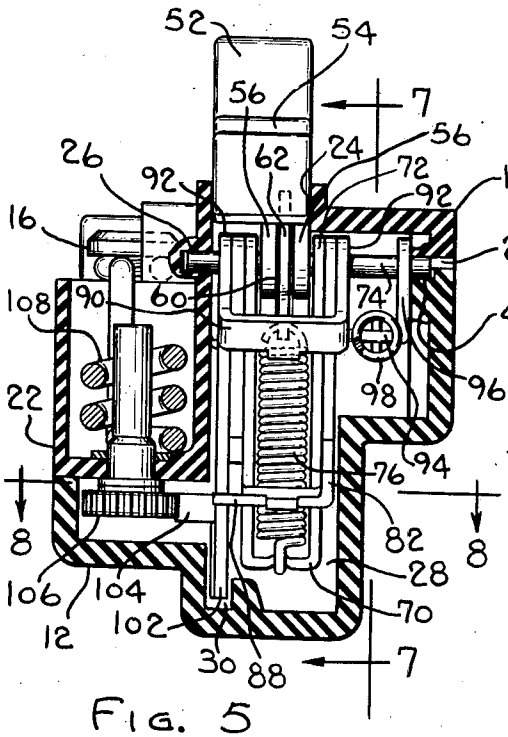


FIG. 5

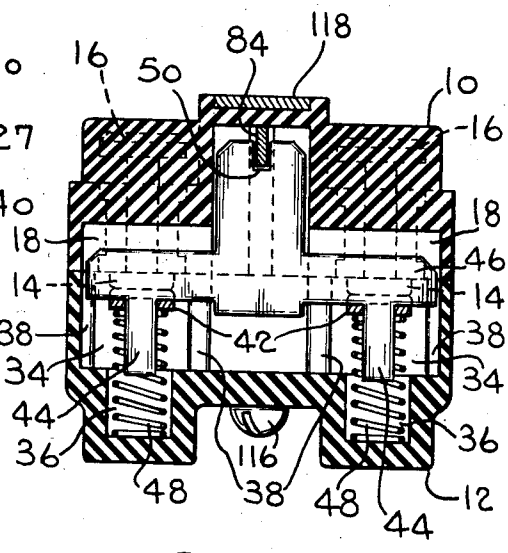


FIG. 6

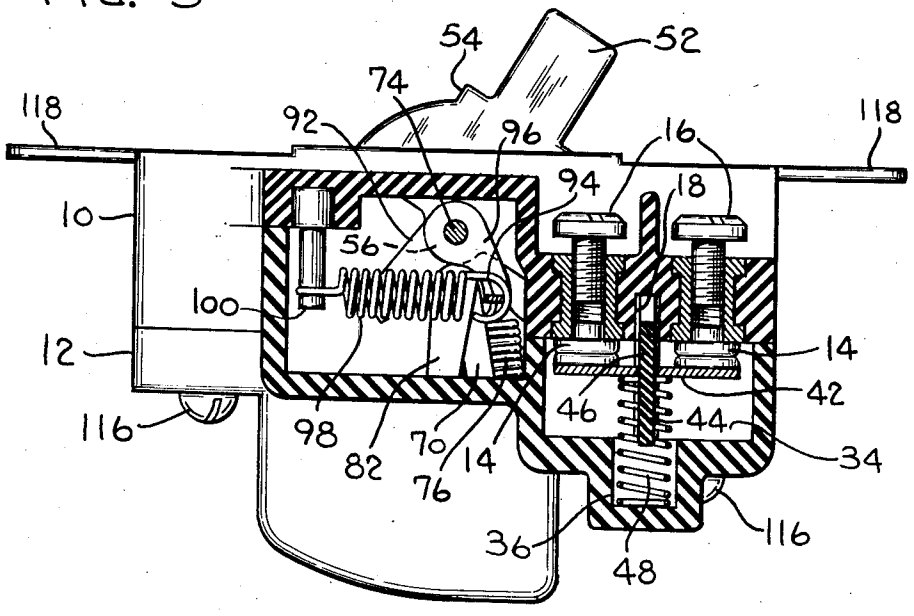


FIG. 7

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Nov. 19, 1957 A. F. KOLB ET AL 2,813,951

