June 16, 1925. 1,541,998

G. PAILIN

CIRCUIT BREAKER

Filed May 12, 1923 4 Sheets-Sheet 1

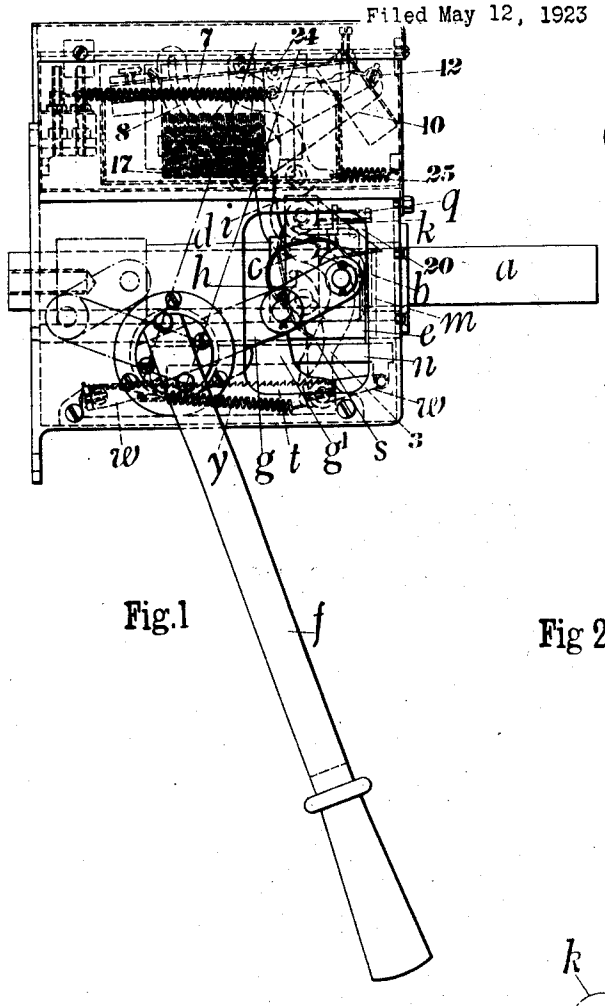

Fig.1

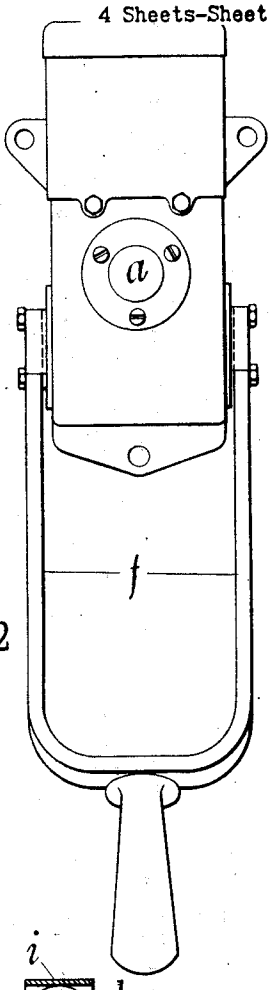

Fig 2

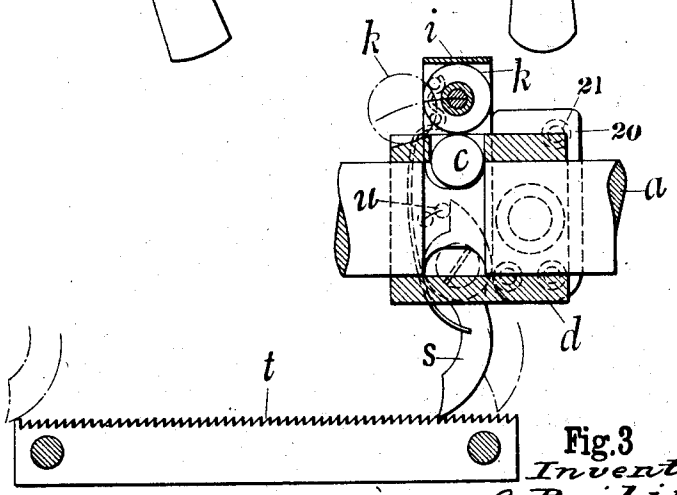

Fig.3

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G. PAILIN

CIRCUIT BREAKER

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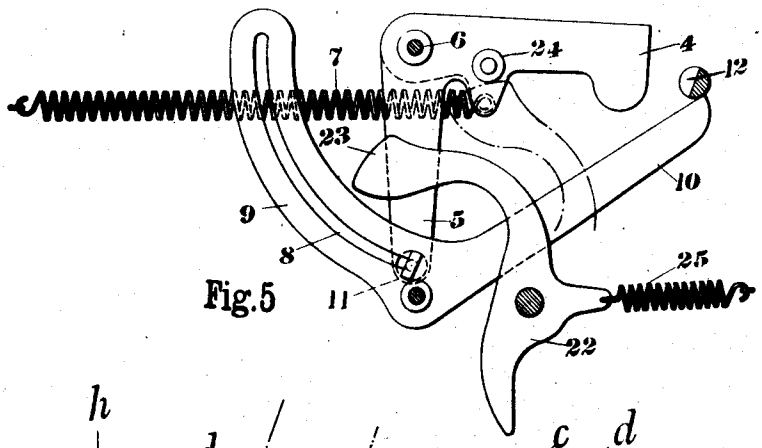

