F. L. SESSIONS.

BREAKER FOR ELECTRIC CIRCUITS.

APPLICATION FILED OCT. 29, 1903.

1,040,440. Patented Oct. 8, 1912.

2 SHEETS—SHEET 1.

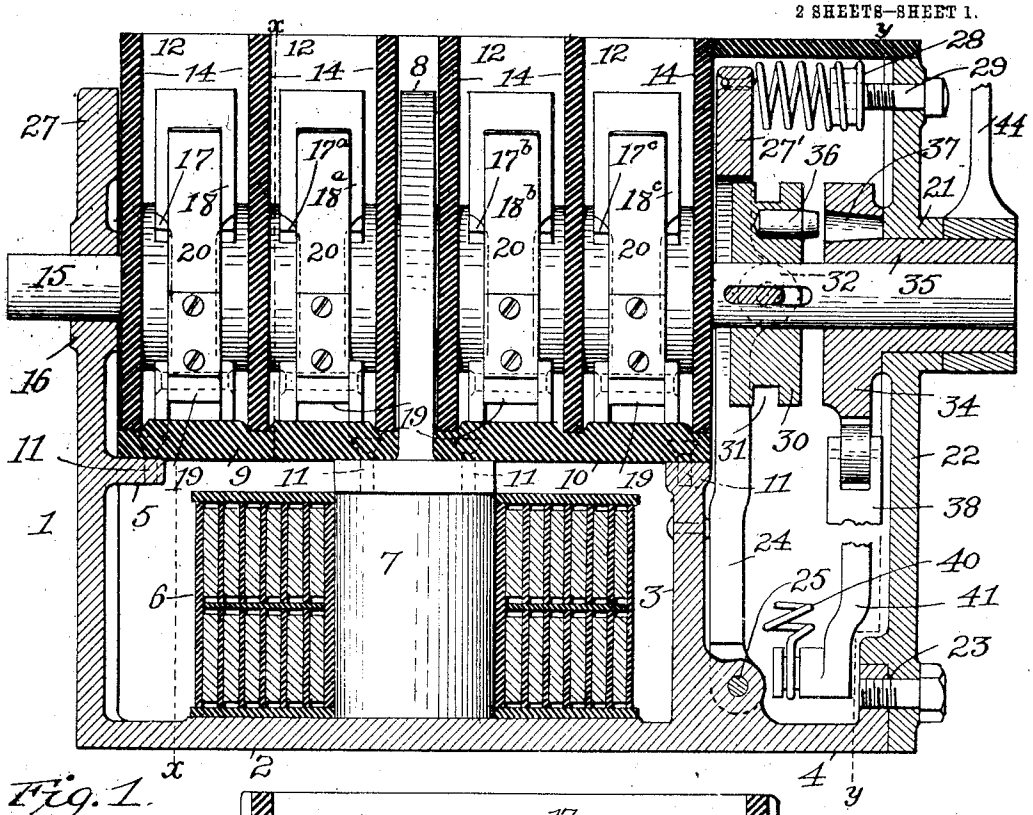

Fig. 1.

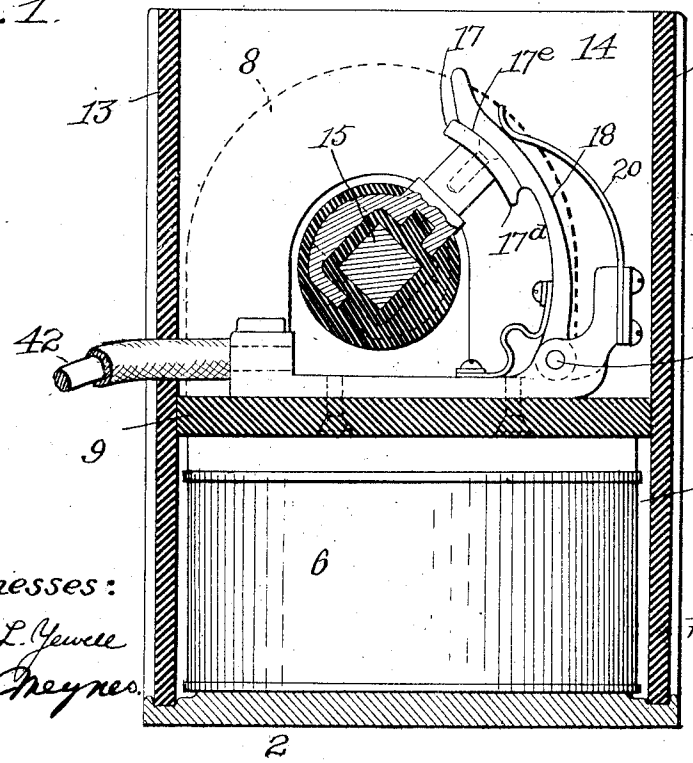

Fig. 2.