CIRCUIT BREAKER

Filed Oct. 16, 1953 4 Sheets-Sheet 4

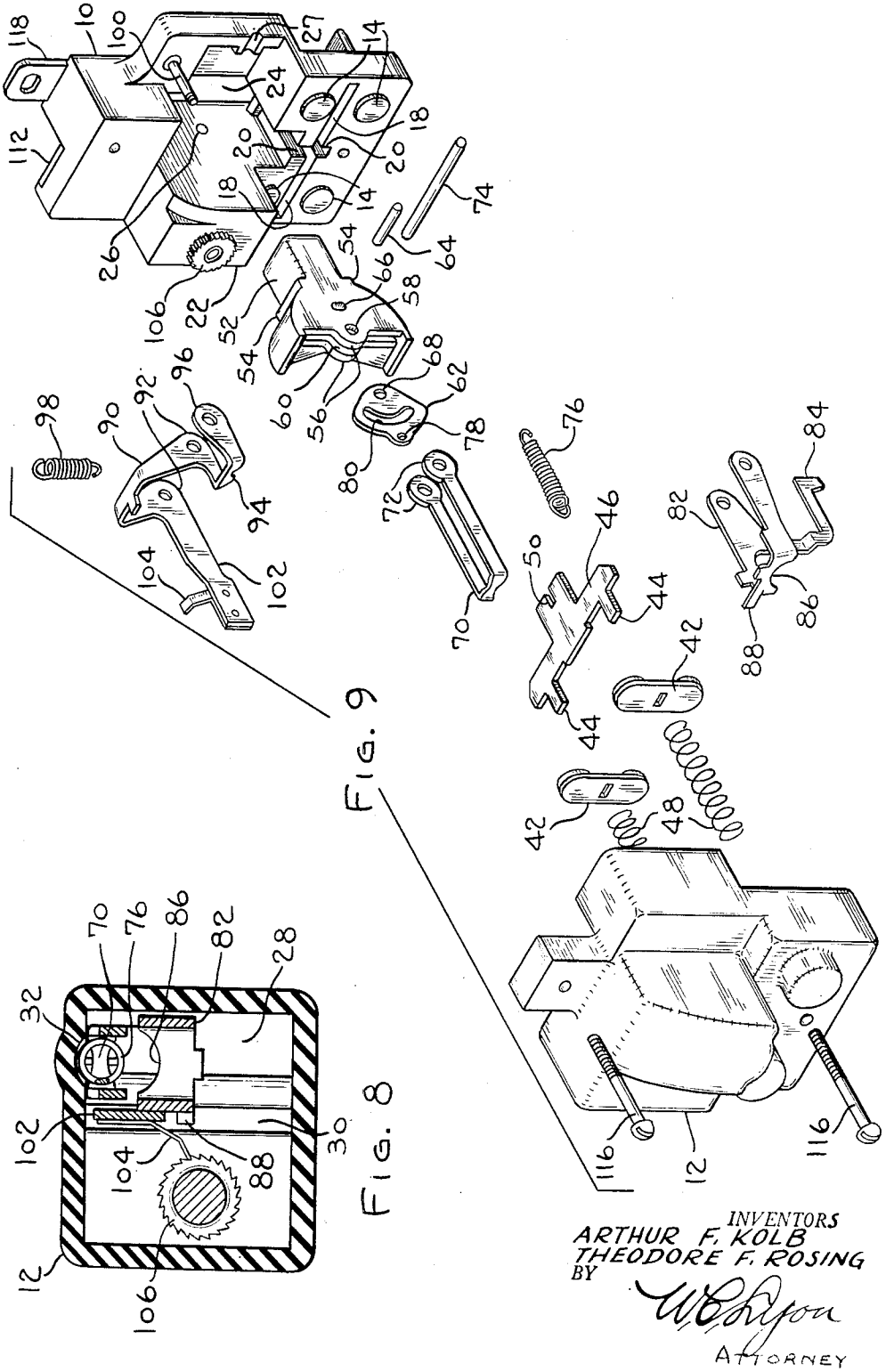


FIG. 9

FIG. 8

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2,813,951

CIRCUIT BREAKER

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Application October 16, 1953, Serial No. 386,436

12 Claims. (Cl. 200—116)

This invention relates to circuit breakers, particularly small circuit breakers adapted for use as motor starters.