Fig.5

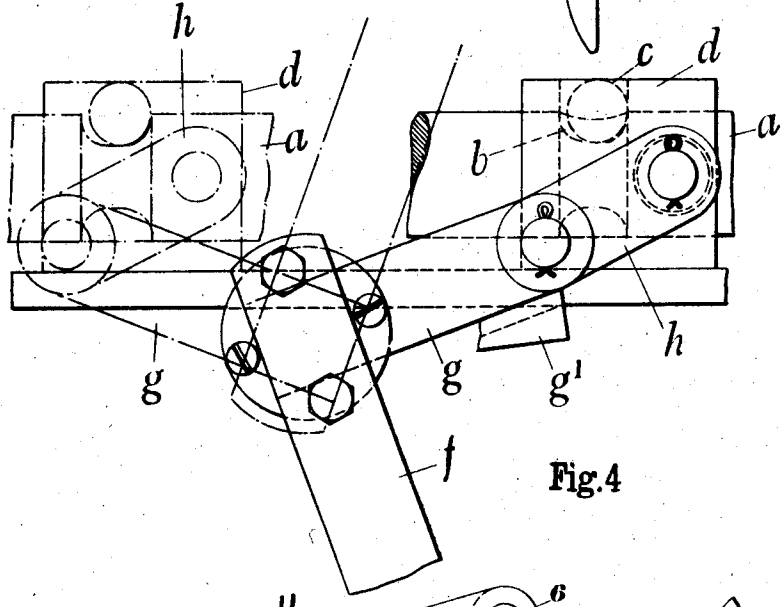

Fig.4

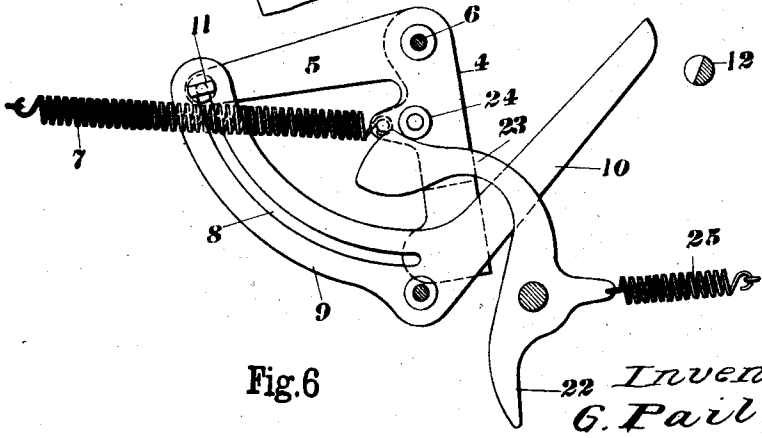

Fig.6

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CIRCUIT BREAKER

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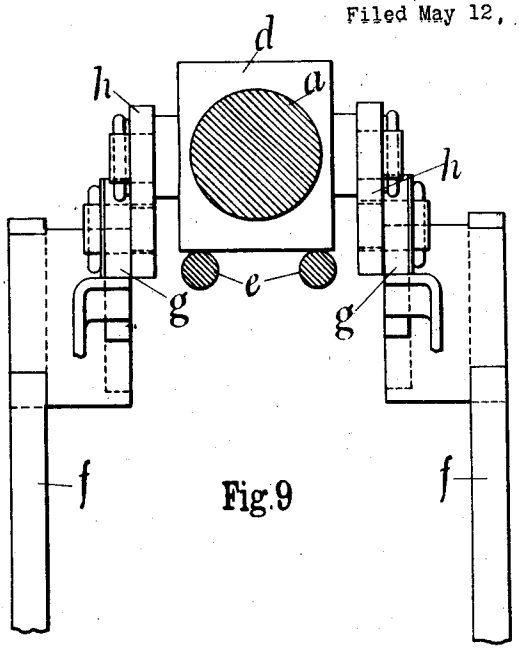

Fig.9

