June 5, 1934. J. R. SANBORN 1,961,573

CIRCUIT BREAKER

Filed Nov. 4, 1930 4 Sheets-Sheet 1

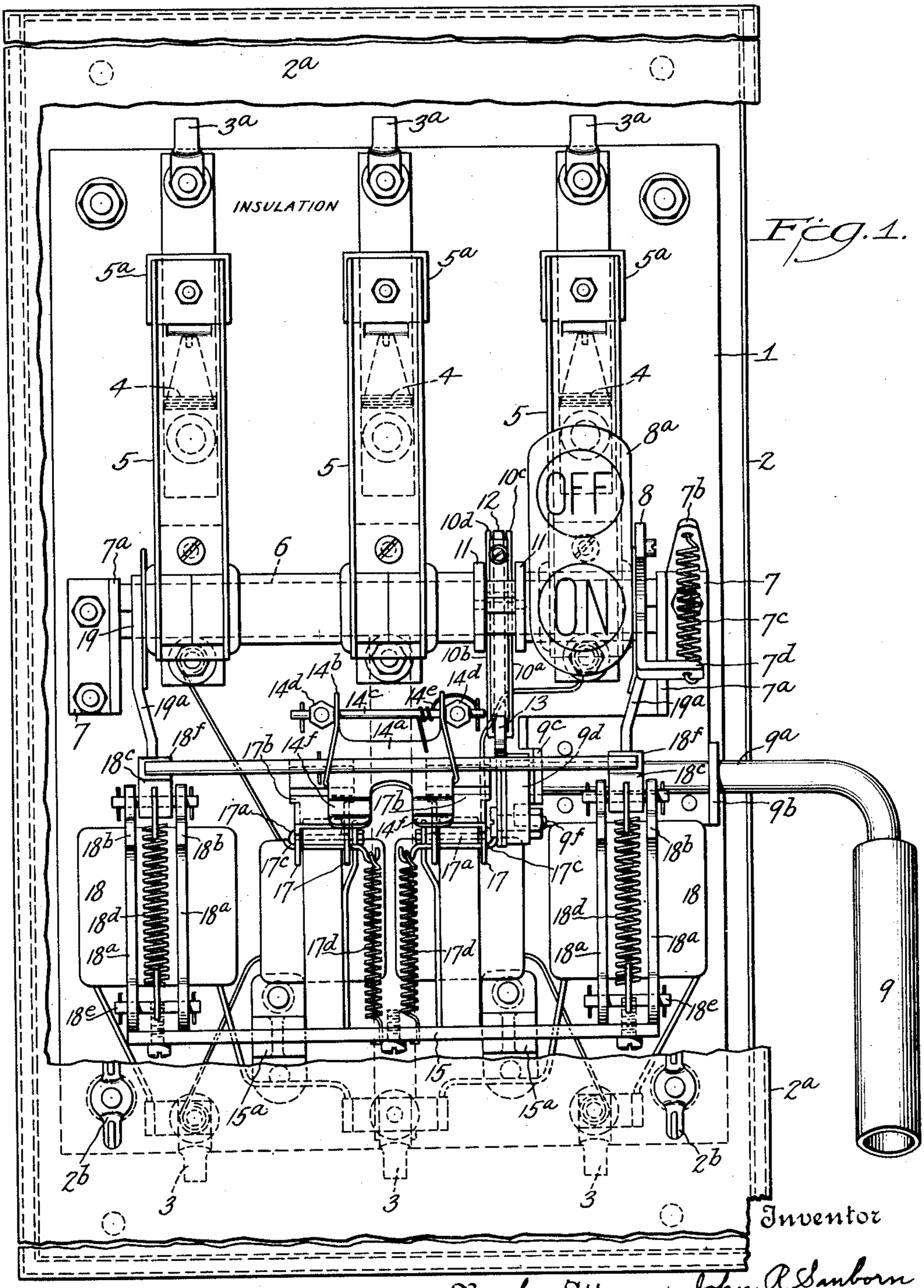

Fig. 1.

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Fig. 2.