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2 SHEETS—SHEET 2.

Fig. 3.

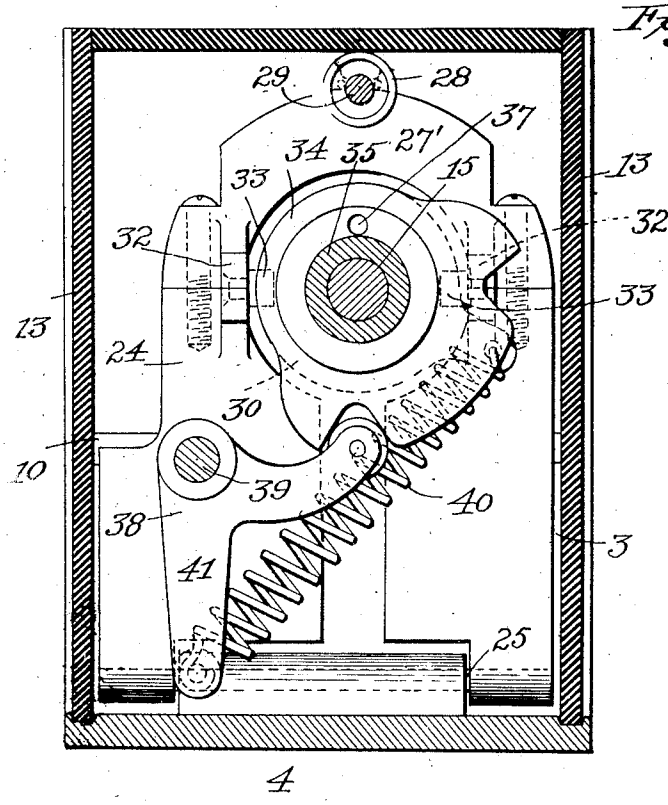


Fig. 5

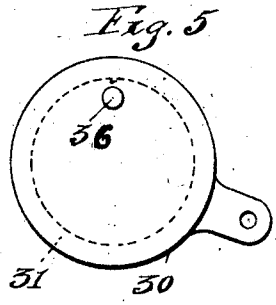
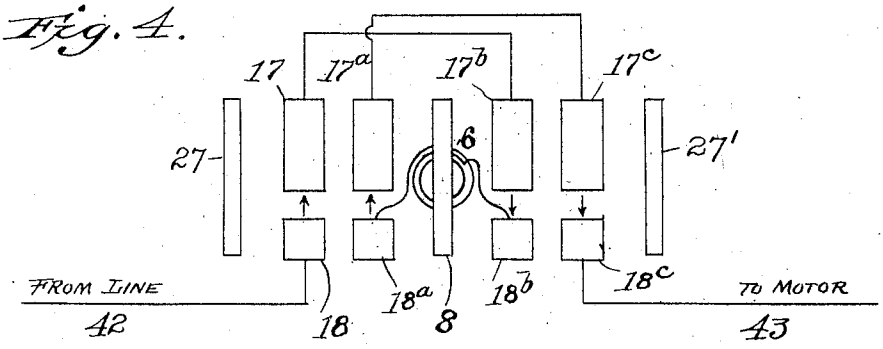


Fig. 4.



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UNITED STATES PATENT OFFICE.

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BREAKER FOR ELECTRIC CIRCUITS.

1,040,440. Specification of Letters Patent. Patented Oct. 8, 1912.

Application filed October 29, 1903. Serial No. 179,096.

To all whom it may concern:

Be it known that I, FRANK L. SESSIONS, a citizen of the United States, residing at Columbus, in the county of Franklin and State of Ohio, have invented certain new and useful Improvements in Breakers for Electric Circuits, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to improvements in electric circuit breakers and in the devices used therewith for blowing out or extinguishing the arc produced at the time of the opening of the circuit.

The object is to provide a simplified mechanism, the parts of which are arranged compactly and in such way as to attain superior results in comparison with those attained with the earlier devices of this class.