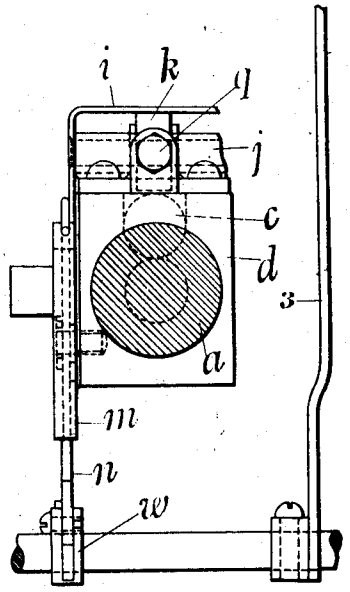

Fig.10

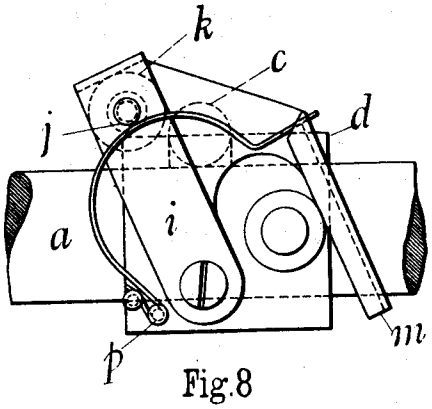

Fig.8

Fig.7

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CIRCUIT BREAKER

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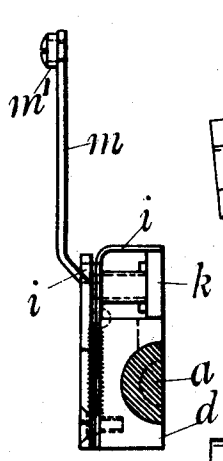