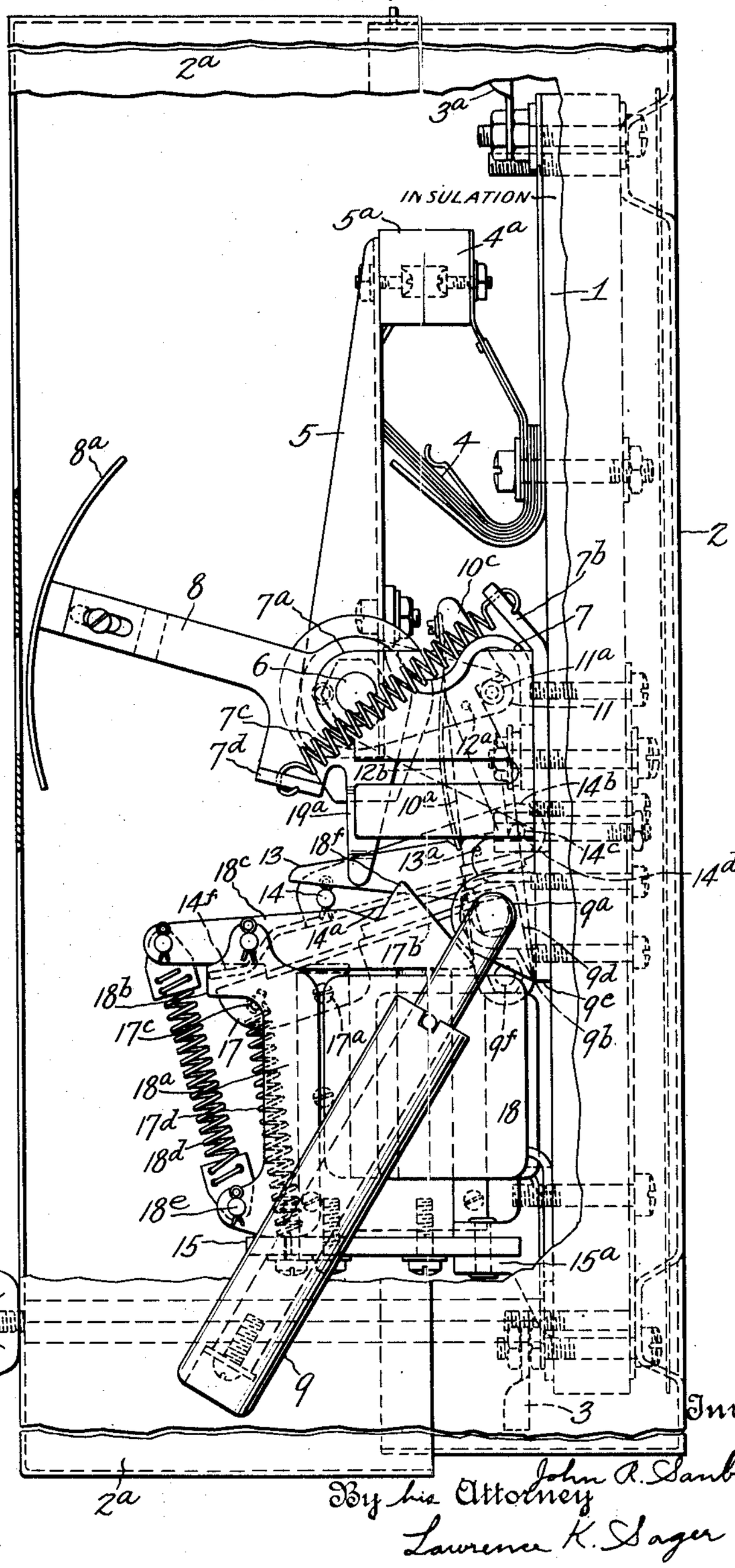

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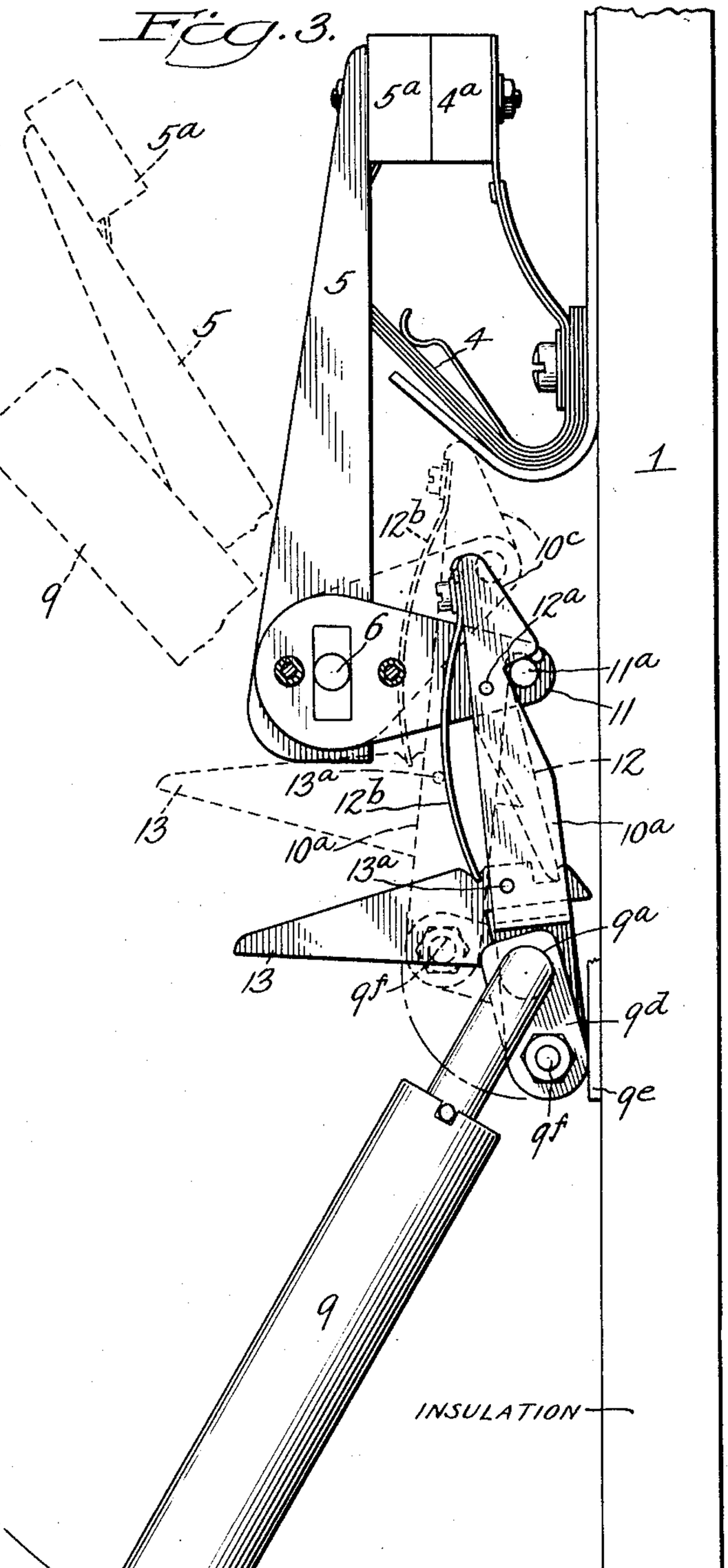
Fig. 3.