Figure 1 is a longitudinal section of a circuit breaker embodying my improvements. Fig. 2 is a cross section on the line *x*—*x* of Fig. 1. Fig. 3 is a cross section on the line *y*—*y* of Fig. 1. Fig. 4 is a diagram of the electrical connections of the circuit breaker. Fig. 5 is a detail view.

1 is an end wall and 2 is a wall at right angles thereto, these being adapted to form parts of a box or housing. At 3 there is a wall parallel to that at 1, but not extended up from the bottom wall 2 as far as the wall 1.

4 is an extension of the bottom wall 2 for a purpose to be described.

5 is a flange extending inward from the wall 1 with its top surface in the plane of the top surface of the wall 3.

6 indicates as an entirety a magnet which is situated centrally on the bottom wall 2 with its core 7 at right angles thereto. From one end of the core there extends a pole piece 8 situated in a transverse plane midway between the walls 1 and 3.

9 and 10 represent plates of insulating material, that at 9 being supported at one edge upon the flange 5 of the wall 1, and at the other edge being supported upon the magnet core; and that at 10 being supported at one edge upon the wall 3 and at the other edge upon the magnet core. These insulating plates are secured in place by means of countersunk screws 11. Above each of the plates 9 and 10 there are formed two contact chambers 12, these having side walls 13, 13 of insulating material which extend from the bottom wall 2 up to lines somewhat above the end wall 1, and having transverse walls 14, 14 of insulating material. Through these contact chambers passes a shaft 15, which, at one end, is mounted in a bearing 16 in the end wall 1, and at the other end in a bearing to be described. This shaft carries a series of movable contacts 17, 17^a, 17^b, 17^c. Each of these movable contacts is situated within one of the aforesaid chambers 12, 12. Opposite to each of them there is placed a stationary contact. These stationary contacts are indicated on the drawings by 18, 18^a, 18^b, and 18^c and they may be made in any preferred way. As shown, each stationary contact consists of a curved bar or arm pivoted at 19 and having a spring 20 arranged to bear against it and force it toward the axis of the shaft 15. The contacts of each of the two series 17 to 17^c and 18 to 18^c may be insulated in any preferred way in relation to each other and in relation to the other parts of the mechanism. For the sake of illustration I have shown all of these parts of the circuit, together with the magnet coils as being in series, as illustrated in the diagram in Fig. 4.

That end of the shaft opposite to the bearing at 16 is supported in a bearing at 21. This is formed in or upon a wall or standard piece 22 which at 23 is secured to the bottom wall 2. Preferably this wall or standard 22 is made of zinc, brass or other non-magnetic material for reasons that will be understood from the description below.

At 24 a magnetic mass such as a plate or bar of iron is placed. It is movable on lines substantially parallel to the axis of the shaft 15. Preferably it is pivoted at 25 to the bottom plate 2. The lines of magnetic force generated in the magnet at 6 are conducted along this part at 24, there being two magnetic circuits in the apparatus as a whole, one extending from the magnet core 7 upward along the plate at 8 and thence to the left toward the wall 1, (the upper part of which at 27 may be regarded as a pole) and thence downward to the bottom wall 2 below the magnet, and the other of which extends from the magnet core upward through the said part 8 and thence across toward the right to the lately described part at 24, the upper portion 27′ of which may be regarded as a pole, and thence downward to the bot-

tom plate 2. One of these poles, namely, that at 27′ being movable toward the pole metal at 8, it will naturally tend to travel in the direction thereof as far as possible when current is passing through the magnet. To prevent such motion of this pole 27′ until a predetermined strength of current has been reached, a spring 28 is connected to the upper end thereof and adjustably connected to a holder 29. The latter is preferably in the form of a screw engaged with a button or disk at the end of the spring 28 and adapted to move it farther in or out as desired. 30 is a disk or collar mounted upon the shaft 15. It is adapted to move along the shaft freely to a limited extent, its longitudinal movement being limited and rotation with respect to the shaft being prevented by means of a feather and groove, or by a pin passing through a slot in the shaft, or by an equivalent device.

31 is a peripheral groove formed in the disk or collar 30. A clutch connection is provided between the vibrating pole piece 24 and this clutch or collar. As shown, the pole piece has ears 32 which carry pins or rollers 33 fitting loosely in the groove 31. As the pole piece moves in or out along the shaft, the pins 33 cause a corresponding movement of the disk or collar.