The principal object of this invention is to provide a simple reliable and inexpensive circuit breaker of this character.

A further object of this invention is to provide a circuit breaker of this character which is easy to assemble, requires a minimum number of working parts, is fully protected against deleterious effects from sparking and external dust and dirt particles.

A still further object of this invention is to provide a circuit breaker of this character which does not require detrimentally sharp hammer blows to open the circuit.

In obtaining these objects the circuit breaker is provided with the following general characteristics: The movable contact carrying bridging members are loosely mounted on a contact bar which is slidably guided in the base and cover forming the circuit breaker housing. Such bridging members are spring biased toward closed circuit position and with the contact bar move back and forth in a path substantially perpendicular to parting line between cover and base. This facilitates assembly of the circuit breaker. The contact bar is moved toward the closed end of the cover to open the normally closed contacts by a manually controlled over-center spring action carried in the base. This action is installed in the base by the simple expedient of axially sliding its main pivot into a bearing in the base while such action is momentarily held in place. The action includes a contact operating lever which engages with the contact bar to move it to opened position. Such lever has an overload bar which in overload conditions is engageable by an overload lock and reset lever also included in such action. These levers, a spring support and a manually operated lever are all mounted on the same pin in such action. While there is a slight tolerance built into the mechanism to provide for wear of the contacts, this is not sufficient to impart a hammer blow in the opening of the contacts. Instead the over-center spring action imparts a positive and instantaneous opening to the contacts without the necessity of damaging hammer blows which soon wear and break down such small lightly constructed circuit breakers. The base and the cover completely enclose the contacts and all operating members, except the handle of the manually operated lever, to protect them from dust and dirt and to keep harmful sparking fully shielded.

For a more detail description of this invention reference should be made to the following description of a specific embodiment read in connection with the accompanying drawings, in which:

Figure 1 is a top plan view of a circuit breaker embodying the present invention with the manually operated lever in "off" position;

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

Fig. 3 is a sectional view taken on the line 2—2 of Fig. 1 showing the parts as positioned with the manually operated lever in "on" position;

Fig. 4 is a sectional view taken on the line 2—2 of Fig. 1, with the parts shown in the position assumed when the contacts have been opened by the operation of the overload mechanism;

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 3;

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 3;

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 5;

Fig. 8 is a sectional view taken on the line 8—8 of Fig. 5; and

Fig. 9 is an exploded prospective view of the circuit breaker shown in Figs. 1–8 (incl.)

The circuit breaker illustrated in the drawings is a multiple pole starter rated at approximately 1 horsepower, single phase on 115 and 230 volts. Completely assembled it is approximately 1½ inches wide, 2½ inches long and 2 inches high. Such small circuit breaker has a base **10** and a cover **12** formed of molded insulating material which are secured to provide a housing for the complete circuit breaker operating mechanism except the handle of the manually operated lever. On a flat portion of the base **10** facing the cover **12** there are mounted fixed contacts **14** into the threaded supports of which are threaded exterior terminal screws **16**. Between these contacts is a groove **18** for guiding the contact carrier. Slots **20** transverse to such groove guide the finger of the contact operating lever. A projection **22** on the base **10** houses the thermal release assembly. A rectangular hole **24** accommodates the handle of the manually operated lever and provides shoulders limiting the extreme movements of such handle. The over-center spring action is held in the base **10** during assembly of the circuit breaker by having an extending end of the pivot of such action project into a bearing **26** in such base. Opposite this bearing is a cylindrical groove **27** which cooperates with a similar cylinder groove in the cover to form the other bearing for such pin.

The cover **12** has a recess **28** which accommodates the swinging elements of the over-center spring action. At the bottom of this recess is a groove **30** which guides the end of an overload lever. The right-hand wall of such recess has a semi-cylindrical groove **32** (see Figs. 4 and 8) which provides an abutment for the spring of the over-center spring action. Adjacent to the recess **28** are a pair of spaced recesses **34** (see Figs. 6 and 7) terminating in cylindrical wells **36** which provide operating space for the contact bridging members and their compression springs. Slots **38** cooperating with the grooves **18** in the base **10** provide the complete guide for the contact bar. A semi-cylindrical bearing **40** in the cover **10** (see Fig. 5) cooperates with the semi-cylindrical bearing **27** in the base **10** to form the outer bearing for the main pivot of the over-center spring action.