Fig.16

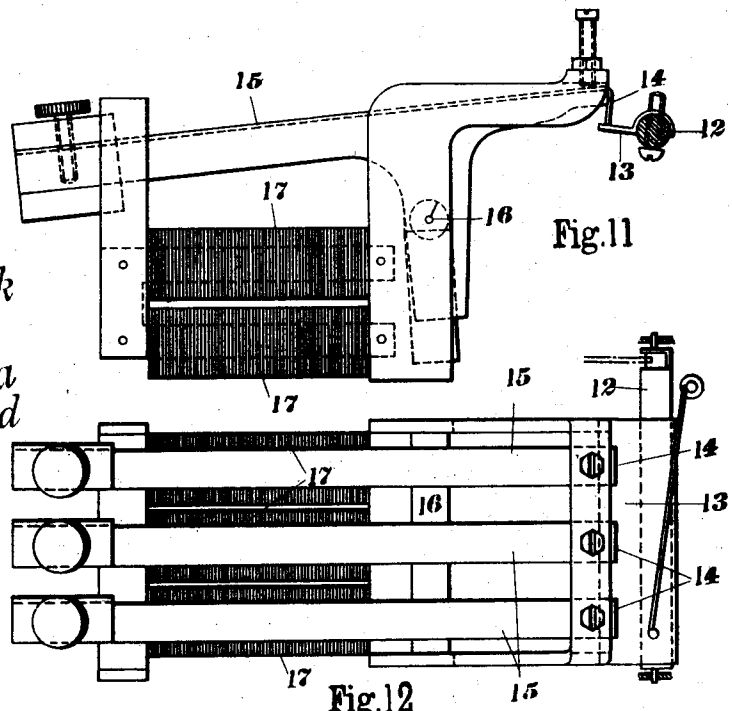

Fig.11

Fig.12

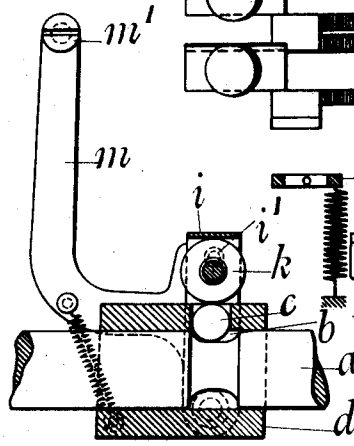

Fig.15

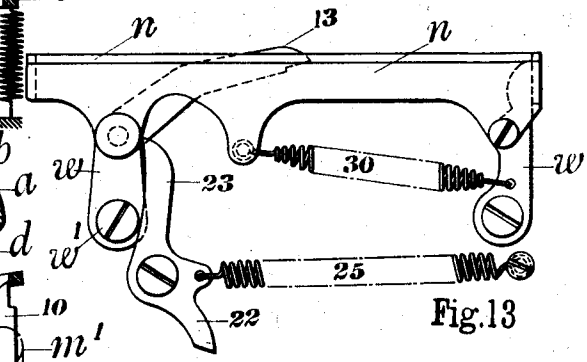

Fig.13

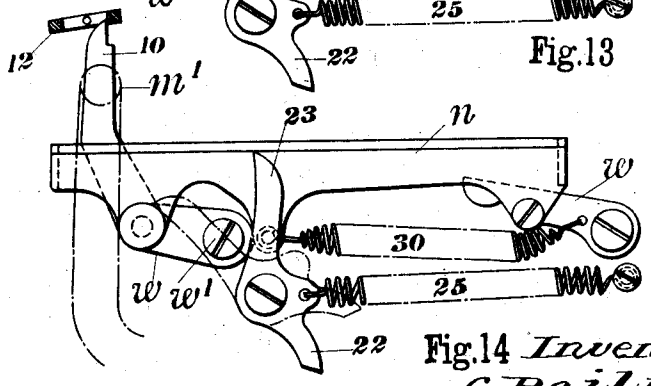

Fig.14

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Patented June 16, 1925. 1,541,998

UNITED STATES PATENT OFFICE.

GEORGE PAILIN, OF MANCHESTER, ENGLAND, ASSIGNOR TO FERGUSON PAILIN LIMITED, OF MANCHESTER, ENGLAND, A BRITISH COMPANY.

CIRCUIT BREAKER.

Application filed May 12, 1923. Serial No. 638,540.

To all whom it may concern:

Be it known that I, GEORGE PAILIN, a subject of the King of Great Britain and Ireland, and resident of Buckley Street, Higher Openshaw, Manchester, England, have invented certain new and useful Improvements in Circuit Breakers, of which the following is a specification.

This invention relates to electric switches, circuit breakers and the like and more particularly to the tripping mechanism thereof, and has for its object to provide an improved arrangement of such mechanism in which the electrical trip gear is unaffected by the pressure exerted on the switch operating arm or equivalent part when in its closed position so that the trip coil need not be calibrated specially for any particular conditions and may be of much less power than usually requisite.

My invention further comprises the interposition between the switch operating arm or equivalent part and electrical trip gear, of an energy accumulator in which energy is stored during the manipulation of the switch control handle, whilst the switch is open, and a locking device which holds the switch arm in the switch closed position, and is unlocked by the application of said stored up energy when the latter is released by the electrical trip gear under fault conditions.