34 is a second disk which is loosely mounted upon the shaft 15, preferably by being formed upon the end of a sleeve 35. This sleeve projects through the bearing wall or standard 22 above described, the disk 34 lying upon the inside and adjacent to the sliding disk or collar 30.

The disks 30 and 34 can be temporarily connected by means of a pin 36 carried by one, and a pin socket or cavity 37 formed in the other.

Under normal circumstances the spring 28 tends to hold the disk 30 in its outermost position with the pin 36 in the socket 37. And when the parts are in such positions the turning of the sleeve 35 and the disk 34 will result in a corresponding turning of the shaft 15 and of the movable contacts 17 to 17ᵉ.

There are two ordinarily occupied positions of the parts, one referred to as the "on" and the other as the "off" position. The disk 34 can be yieldingly held in either of these two positions.

38 is a pawl pivoted at 39 and adapted to engage with either of two notches or abutment shoulders on the disk 34, these respectively corresponding to the "on" and "off" positions of the contacts. This pawl is normally held under pressure against the disk by a spring 40 which is connected to an arm 41 rigid with it. The spring 40 extends up from the lower end of the pawl arm 41 and is connected to a projection or radial extension on the disk or collar 30, and its normal tendency is to turn this disk 30 around upon its axis and therefore to turn also the shaft 15. When, however, the pin 36 is seated in the cavity at 37 in the disk 34 such turning of the disk 30 is prevented. The parts at 30, 34 and 35 are also preferably made of zinc or other non-magnetic material in order that they may act in the least degree attainable in the scattering or dissipating of the lines of magnetic force.

The inleading wire or main is indicated by 42 and the outleading wire is indicated by 43, extending from the circuit breaker to the motor or to the controller.

The sleeve 35 is connected with a lever, such as indicated at 44, by which the operator can turn the disk 34 as required.

I intend also to combine a circuit breaker of this character directly with a controller apparatus, in which case the sleeve 35 or its corresponding part will be connected with a rotary shaft or barrel on the controller and both sets of parts can be actuated by a single lever. In such case it will be found advantageous to vary the circumferential lengths of the contacts 17 to 17ᵉ, or the contacts 18 to 18ᵉ, or both, to satisfy such circumstances as may be met with.

The manner in which the device above described operates will be readily understood.

Assuming that no current is passing through the train of conducting devices, and that the operator desires to introduce it to the motor, he first, by means of the lever 44, imparts a partial rotation to the sleeve 35, and that in turn partially rotates the grooved collar 30, and the shaft 15 brings the contacts 17 to 17ᵉ, respectively, into contact with those at 18 to 18ᵉ. The current now passes from one set of contacts to the other, and thence to the motor or other translator. These positions of the parts will be maintained as long as the current flows in quantity less than that which is predetermined. As soon as the current exceeds the predetermined limit the magnetic effort of the magnet 6 is increased, and the magnetic lines which pass from the magnet pole 8 to those at 27 and 27′ are correspondingly increased. The first effect is to cause the pole piece 27′ to move toward the pole piece 8 in opposition to the spring 28. The result of this movement is that the pins 33 in the groove 31 of the collar 30 draw the collar inward and the pin 36 is drawn out from the socket or cavity 37 in the disk 34 on the sleeve 35. As soon as the pin and its collar 30 are thus disengaged the spring 40, which is under tension, compels the rotation of the collar 30, and with it the shaft 15. The latter compels the movable contacts 17 to 17ᵉ to move away from the stationary ones at 18 to 18ᵉ, and the circuit is broken. The break occurs simultaneously at each and all of the four pairs of contacts. A break in

an electric circuit of this character creates an arc and causes more or less flame or flash. The disadvantageous results from the break are obviated by the arrangement of the magnetic parts. The lines of force generated by the magnet 6, at least the principally efficient lines which extend between the magnetic poles, are parallel to the axis of rotation of the contacts. The lines of the arcs that are formed between the contacts are circumferential or tangential to this axis of rotation. And the magnetic lines of force between the pole 8 and the poles 27 and 27′ are transverse or at right angles to the planes across the axis in which the arcs exist.