The movable contacts of the circuit breaker are mounted on a pair of bridges **42** apertured to loosely slide on tongues **44** on a contact carrier **46**. The carrier **46** is made of insulating material such as melamine and is slidably guided in the groove **18** and slots **38** to simultaneously move the bridges **42** in the recesses **34** with the contacts thereon in alinement with respective pairs of the fixed contacts **14**. The bridges **42** are continually urged toward the closed circuit position shown in Figs. 3, 6 and 7 by compression springs **48**. It is relatively simple to assemble the bridges **42**, carrier

46 and springs 48. The springs 48 are seated in the wells 36 of the cover. The bridges 42 are placed on the tongues 44 and the contact carrier 46 fitted in the groove 18 of the base 10. When the cover 12 is placed on the base 10, the springs 48 will be properly compressed. The contact carrier 46 has a centrally located slot 50 which engages a finger on the contact operating lever to aid in effecting its movement toward circuit opened position.

The over-center spring action includes a manually operated lever 52 to which is pivoted by a single main pivot 74 a spring support 70, a contact operating lever 82, and an overload and reset lever 90. An over-center spring 76 extends between the bridge of the spring support 70 and a spring yoke 62 pivoted to the manually operated lever 52. The manually operated lever 52 is made of insulating material and has a hand engageable finger which in the assembled condition projects outwardly of the housing through the hole 24. A pair of spaced shoulders 54 alternatively engage the ends of hole 24 to establish the "off" and "on" position of the lever 52. A pair of trunnions 56 with bearings 58 therein are spaced by a groove 60. The latter slidably guides the spring yoke 62 pivoted to the lever 52 by a pin 64 fitting in an elongated bearing 66 in the lever 52 and passing through a hole 68 in such spring yoke. The spring support 70 is U-shaped and has a connecting bridge and a pair of legs terminating in apertured ends 72. These ends straddle the trunnions 56 with the apertures aligned with bearings 58 and mounted on the main pivot 74. The tension spring 76 has one end anchored to the bridge of support 70 and its other end engaged in a hole 78 in the yoke 72. This yoke has an arcuate slot 80 which permits it to swing about the pin 64 without interfering with the main pivot 74. Such linkage will cause the spring support 70 to move back and forth between its limit position of Fig. 2 and its limit position of Fig. 3 upon swinging the lever 52 back and forth between its open circuit position of Fig. 2 and its closed circuit position of Fig. 3. Such motion after dead center is reached is very rapid.

In normal operation the motion of the spring support 70 is transmitted to the contact carrier 46 by the contact operating lever 82. This lever has a pair of supporting legs straddling the spring support 70 and pivoted on the main pivot 74. Such contact operating lever 82 has an extending finger 84 slidable in the slots 20 and seated in the slot 50 of the contact carrier 46. The bridge of lever 82 has an arcuate recess 86 which fits around the spring 76 to permit the clockwise edges of the bridge to be engaged by the legs of the spring support 70 in the normally operating "off" position of the circuit breaker of Fig. 2. The contact operating lever 82 also has an overload bar 88 which is engaged by the overload and reset lever 90 when the latter is released upon an overload.

The overload and reset lever 90 has a main bridge with spaced supporting legs 92 straddling the contact operating lever 82 and pivoted on the main pivot 74. The lever 90 also has a spring anchor 94 with an outer supporting leg 96 also pivoted on the main pivot 74. A tensioned overload spring 98 extends from the anchor 94 to a pin 100 secured in the base 10. A locking arm 102 formed as part of the lever 90 has a spring finger 104 normally engaged with a ratchet 106 of a thermal release assembly 108. Such assembly is well known and is shown and described in Patent No. 2,261,632 issued November 4, 1941 for "Electric Circuit Mechanism." The ratchet 106 is normally held against rotation until the heater coil 108, connected to a terminal 110 and the adjacent terminal 16, melts the eutectic solder upon occurrence of an overload. The ratchet 106 will then rotate and release the overload and reset lever 90 which will under influence of spring 98 operate to open the circuit. The terminal 110 is carried in a plate 112 to which is threadedly fitted a terminal 114 for external connection.