My invention further comprises the improved arrangement of ball type locking means for the switch arm or its equivalent.

My invention further comprises the improved details of construction and arrangement hereinafter described and claimed.

Referring to the accompanying sheets of explanatory drawings:—

Figures 1 and 2 are elevations taken at right angles to one another of switch arm controlling means constructed and arranged in one convenient form in accordance with our invention.

Figures 3 to 12 are detail views of the different parts of the mechanism comprising the switch arm controlling means. Figures 3, 4, 7, 8, 9 and 10 illustrate details of the arm locking means and Figures 5, 6, 11 and 12 illustrate details of the electrical tripping and of the resetting means.

Figures 13 to 16 illustrate a modified arrangement of the switch arm controlling means.

The same reference letters in the different views indicate the same or similar parts.

In one convenient application of my invention, the switch arm a or equivalent part has an annular groove b therearound into which can enter a ball c which projects into an aperture in a slide d capable of longitudinal movement upon the arm a. The said slide is restrained against rotary movement by the rails e (see Figures 1 and 9). The slide is operated from the bifurcated handle f by the toggle links g, h, the links h being pivotally connected to the slide. When the switch arm a is in the switch closed position, the links g, h are against a stop g^1 and slightly beyond a position in line with each other (as shown in full lines in Figure 4) so that the slide d and the switch arm a which is locked to the slide by the ball c, as hereinafter described, are automatically retained in the said switch closed position.

Upon the slide or sliding block d is pivotally carried a stirrup like member i in which is a cross pin j having thereon a roller k. The member i has a downwardly projecting part m adapted to be engaged by the tripping bridge n to be hereinafter more fully referred to. A spring o secured about the pin p on the sliding block d tends to hold the member i in the position shown in Figures 1, 3 and 7 where the roller k comes against the adjustable stop q carried by the sliding block d.

It will be seen by reference to Figure 7 that when the member i is in its normal position, the roller k retains the ball c in the annular groove in the arm a but when the said member is turned about its pivots as shown in Figure 8, the roller k is moved clear of the ball c which can then rise out of the annular groove in the arm a due to the pressure of the arm in a direction tending to open the switch. The tilting of the member i is performed by tripping mechanism as hereinafter described.

One method of and means for tripping the switch by tilting the member i is illustrated in Figures 1 and 3. Upon one of the pivot pins of the member i is pivotally mounted the lever s, the lower end of which is formed

as a pawl and is capable of engaging the teeth of a fixed rack t whilst its upper end has its movement limited by the stop pin u. A spring v tends to hold the lever s with its upper end against the pin u when its lower end is in a position to engage the teeth of the rack t. If the switch attendant is moving the handle f so as to close the switch and if he should release the pressure from the handle before the switch is completely closed, or if he should move the handle jerkily, then during the period that the pressure necessary to close the switch or to hold it stationary is removed from the handle f, the weight of the parts tending to open the switch will be applied through the lever s and rack t to the stop pin u on the member i. The consequent pressure on such pin causes the member i to tilt about its pivotal point from the position shown in Figures 1 and 3 to that shown in Figure 8, when the arm a displaces the ball c from the annular groove in a and allows the switch to open. The displaced positions of the roller k and stop pin u are shown in Figure 3. This arrangement prevents a switch being so operated that serious arcing occurs at the contacts due to faulty manipulation of the handle f. If the switch be closed and the handle f be raised, the lever s and rack t will cause the tripping of the switch.