One of the principal features of the present invention is the provision of a cylindrical switch with a magnetic blow out mechanism having its parts so constructed and arranged that the lines of force run substantially parallel to the axis of rotation of the switch in the regions where the contacts are located while the arcs which occur when the contacts are separated are generated on lines which are circumferential or tangential to the surfaces of the contacts. As a result the arcs are forced away from the contacts along substantially radial lines by the said magnetic action. This is in contrast with other switching and controlling devices having magnetic blow outs of the earlier sorts, wherein the parts are so arranged that the magnetic lines are radial to the axis. The arc is generated on lines which are circumferential or tangential, and the lines of magnetic force drive the arc parallel to the axis of the cylinder with a great tendency to burn the insulation between the contacts, and requiring either frequent renewals or necessitating the use of very thick insulating bodies.

In the present construction, the lines, as above stated, run parallel to the axis of the cylinder and the arc is forced out radially away from the axis and away from the insulating materials.

The contacts 17 to 17^{c} being formed or provided with the peculiarly shaped edges 17^{d} which project somewhat beyond the thicker part of the contact, the arc at the time of the separation of the contacts is drawn away from the principal surfaces at 17^{c}, and if any burning or excessive heating of the metal occurs it is confined to this projecting and reduced part at 17^{d}. The main portion of the rotary contact is thus largely saved from destruction.

My preferred manner of connecting up the different parts of the circuit is illustrated diagrammatically in Fig. 4. The line 42 which conducts the current into the apparatus is connected to the stationary contact 18. The movable contact 17 is electrically connected with the movable contact 17^{b} and the contact at 17^{a} is in turn connected with that at 17^{c}. The terminals of the wire of the magnet 6 are respectively connected to the stationary contacts 18^{a} and 18^{b}. And the outgoing wire 43 from the circuit breaker is connected to the stationary contact 18^{c}, it running thence to the controller, motor or other translator. And when these connections are employed it will be seen that when the shaft brings its movable contacts into engagement with the stationary contacts the current passes from the wire 42 to the contacts 18 and 17, thence to the contacts 17^{b} and 18^{b}, thence through the wire of the magnet 6 to the contacts 18^{a} and 17^{a}, thence to the contacts 17^{c} and 18^{c}, and thence out to the controller or motor.

While I have described a series of connections for the contacts and the magnet, it will be understood that I do not limit the novel features of the invention to any precise arrangement of the contacts, as any number of these can be employed, and if more than one pair are used they can be placed in any desirable multiple or series arrangement.

It will be further seen that the peculiar connection which I provide between the disk 34 and the sleeve 35, and the rotary contacts, is of such nature that there is no manual control of the automatic break of the circuit. If the current passes the desired and predetermined limit, the contacts will automatically separate even though an operator should, by hand, prevent the sleeve 35 and disk 34 from turning. As soon as the increase of current results in an increase of magnetism the grooved disk or collar 30 is disengaged from the sleeve 35 and disk 34 (which is the only part the operator can control) and thereupon the breaking of the circuit is automatically effected by the instantaneous and powerful action of the spring 40. Thereafter the operator is compelled to rotate the sleeve 35 and the disk 34, by means of his lever 44, to again bring the socket 37 and the pin 36 into lines of registering before he can close the circuit by bringing the contacts together. As soon as he does thus, by hand, turn the disk 34 far enough to bring the socket 37 opposite the pin 36, the spring 28 will cause the pin to snap into the socket and the two disks will be again joined together. Then by giving a reverse motion to the disk 34 he can compel it to cause the collar 30 to rotate the shaft and bring the movable contacts 17 to 17^{c} into engagement with the contacts 18 to 18^{c}.

It will be understood that there can be numerous modifications with respect to the features of construction which I have described. The disk 30 and the spring 40 can be regarded as a motor adapted to actuate the movable contacts, which motor is interposed between the manual setting devices and the contacts in such way that its action

cannot be interfered with. The lock or stop which holds the spring motor in position ready for action can be electro-magnetically released independently of the movement of the pole piece 27', although I prefer the construction illustrated on account of its simplicity and the reduction of the number of parts. So, too, the number of the pairs of contacts can be varied to meet differing requirements.

What I claim is:

1. In a circuit breaker, the combination of the separable contacts, and the magnet having its poles disposed on opposite sides of said contacts so that the arcing space of the contacts lies in the magnetic air gap between said poles, one of said poles being movable toward and from the other under the action of the magnetic flux, substantially as set forth.

2. In a circuit breaker, the combination of the separable contacts, the magnet having its poles disposed on opposite sides of said contacts so that the arcing space of the contacts lies in the magnetic air gap between said poles, one of said poles being movable toward and from the other under the action of the magnetic flux, and the spring for controlling the movements of said movable pole, substantially as set forth.