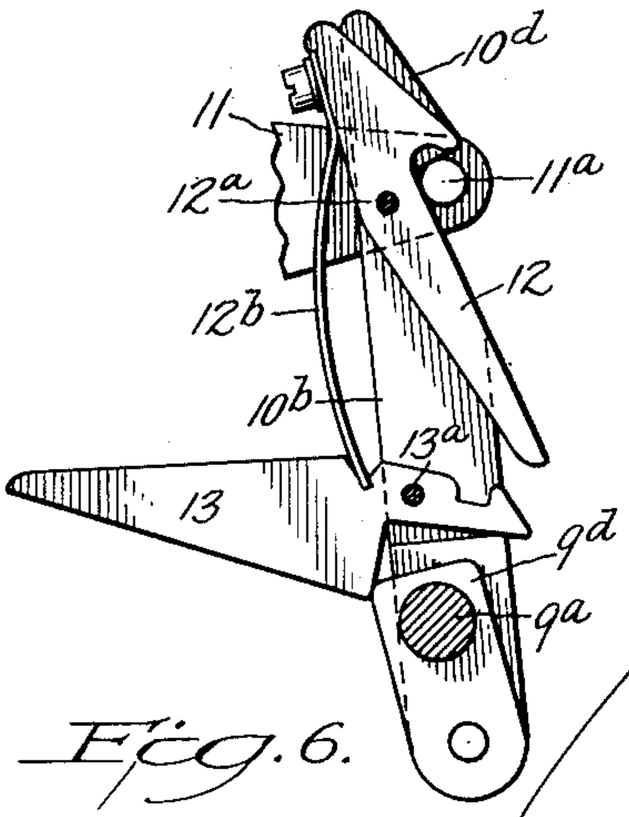


Fig. 6.

Fig. 8

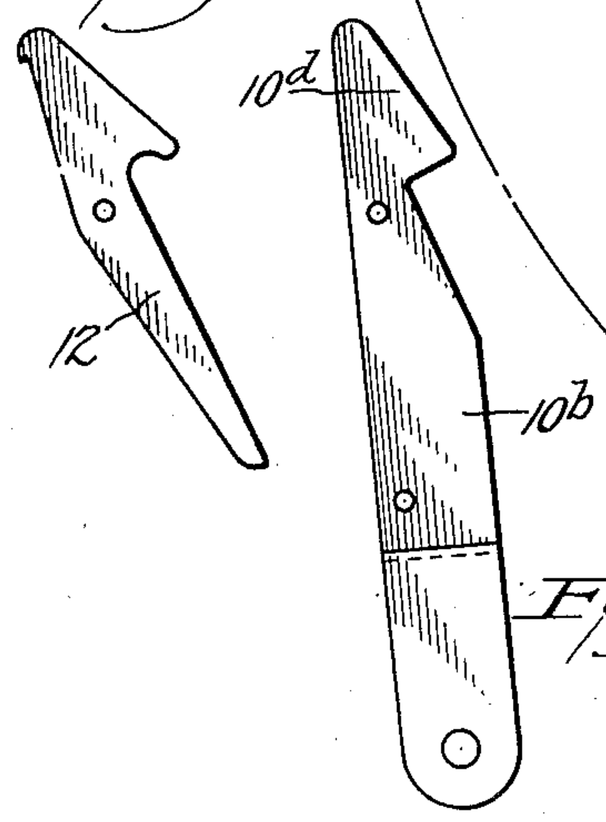


Fig. 7.