The tripping bridge n before referred to is carried by two radius links w (see Figure 7) which ensure that the said bridge moves with a parallel motion. Stop pins x limit the movement of the bridge under the effort of the spring y. To the pivot pin z upon which one of the links w is secured, is attached the tripping arm 3 which extends above the sliding block d as shown in Figures 1 and 7. The upper end of said tripping arm is adapted to be engaged by the weighted end 4 of the bell crank lever 4, 5 pivoted at 6 when the said lever is moved into the position shown in Figure 6 under the action of its spring 7. The arm 5 of the bell crank lever 4, 5 carries a projecting pin 11 which enters the cam groove or slot 8 in the bell crank lever 9, 10 which constitutes the catch lever. The end of the arm 10 of the latter is adapted to engage a catch piece 12 which consists of of spindle cut away at one side as shown in Figures 5, 6 and 12. The spindle 12 carries thereon a projecting lip-like part 13 (see Figures 11 and 12) adapted to be engaged by members 14 attached to bell crank lever 15 pivoted at 16 and moves about their pivots by electro-magnets 17, one or more of which is or are energized under fault conditions. A spring 18 tends to hold the spindle 12 in the position shown in Figures 5, 6, 11 and 12 in which the catch lever is held with its end 10 depressed. If the spindle 12 be turned by one or other of the electro-magnets 17 operating one of the parts 14, engaging the lip 13, the cut-away part of the spindle 12 will be presented to the end of the arm 10 which can therefore rise under the action of the spring 7 acting on the bell crank lever 4, 5, the end 5 of which enters the cam slot 8. The parts then move from the position shown in Figure 5 to that shown in Figure 6 and the hammer like end of the bell crank lever 4, 5 strikes the tripping arm 3 (Figures 1 and 7) the latter turning a radius link w about its pivot and raising the tripping bridge n, so that it engages the projecting part m of the member i, tilting the latter and moving the roller k clear of the ball c as shown in Figure 8). The switch arm a can then force the said ball c clear of the annular groove b and allow the switch to open.

The trip coils may, if desired, be immersed in oil.

The parallel motion of the tripping bridge n allows it to trip the part m at any point of its traverse as the sliding block d is being moved by the handle f to close the switch. The latter cannot therefore be closed on a fault.

For resetting the tripping mechanism after its operation, we provide a bracket 20 on the sliding block d (see Figures 1 and 3) and upon the said bracket is mounted a roller 21 which is adapted when the sliding block d is traversed by the handle f, to engage the arm 22 of the bell crank lever 22, 23, the other arm 23 of which is adapted to engage the roller 24 carried by the arm 4 of the bell crank lever 4, 5. The lever 22, 23 is maintained in a mid or inoperative position by a spring 25. Referring now to Figure 6 where the parts of the tripping mechanism are shown in the positions they occupy after tripping the switch and assuming that the operator is now raising the handle f in Figures 1 and 2 in order to move the sliding block d to the left in Figures 1 and 3, in order to allow the ball c to enter the annular groove b in the arm a, which moves to the left in Figure 1 when the switch opens, then as the sliding block moves to the left on its inoperative stroke, the roller 21 engages the arm 22 and turns such arm about its pivot so that the arm 23 raises the arm 4 to the position shown in Figure 5, where the final position of the arm 23 is shown in dotted lines. The movement of the bell crank lever 4, 5 from the position shown in Figure 6 to that shown in Figure 5 stores up energy in the spring 7 which serves therefore as an energy accumulator and it will be noted that such energy is acquired from the operator when the handle f is performing its idle or inoperative stroke. The pin 11 in the arm 5 acting in the cam slot 8 causes the catch lever 9, 10 to turn about its pivot from the position shown in Figure 6 to that shown in Figure

5 when the end of the arm 10 passes beneath the catch 12 and is held thereby. The spring 25 returns the resetting lever 22, 23 to its initial position. The spring y returns the bridge n and tripping arm 3 to their initial positions ready to trip the switch under fault conditions.

When the ball c is in the annular groove in the arm a, there is a shearing strain thereon due to the tendency of the switch to open. A ball forms a very efficient and convenient means for resisting such strain and will operate effectively for long periods.

In the modified and simplified construction and arrangement of parts illustrated at Figures 13 to 16, the member i is operated through a pin and slot connection i^1 by an arm m which extends upwards, instead of downwards as in the arrangement previously described. The slot of the said connection is made slightly larger than the pin to permit of a certain degree of freedom of movement of the arm m. The latter has a pin m^1 thereon at its upper end. The catch lever or arm 10 engages the catch device 12 which is oscillated by mechanism similar to that before described. The said arm 10 is pivoted at w^1 and a portion of it constitutes one of the radius links w of the tripping bridge n. 22, 23 constitutes the resetting lever and acts in the same manner as in the previous construction to store up energy in the energy accumulator or spring 30 when it resets the bridge n and the catch lever 10 whilst the switch handle f is being moved on its idle stroke to cause the ball c to engage the groove b in the arm a. The end 22 of the resetting lever is engaged by the end of the link h (see Figure 1) for resetting purposes instead of by a roller on the block d.