3. In a circuit breaker, the combination of the separable contacts, the magnet having its poles disposed on opposite sides of said contacts so that the arcing space of the contacts lies in the magnetic air gap between said poles, one of the said poles being movable toward and from the other under the action of the magnetic flux, a spring for controlling the movements of said movable pole, and means for varying the tension of the spring, substantially as set forth.

4. In a circuit breaker, the combination of the separable contacts, the magnet having its poles disposed on opposite sides of said contacts so that the arcing space of the contacts lies in the magnetic air gap between said poles, one of said poles being movable toward and from the other under the action of the magnetic flux, the motor for separating the contacts, and a lock for the motor connected to the movable pole, substantially as set forth.

5. In a circuit breaker, the combination of the separable contacts, the magnet having its poles disposed on opposite sides of said contacts so that the arcing space of the contacts lies in the magnetic air gap between said poles, one of said poles being movable toward and from the other under the action of the magnetic flux, manual means for setting the movable contact, and means connected with the said movable pole for rendering the manual means inoperative, substantially as set forth.

6. In a breaker for electric circuits, the combination of the separable contacts, the magnet having a pole piece on one side of the arcing space of the contacts, a pole piece on the other side of said arcing space movable magnetically to its arc blowing position, means for moving it from said position, a spring for separating the contacts, locking devices for holding the spring under tension when the contacts are in mutual engagement, and means connecting the locking devices with the movable pole piece, substantially as set forth.

7. In a circuit breaker, the combination of a series of pairs of separable contacts, and the electromagnet having a single coil all of the turns of which are in one direction and having a plurality of poles and a plurality of air gaps therebetween, some of the said contacts being disposed in each of the several air gaps, substantially as set forth.

8. In a circuit breaker, the combination of several pairs of contacts, one contact of each pair being movable, the rotary shaft upon which the movable contacts are mounted in a series extending lengthwise of said shaft, and the electro-magnet having a single coil all of the turns of which are in one direction and having a plurality of poles and a plurality of magnetic air gaps extending therebetween, some of the said contacts being disposed in each of the said air gaps, substantially as set forth.

9. In a circuit breaker, the combination of several pairs of contacts, one contact of each pair being movable, the rotary shaft upon which the movable contacts are mounted in a series extending lengthwise of said shaft, an electro-magnet having a single coil all of the turns of which are in one direction and having a plurality of poles and a plurality of magnetic air gaps extending therebetween, some of the said contacts being disposed in each of the said air gaps, and the lines of force in said air gaps being parallel to the axis of motion of the movable contacts and transverse to the lines of the arcs formed between the contacts of each pair, substantially as set forth.

10. In a breaker for an electric circuit, the combination of the series of several pairs of contacts, one contact of each pair being movable, the rotary shaft carrying each of the said movable contacts, the magnet having a single coil all of the turns of which are in one direction and having a pole of one polarity situated with one or more pairs of contacts on each side of it and two poles of similar polarity opposite to that aforesaid arranged at the outer ends of both series of pairs of contacts, a motor for rotating the movable contacts and an electro-magnetically movable lock or stop for the motor, substantially as set forth.

11. In a circuit breaker, the combination of a series of several pairs of contacts one

contact of each pair being movable, the rotary shaft carrying each of the said movable contacts, and the magnet having a single coil all of the turns of which are in one direction and having a pole of one polarity situated with one or more pairs of contacts on each side of it and two poles of similar polarity opposite to that aforesaid arranged at the outer ends of both series of pairs of contacts, substantially as set forth.

12. In a circuit breaker the combination of separable contacts, a magnet having its poles disposed on opposite sides of the said contacts, so that the arcing space of the contacts lies in the magnetic air gap between the said poles, one of said poles being movable toward and from the other under the action of the magnetic flux and means controlled by the movement of the said movable pole for separating the said contacts, substantially as set forth.

13. In a circuit making or breaking device, the combination of an electro-magnet having two poles one of which is movable toward or away from the other, separable contacts between the two poles, and mechanism controlled by the movable pole for separating the contacts.

14. In a circuit breaker the combination of a box composed of insulating material, separable switch contacts within the box, an electro-magnet, pole pieces for the magnet outside the box on opposite sides thereof, one of the pole pieces being movable, and mechanism controlled by the movable pole piece for separating the contacts upon the movement of the pole piece, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

FRANK L. SESSIONS.

Witnesses:
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L. E. HAMILTON.