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CIRCUIT BREAKER

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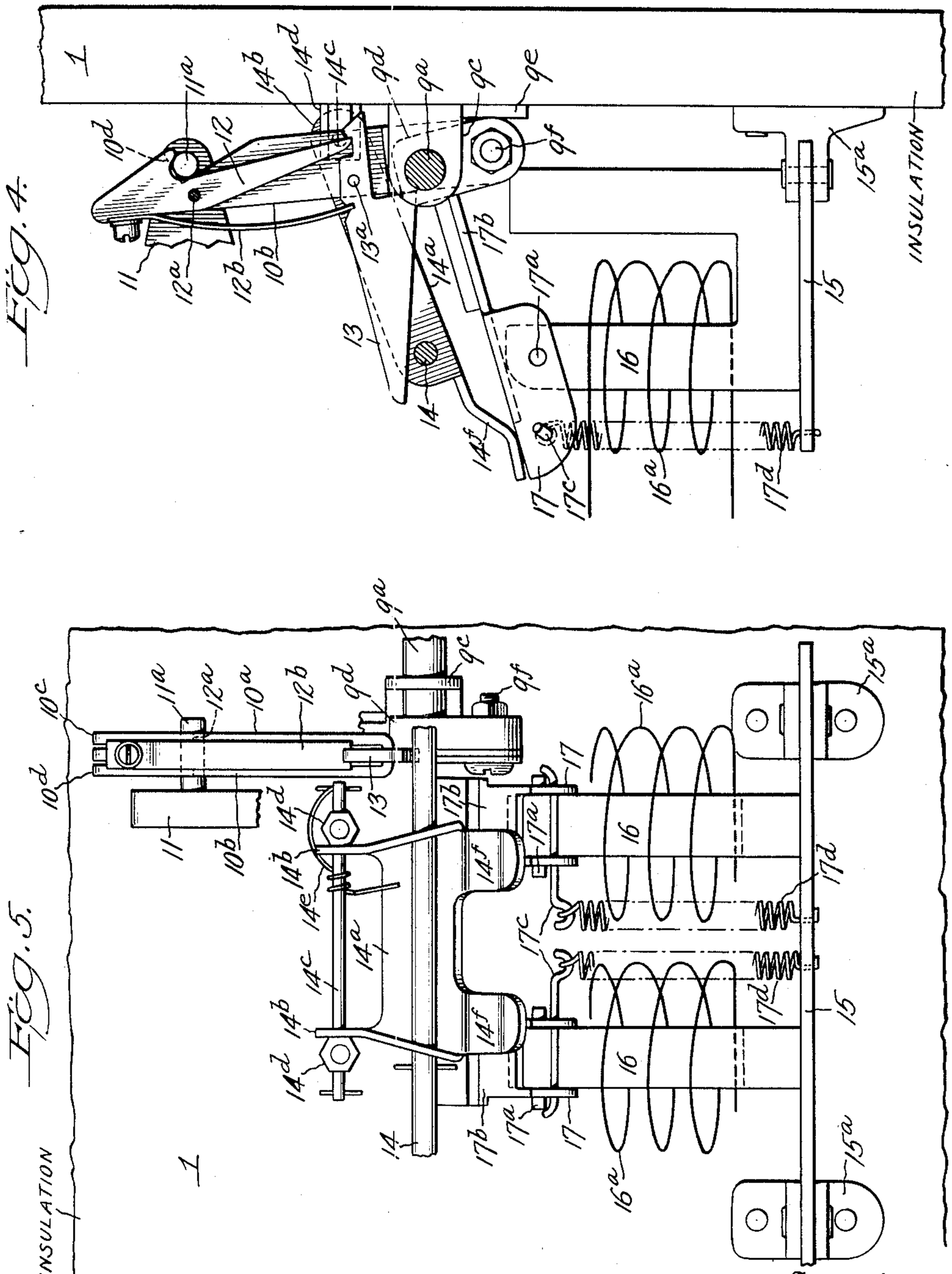

Fig. 4.

Fig. 5.

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UNITED STATES PATENT OFFICE

1,961,573

CIRCUIT BREAKER

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Application November 4, 1930, Serial No. 493,297

14 Claims. (Cl. 200—89)

This invention relates particularly to the release from the handle type of circuit breaker, or so-called nonclosable under an abnormal circuit condition, such as overload, under-voltage, or any other desired controlling factor or factors. The breaker is also adapted, in some of its improved features, to be used with breakers of other than the release from the handle type.

The main object of the invention is to produce an improved circuit breaker which will be rugged in form of construction, dependable in operation and durable with long continued use; and to accomplish this by an improved form of construction of a simple character in the form and relationship of its parts and which permits economical manufacture and simplicity in assembling. Another object is the provision of a form of construction wherein the operating handle may be located close to the base, thereby avoiding any undue projection thereof or its being subject to accidental interference, and likewise permitting enclosure by a shallow casing, where enclosure of the parts is desired. Another object, where the handle is outside the casing, is to provide for the location of the operating handle at the side of the breaker close to the base where it is in a protected position. It likwise permits convenient enclosure of the breaker by permitting the removal of the outer casing without disturbing the operating handle. Another object is to provide an improved form of mechanism wherein the controlling force for causing the opening of the breaker may be made quite small. Another object is to provide a simple form of construction of breaker wherein any desired number of switch elements may be used and all controlled by one closing mechanism, and all released by the effect of any one of a number of different controlling coils. Other objects and advantages of this invention will be understood from the following description and accompanying drawings which illustrate a preferred embodiment thereof.