To assemble the over-center spring action, the spring

yoke 62 is placed in the groove 60 and pin 64 inserted in bearing 66 through hole 68. Then the spring 76 is secured to the anchor 78. The spring support 70, contact operating lever 82 and overload and reset lever 90 are then fitted over the trunnions 56 and the main pivot 74 inserted through them and the bearings 58 until its inner end (left as viewed in Fig. 9) is flush with the inner of the legs 92. The spring 76 is then connected to the support 70. The action is assembled as a unit into the base 10 with the handle of the lever 52 projecting out of hole 24. The main pivot 74 is then moved inwardly, so that its inner end slides into the bearing 26 thus holding the action in place. After the contact bar 46 and spring 98 are assembled in the base 10, the cover 12, with bridges 42 and springs 48 in place, is placed on the base 10 and secured by screws 116 which are threaded into mounting strips 118.

Starting with the circuit breaker in the "off" position, shown in Figs. 1 and 2, assume that the handle of the operating lever 52 is swung from the "off" position to the "on" position shown in Fig. 3. During the first part of such movement the contact operating lever 82 holds the spring support 70 in the position shown in Fig. 2. As the pin 64 moves clockwise about the main pivot 74, such pin, pivot and anchor 78 approach a position of alignment with the central axis of spring 76. Slightly before such alignment position is reached the force exerted by springs 48 is sufficient to overcome the then opposing force of spring 76, and movement of the contact carrier toward closed position results in the forced movement of lever 70 through the aforementioned aligned position to its opposite extreme position shown in Fig. 3. During the aforementioned movement pin 64 moves to engage with the other end of slot 66 in lever 52.

Starting with the parts shown in the "on" position of Fig. 3, movement of operating lever 52 in the counterclockwise direction to the "off" position shown in Fig. 4 will cause pin 64, pivot 74 and anchor 78 to be brought toward the aforementioned alignment position. During such movement pin 64 moves from the right end to the left end of slot 66 thereby providing a slight lost motion action, offsetting any retarding tendency caused by the speed or manner of movement of lever 52. Spring support 70 is held against the groove 32 as shown in Fig. 3 during the initial part of such movement. As the alignment position is passed, the tension of the spring 76 moves spring support 70 rapidly in the clockwise direction from such position, to the position shown in Fig. 2. The legs of the spring support 72 will contact the bridge of operating lever 82 and swing it clockwise to the position shown in Fig. 2 with a rapid motion but without hammer action. The finger 84 instantly depresses the contact bar 46 with the consequent opening of the contacts as the effective force of spring 76 is considerably greater than the combined effective force of springs 48.

With the circuit breaker in the normally "on" position shown in Fig. 3, an overload will release the ratchet 106 and the overload and reset lever 90 will instantly pivot under the influence of spring 98 to the position shown in Fig. 4. Its arm 102 will engage the overload bar 88 and swing the contact operating lever 82 to the circuit open position shown in Fig. 4. This takes place without any interference to or from the manually operated lever 52, the over-center spring 76, and the spring support 82. After the overload has been removed and the solder in the thermal element hardened, the circuit breaker may be reset. This is accomplished by swinging the manually operated lever 52 from the "on" position of Fig. 4 to the "off" position of Fig. 2. This movement causes the left-hand lower edge of such lever to engage the bridge of the lever 90 and swing such lever counterclockwise to carry the arm 102 to the position shown in Fig. 2, so that the spring 104 will again engage with the ratchet 106 and hold such lever with energy stored in spring 98. Lever 90 in so moving disengages from lever 82, and the latter

momentarily freed rotates a slight amount in the counterclockwise direction thereby permitting contact carrier **46** to move a slight amount toward contact closed position. During the aforementioned "resetting" operation, spring support **70** is caused to snap over-center to the position shown in Fig. 2, and in so doing engages with lever **82** to drive the latter in the clockwise direction before it can move freely any appreciable amount in the counterclockwise direction.