When the catch piece 10 is released from the catch 12, the spring 30 raises the bridge n which strikes the pin or roller m^1 on the arm m and tilts the member i so as to move the roller k clear of the ball c and thus allow the arm a to displace the ball and open the switch. Figure 14 shows in dotted lines the position of the resetting lever 22, 23 when the parts are being reset thereby.

It will be seen that the electrical trip coils 17 merely serve to release the catch or lock 12 which holds the energy represented by the spring 7 (Figures 1–12) or 30 (Figures 13–16) in a stored up condition. The said trip coils have therefore a definite but small amount of work to perform so that coils of but small power are requisite. The actual release of the lock upon the switch arm by the tilting of the member i is performed by the force stored up in the said spring 7 or 30 when the operator moves the switch handle f on its idle stroke preliminary to closing the switch.

In the arrangement illustrated at Figures 13 to 16, the switch arm a moves from left to right to open the switch.

I do not limit myself to any particular means for storing energy in the accumulators 7 or 30, nor to any particular type of accumulator, or arrangement of the tripping catch and co-operating parts but may vary the same to suit any particular services or requirements. With our improved constructions and arrangements, the toggle mechanism which is usually incorporated with the switches, is incorporated in the lever operating gear.

The employment of my improved controlling mechanism in which the actual tripping and releasing of the switch arm is performed by stored up energy and not by the electrical trip coils, renders possible the elimination of electrical relays and auxiliary tripping batteries, and the disadvantages associated therewith, in nearly all systems of protective gear including leakage systems and balanced discriminating systems. Also the elimination of auxiliary tripping batteries on protective systems where it is desirable to retain relays as with reverse current protection. In this case, the fault current is utilized to trip the switch instead of the auxiliary supply. My invention also renders possible the utilization of ring type current transformers for tripping oil switches on low current capacity circuits. This type of transformer has many advantages.

I claim:—

1. In circuit breakers, the combination comprising a switch arm, a slide on said arm, a hand lever, means transmitting the movements of said lever to said slide, means connecting said slide to said arm whereby they move together on the operation of said lever, means for disengaging the said connection, an energy accumulator, means whereby said accumulator is charged by movement of the said lever when said slide and arm are disconnected, and means whereby such accumulated energy is utilized to release the arm for a switch opening movement.

2. In circuit breakers, the combination comprising a switch arm having an annular groove therein, a block slidable on said arm, a ball carried by said block and detachably engaging said annular groove, a member pivoted upon said block for retaining said ball in the said groove, means for releasing said ball retaining member, means for reciprocating the said block both with and without imparting such movement to the switch arm, an energy accumulator, means whereby said accumulator is charged during the movement of said block without movement of said arm, and means whereby said energy is caused to actuate the said releasing means of the said ball retaining member.

3. In circuit breakers as claimed in claim 2, means whereby the ball retaining member is set in its service position during the movment of the sliding block for storing energy in the accumulator.

4. In circuit breakers as claimed in claim 2, means for releasing the ball retaining member in the event of an incomplete closing movement of the switch arm.

5. In circuit breakers as claimed in claim 2, means whereby the ball retaining member is released to arrest a closing movement of the switch arm.

6. In circuit breakers, the combination comprising a switch arm having an annular groove therein, a block slidable on said arm, a ball carried by said block and detachably engaging said annular groove, a stirrup pivoted on said block, a roller pivoted in said stirrup, means for tripping said stirrup about its pivot to bring said roller into and out of engagement with said ball, a handle, a toggle connection between said handle and said block, a spring, means whereby energy is stored in the said spring by a movement of said handle without imparting movement to the switch arm, and means whereby the said energy is caused to trip the said stirrup.

In testimony whereof I have signed my name to this specification.

GEORGE PAILIN.