Fig. 1 is a front elevation of a three pole circuit breaker embodying my invention provided with four controlling coils and showing the breaker in closed position, the outer casing being partly broken away; Fig. 2 is a similar side view thereof; Fig. 3 is a side view of the closing and releasing parts; Fig. 4 is a side view showing part of the tripping mechanism and in the position corresponding to the closed position of the breaker; Fig. 5 is a front elevation of part of the tripping mechanism; Fig. 6 is a side detailed view showing the retaining latches released for permitting the opening of the breaker; Fig. 7 is a side view of the main hook element; and Fig. 8 is a side view of the latch holding element.

Referring to Figs. 1 and 2, the breaker is shown mounted on an insulating base plate 1 which is shown secured to the back of the inner portion 2 of an enclosing casing. The breaker illustrated is of the three pole type, one set of terminals 3 being mounted upon the lower portion of the base plate and the other set of terminals 3*a* being mounted upon the upper portion of the base plate. The inner portion of the enclosing casing is comparatively shallow, and the outer portion 2*a* of the casing is likewise comparatively shallow and is shown as telescoping over a portion of the inner casing and secured in place by wing nuts 2*b* which engage studs extending outwardly from the base plate.

The yieldable fixed contacts 4 of the breaker are suitably mounted upon the base plate and provided with the usual auxiliary carbon contacts 4*a*. The contact arms 5 engage the yieldable contacts and have auxiliary carbon contacts 5*a* at their upper ends. The contact arms are fixed to, but insulated from, a shaft 6 which is rotatably supported in two bearing brackets 7, one at each side of the breaker. These brackets are fixed to the base plate and have outwardly extending portions 7*a* for supporting the contact arm shaft 6. The right hand bearing bracket has an extension 7*b* to which one end of the operating spring 7*c* is secured, the other end of the spring being secured to an arm 7*d* secured to the contact arm shaft. This spring serves to quickly throw the breaker to open position when released. Fixed to the contact arm shaft is an outwardly extending arm 8 carrying a curved plate 8*a* marked "On" and "Off" on its face. Evidently, the position of the curved plate 8*a* will show whether the breaker is open or closed, a small opening in the front portion 2*a* of the casing permitting the word "On" or "Off" to be exposed, according to the condition of the breaker.

The operating handle 9 for closing the breaker, is external to the casing and located at the right hand side thereof and is connected to a shaft 9*a*, which is pivotally supported by two outwardly extending bearing supports 9*b* and 9*c* secured to the base plate within the casing. Fixed to the handle shaft is a crank element 9*d* which extends downwardly from the handle shaft and when in closing position strikes against a stop 9*e* on the base plate, formed by an ex-

tension from the support for the handle bearing brackets, or may be an independently mounted plate or nut to serve as a stop for the crank element. This stop prevents the breaker from being unduly strained by the operator when closing the breaker, and also serves to limit the over-center position of the crank element 9*d*, as hereinafter explained.

The breaker is closed by means of a hook, the operation of which is controlled by the handle through the crank element 9*d*. The closing hook is made up of two side plates 10*a* and 10*b* clamped together at their lower ends and also pivotally connected to the crank pin 9*f* in the outer end of the crank element, as shown in Figs. 1 and 5. The side plates of the closing hook are spaced apart from each other, in their upper portions, their upper ends forming a pair of hooks 10*c* and 10*d*. Fixed to the contact arm shaft 6 is an inwardly extending crank arm 11 which carries a pin 11*a* at its inner end and extending sidewise therefrom to the right of the arm 11. The hooks 10*c* and 10*d* are adapted to engage the pin 11*a* for the purpose of closing the breaker. That is, when the operating handle 9 is turned upwardly to the dotted position indicated in Fig. 3, it swings the crank 9*d* to the dotted position shown in Fig. 3 and correspondingly raises the side plates 10a and 10b, so that the hooks 10*c* and 10*d* pass over the top of the pin 11*a* of the arm 11 in their upper position corresponding to the open position of the contact arms 5, as indicated in dotted lines in Fig. 3. Downward movement of the closing handle will then cause the contact arms to be moved to their closed position, indicated in full lines in Fig. 3.

As it is desired to permit the opening of the breaker when attempted to be closed, in case of the occurrence of an abnormal circuit condition, and also during running conditions, without disturbing the closing handle from its closing position, the hooks 10*c* and 10*d* are shaped, where they engage the pin 11*a*, so as to readily pass off the pin and release the contact arm shaft, so that the breaker may move to open position. Thus, the shape of the engaging faces or edges of these hooks with the pin 11*a* form substantially plane surfaces; and were it not for auxiliary retaining means, the hooks would run off the pin or roller 11*a*. Under such conditions, the breaker could not be closed, or held closed, by the hooks 10*c* and 10*d* . Therefore, there is provided an auxiliary hook holding element 12, well shown in Figs. 3, 4 and 6 and separately shown in Fig. 8. This holding latch or hook is pivotally mounted between the upper portions of the hook plates 10*a* and 10*b* on a pin 12*a*, which pin is mounted upon and extends between the side hook plates. The holding hook has secured to it, at its upper end, a downwardly extending leaf spring 12*b*, for the purpose of normally forcing the upper portion of the holding hook inwardly, so as to normally engage the pin 11*a* and thereby prevent the hooks 10*c* and 10*d* from sliding off the pin.