It will be observed that because lever **90** can move lever **82**, to contact opening position independently of lever **52** and spring carrier **70**, that the circuit breaker is of the "trip-free" type, that is to say, the contacts cannot be closed by movement of lever **52** to "on" position, following "resetting" operation of the latter if the thermal element has not rehardened.

While there is shown a particular embodiment of this invention, many modifications may be made and it is contemplated that the following claims cover any such modifications as fall within the spirit and scope of this invention.

We claim:

1. A circuit breaker comprising a movable contact constantly biased toward closed circuit position, an insulating contact bar having a projection along which said contact is movably guided, a housing providing guides for said bar, a lever engageable with said bar, an over-center spring action manually operable to one position to move said lever and thereby overcome said bias to move said contact to open circuit position and manually operable to a second position to permit said contact to move to closed circuit position under its bias, and means responsive to current overload to move said lever and operate said contact to open circuit position independently of said over-center spring action.

2. The combination according to claim 1 in which said housing includes a base and a cover and said guide directs said bar to movement in a path substantially perpendicular to the parting line between said cover and base.

3. The combination according to claim 1 in which said action includes a main pivot having limited axial movement and said housing has a bearing receiving an end of said pivot following axial movement thereof.

4. A circuit breaker comprising an insulating base having an inner flat surface, a bearing in said base having an opening in said surface, a semi-cylindrical groove in said base aligned with said bearing, a movable over-center spring action in said base and guided by said surface, a main pivot for said action having one end projecting into said bearing and the other end resting in said groove, and a cover for said circuit breaker having a semi-cylindrical groove cooperable with said first groove to form a bearing for said other end of said shaft, said second groove having an abutment engageable with the end of said pivot to prevent axial displacement thereof.

5. A manually operable over-center spring action for the movable contact of a circuit breaker comprising a main pivot, a manually operated lever on said pivot, a contact operating lever swingably mounted on said pivot, said lever having a contact operating finger and an overload bar, a spring support swingably mounted on said pivot engageable with said contact operating lever, a spring acting between said spring support and said manually operated lever, and an overload lever swingably mounted on said pivot and operable when released to engage said overload bar and operate said contact operating lever without movement of said spring support.

6. The combination according to claim 5 in which said overload lever has a portion engageable by said manually

operated lever to operate said overload lever for resetting thereof.

7. The combination according to claim 5 in which said overload lever has a spring anchor integral therewith and pivoted on said pivot.

8. A circuit breaker comprising a movable contact constantly biased toward closed circuit position, a slidable contact bar, a manually operable over-center spring action, a contact operating lever engageable with said bar, and a spring support positioned closely adjacent said lever in circuit closed position and immediately engageable with said lever as said over-center spring action is operated to circuit open position.

9. The combination according to claim 8 in which said over-center spring action has a manually operated lever having a pivotal axis and an elongated bearing spaced from said axis, there being a pin in said bearing, and a spring anchored on said pin and said spring support, said pin sliding from end to end of said bearing as said action passes over-center to eliminate possibilities of wavering movement due to manual sluggishness at the over-center position.

10. A circuit breaker comprising an insulating base having an opening therein, a groove in said base, a slot in said base transverse to said groove, a fixed contact on said base adjacent said groove, a contact bar slidably guided in said groove and engageable with a movable contact to move such movable contact to circuit open position, an over-center spring action mounted in said base having a manually operated lever projecting through said opening, said action including a contact operating lever having a finger guided in said slot and engageable with said bar to move said bar to circuit open position, an insulating cover for said base forming therewith an enclosure for said over-center spring action, a recess and well in said cover, a movable contact operable in said recess, and a spring in said well for normally biasing said movable contact into engagement with said fixed contact.

11. A circuit breaker as claimed in claim 10 in which said over-center spring action includes a swingable spring support for moving said contact operating lever to circuit open position, said cover having a portion for engaging said spring support in the circuit closed position thereof and holding said support closely adjacent said contact operating lever so that upon operation of said over-center spring action said support will engage and move said contact operating lever without a hammer blow.

12. A circuit breaker as claimed in claim 10 in which said over-center spring action includes a spring biased swingable overload lever having an arm engageable with said contact operating lever to move said lever to circuit open position, there being a groove in said cover for guiding the end of said arm.

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