The spring 12*b* also serves another function of engaging another latching element 13 to hold it in normal position. The latch 13 is pivotally mounted at its inner end upon a pin 13a, extending between the side plates 10*a* and 10*b*. The outwardly extending portion of the latch 13 is adapted to be engaged by a tripping element upon the occurrence of an abnormal circuit condition and is raised to release the breaker. The inner end of the latch 13 beyond the pivot 13*a* forms the hook for engaging and normally restraining the lower end of the latch holding element 12. These parts are shown in their normal closed position in Figs. 3 and 4, where it is seen that the lower end of the holding latch 12 is restrained by the inner end of the latch 13, so as to be locked to the pin 11*a*, while the leaf spring 12*b* engages a notch in the upper edge of the latch 13 in front of the pivot 13*a*, so as to tend to hold the outer end of the latch 13 down. When the holding latch is released, the spring tends to force the upper portion thereof over the pin 11*a* to such a position that the lower end of latch 12 is engaged by and retained by the inner end of the hook 13. Fig. 6 shows the relation of the latching elements to each other at a time when the outer end of the latch 13 has been raised by the tripping element, permitting the lower end of the latch 12 to be released and unhooked from the pin 11*a*. This obviously permits the hooks 10*c* and 10*d* to pass off the pin 11*a* and thus permit the opening of the breaker. In this releasing action, although the spring 12*b* tends to hold the latch 12 in position on the pin 11*a*, the force tending to open the breaker tends to move the pin 11*a* upwardly, so that, when the holding latch 12 is released, the pin 11*a* swings the latch 12 counter-clockwise on the pivot 12*a* against the action of the spring 12*b*. Thus the lower end of the latch 12 is thrown inwardly by the action of the pin 11*a*, until this pin has passed from under the holding elements, after which, the spring 12*b* tends to turn the latch 12 in a position to again engage the pin 11*a* during the closing operation of the breaker. It should also be noted that when the breaker is closed the center line of the pin 9*f* is passed beyond the dead center line extending between the axis of the handle shaft 9*a* and the axis of the pin 11*a*. Thus in the closed position of the operating handle of the breaker, the breaker is held closed by reason of the over-center position of the pin 9*f*. Obviously, when the pin 11*a* is released, the breaker handle and parts controlled thereby, remain in position corresponding to the closed position of the breaker, until raised by the operator for the purpose of closing the breaker in the manner already explained.

In the breaker shown in the drawings, there are provided means for automatically tripping the breaker upon the occurrence of over-load and also upon the occurrence of under-voltage, two over-load controlling coils and two under-voltage controlling coils being shown and being adapted for connection in a three phase circuit. Each of these controlling elements serves to raise the front end of the single tripping latch 13. Thus any one of the controlling elements may automatically cause the opening of the breaker through its effect upon this single releasing element. For securing this result, there is provided a single tripping element 14 in the form of a pin which extends across the front of the breaker and is located immediately under the front end of the tripping latch 13. The controlling elements are related to this tripping pin so that upon the occurrence of any one or more abnormal conditions, this pin would be raised to actuate the releasing latch. The tripping pin is mounted as shown in Figs. 1, 4 and 5. It is carried by a tripping bracket 14*a* in the form of a metal plate having upwardly turned side portions through which the pin passes and by

which the pin is carried. These side portions of the bracket extend rearwardly to form ears 14*b* which are in turn pivotally mounted upon a hinge pin 14*c*. This hinge pin is in turn supported by studs 14*d* which are fixed to the base plate. A spring 14*e* encircles the hinge pin and has one end secured thereto while the other end is brought forward and engages the upper surface of the tripping bracket which assists gravity in tending to hold it and the tripping pin in their lowest position.

The controlling magnets are all supported upon a common horizontal plate 15 which in turn is supported by a pair of forwardly extending jaws 15*a* suitably fixed to the base plate. Each of the magnets has a U-shaped iron core with upwardly extending legs upon which the coils are mounted. The cores are fixed to and supported upon the plate 15 and the legs of each core lie in a vertical plane perpendicular to the base plate.

The cores 16 of the two over-load coils are particularly shown in Figs. 4 and 5 with the over-load coils 16*a* diagrammatically indicated thereon. In Fig. 4 the over-load coil is omitted upon the rear leg of the core for simplicity and it is immaterial, as far as the present invention is concerned, whether both legs of the core are provided with coils, or only one leg is so provided. The particular form of magnet will be made as desired to suit the particular conditions. On the upper end of each front leg of the cores 16, is pivotally mounted an armature 17. Its shape is indicated in Figs. 4 and 5 and is in the form of a plate extending over the front leg of the core and having downwardly extending side portions over the front leg of the core, to which it is connected by a pin 17*a* which passes through the side portions of the armature and through the front leg of the core. Each of these armatures has a rearwardly extending portion 17*b* which extends over the rear leg of the over-load magnet. When the over-load current attains a predetermined limit, in either of the over-load magnets, its respective armature will be attracted and cause the rear portion thereof to move downwardly towards the rear leg of the magnet. The front end of each over-load armature is perforated to receive a horizontally extending pin 17*c*, one end of which pin is in hook form to receive one end of a spring 17*d*, as shown in Fig. 1. This spring extends downwardly and is suitably secured to the plate 15. This spring tends to hold the front end of its over-load armature down and thus cause the rear end of the armature to be raised above the rear pole of the magnet, as shown in Fig. 4, under normal conditions. Any suitable stop or adjustable means is provided to limit the unattracted position of the armature, in any of the well-known ways. A graduated scale may be placed adjacent to the armature, said scale to indicate the current for which the armature is set to trip. The tripping bracket 14*a* which is located above the over-load magnets, is provided with a pair of downwardly extending portions 14*f*, which respectively rest upon the front ends of the over-load armatures. It is evident that upon a predetermined over-load, the armature of the respective magnet carrying the over-load will be attracted and the front end thereof raised. This in turn causes the raising of the front end of the tripping bracket around the hinge pin 14*c* and thereby raises the tripping pin 14 to trip the releasing latch 13, to cause the opening of the breaker, as already described.

The low voltage, or under-voltage, controlling magnets 18 are shown located one at each side of the base plate. Each of these magnets is provided with a pair of plates 18*a* in front of the coil and suitably secured to the core of the magnet, see Figs. 1 and 2. These plates each have an outward extension 18*b* at their upper ends and carry a pin extending between them on which is pivoted the armature 18*c*, the rear portion extending over the poles of the magnet. The front end of the armature has a spring 18*d* connected to it which extends downwardly and is fastened to a pin 18*e* extending between the lower ends of the plates 18*a*. The inner portion of the armature extends under the tripping pin 14, so that when it is released upon the occurrence of a predetermined under-voltage, it will be thrown upwardly by the action of the spring 18*d* and so raise the tripping pin to cause the automatic opening of the breaker, in the manner already described. For the purpose of causing the under-voltage armature to be pushed toward the poles of its magnet when the breaker is closed and to so give the magnet an opportunity to retain the armature in place, under normal voltage conditions, the armature is provided with a projection 18*f* and an inclined downwardly extending surface at its rear end, as shown in Fig. 2. This inclined end of the armature is engaged by any suitable projection mounted upon the contact arm shaft 6, or controlled by the movement thereof. In Fig. 1, at the left, is shown a plate 19 mounted upon the contact arm shaft and having an extension 19*a* which is over the armature of the left-hand voltage magnet. The right hand voltage magnet is controlled by a similar projection 19*a* which in this instance is an extension from the arm or plate 8 carrying the indicator. Referring to Fig. 2, it will be evident that when the breaker is open, the projections 19*a* will be nearer the base plate than when the breaker is closed, and that the inner ends of the voltage armatures will be above the retained position shown in Fig. 2. Thus during the closing of the breaker, the projections 19*a* will move outwardly and engage the inner surfaces of the voltage armatures and force them in position to be magnetically held if normal voltage exists, the projections 19*a* in the meantime passing over and in front of the projections 18*f* of the armatures to the position shown in Fig. 2. If under-voltage exists in either circuit, the armature corresponding thereto will not be held by its magnet; and the spring 18*d* will cause it to be thrown to raise the tripping pin 14, the projection 19*a* having passed away from the projection 18*f* of the armature.

It will be understood that the automatic tripping magnets may be variously arranged in relation to the breaker mechanism and may, of course, be made to respond to any abnormal condition desired and may be variously connected to suit the particular requirements. In the present case, as indicated in the drawings, the left hand under-voltage magnet 18 is connected between the left hand terminal 3 and the middle terminal of the three phase circuit; and the right hand voltage magnet is connected between the right hand terminal 3 and the middle terminal 3. The right hand over-load coil is connected between the right hand terminal 3 and the right hand contact arm 5; and the left

hand over-load coil is connected between the left hand terminal 3 and the left hand contact arm 5, while the middle terminal 3 is connected directly to the middle contact arm.

Although the particular circuit breaker described is adapted for three phase alternating current, my invention is likewise adapted for the control of direct current and may be used in various types of circuit breakers. It is also evident that it is adapted for the control of a single pole breaker, as well as for breakers having any desired number of poles, or switch arms, all controlled by a single closing and releasing device and subject to automatic opening by any desired number of control magnets operating under any desired conditions. Where necessary, insulating barriers may be placed between the different contact arms and the contacts controlled thereby for the purpose of preventing flashing over from one pole to the adjoining pole, but such barriers are omitted from the present drawings for the sake of simplicity and clearness.

Although I have described a preferred embodiment of my invention, it will be understood that the same may be embodied in various forms of construction and relationship of the parts and various modifications made without departing from the scope thereof.

I claim:

1. A circuit breaker comprising a base plate, a rotatable contact arm, a pivotal support for said contact arm mounted on said base plate, a rotatable operating shaft supported on said base plate below said support, an operating handle connected with said shaft and located at one side of the breaker, an arm fixed to said shaft below said contact arm, an arm connected with said contact arm and extending inwardly toward said base plate, and a releasable hook device connecting said inwardly extending arm and said arm fixed to said shaft for closing said contact arm.

2. A circuit breaker comprising a base plate, a rotatable contact arm, a pivotal support for said contact arm mounted on said base plate, a rotatable operating shaft supported on said base plate below said support, an operating handle connected with said shaft and located at one side of the breaker, an arm fixed to said shaft below said contact arm, an arm connected with said contact arm and extending inwardly toward said base plate, and a releasable hook device connecting said inwardly extending arm and said arm fixed to said shaft for closing said contact arm, said device comprising a main latch and a latch for holding the main latch.

3. A release from the handle circuit breaker comprising a base plate, a contact arm, a pivotal support on said base plate for said contact arm, a crank arm rigidly connected with said contact arm and extending inwardly toward said base plate, a hook element releasably connected with said crank arm, an operating shaft below said support, a crank arm on said operating shaft connected with said hook element, a holding latch for maintaining said hook element in operative engagement with said first-named crank arm, and a tripping device for releasing said holding latch.

4. A release from the handle circuit breaker comprising a shaft, a contact member fixed to said shaft, an arm connected with said shaft, a pin carried by said arm, a hook element engaging said pin, a holding latch pivotally supported on said hook element and engaging said pin for normally holding said hook element in engagement with said pin, an operating shaft having an arm connected with said hook element, and means for automatically tripping said holding latch.

5. A release from the handle circuit breaker comprising a shaft, a contact member fixed to said shaft, an arm connected with said shaft, a pin carried by said arm, a hook element engaging said pin, a holding latch pivotally supported on said hook element and engaging said pin for normally holding said hook element in engagement with said pin, an operating shaft having an arm connected with said hook element, and means for automatically tripping said holding latch, said last-named arm passing beyond the center line of said pin and said operating shaft in the closed position of the breaker.

6. A circuit breaker comprising a base plate, a rotatable contact arm, an arm connected with said contact arm and extending inwardly toward said base plate, said arm having a pin on its inner end, a rotatable operating shaft supported on said base plate below said contact arm, and an upwardly extending hook moved upwardly and downwardly by rotation of said shaft, the upper end of said hook passing over said pin when in its upper position to engage the same and causing the contact arm to close by the downward movement of said hook.

7. A release from the handle circuit breaker comprising a rotatable contact element, a rotatable operating element, and a latching mechanism operatively connecting said elements, said mechanism comprising a main latch for moving said contact element to closed position, a latch for holding said main latch in operative engagement for moving said contact element, and a tripping latch for normally restraining said holding latch.

8. A release from the handle circuit breaker comprising a rotatable contact element, a rotatable operating element, a latching mechanism operatively connecting said elements, said mechanism comprising a main latch for moving said contact element to closed position, a latch for holding said main latch in operative engagement for moving said contact element, a tripping latch for normally restraining said holding latch, and means for automatically moving the tripping latch.

9. A release from the handle circuit breaker comprising a rotatable shaft, a contact member mounted on said shaft, an operating shaft having a crank arm, and a releasable hook device connecting said crank arm and said first named shaft, said crank arm being carried over-center in the closed position of the breaker.

10. A release from the handle circuit breaker comprising a shaft, a contact member carried by said shaft, an arm connected with said shaft, a pin carried by said arm, a pair of hook plates engaging said pin, a holding latch for retaining said hook plates in engagement with said pin and pivotally supported between said plates and also engaging said pin, an operating shaft having an arm connected with said hook plates, and means for automatically tripping said holding latch.

11. A release from the handle circuit breaker comprising a shaft, a contact member carried by said shaft, an arm connected with said shaft, a pin carried by said arm, a pair of hook plates

engaging said pin, a holding latch for retaining said hook plates in engagement with said pin and pivotally supported between said plates and also engaging said pin, an operating shaft having an arm connected with said hook plates, and means for automatically tripping said holding latch, said arm passing beyond the center line of said pin and said operating shaft in the closed position of the breaker.

12. A circuit breaker comprising a common rotatable shaft, a plurality of movable contact members carried thereby and fixed thereto, a rotatable operating shaft, a releasable latching device operatively connecting said operating shaft and said first named shaft for rotating said first-named shaft and thereby moving said contact members to closed position, a tripping mechanism for releasing said latching device, a single movable element for controlling said tripping mechanism, and a plurality of magnets for individually controlling the movement of said single element.

13. A circuit breaker comprising a common rotatable shaft, a plurality of movable contact members carried thereby and fixed thereto, a rotatable operating shaft, a releasable latching device operatively connecting said operating shaft and said first named shaft for rotating said first-named shaft and thereby moving said contact members to closed position, a tripping mechanism for releasing said latching device, a single movable element for controlling said tripping mechanism, a plurality of magnets for individually controlling the movement of said single element, a main base plate for the breaker, and a common support for said magnets mounted on said main base.

14. A release from the handle circuit breaker comprising a rotatable shaft, a plurality of contact members carried by said shaft and fixed thereto, a rotatable operating shaft, a device connecting said shafts for closing the breaker by rotation of said first-named shaft, said device comprising a hook, a holding element for retaining said hook in position, a pivoted element for controlling the movement of said holding element, a plurality of tripping magnets, and a movable element actuated by each of said tripping magnets for affecting said pivoted element to cause the release of said holding element.

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