(No Model.)

F. B. RAE.

LIMIT SWITCH.

No. 454,496. Patented June 23, 1891.

Fig. 3.

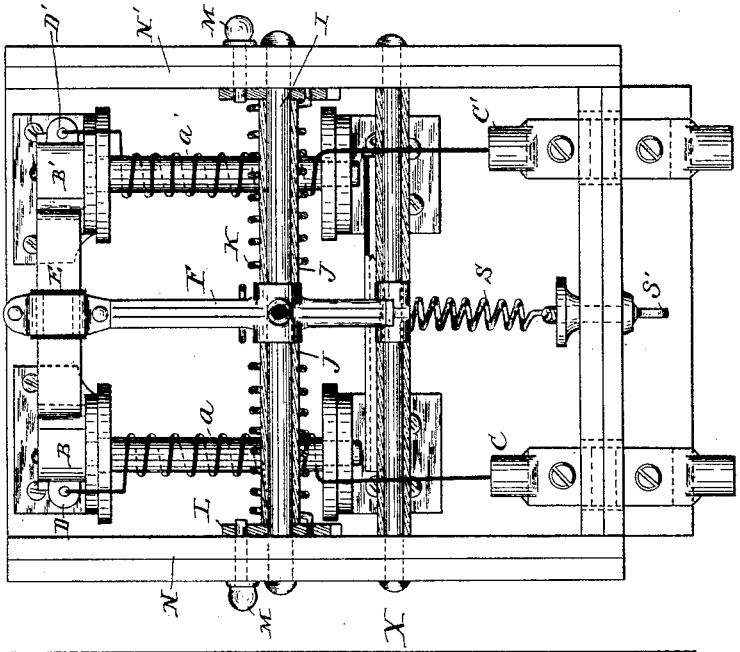


Fig. 2.

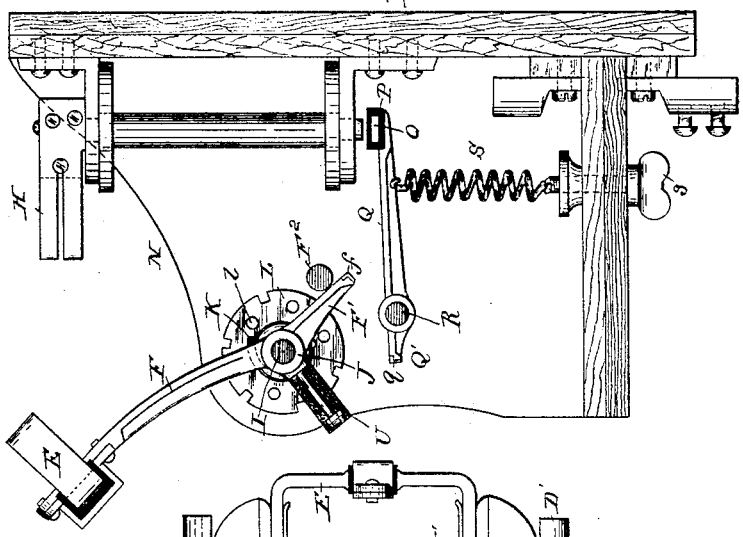
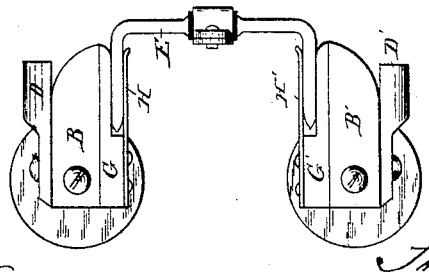


Fig. 1.



WITNESSES

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UNITED STATES PATENT OFFICE.

FRANK B. RAE, OF DETROIT, MICHIGAN, ASSIGNOR TO THE DETROIT ELECTRICAL WORKS, OF SAME PLACE.

LIMIT-SWITCH.

SPECIFICATION forming part of Letters Patent No. 454,496, dated June 23, 1891.

Application filed January 14, 1890. Serial No. 336,913. (No model.)

To all whom it may concern:

Be it known that I, FRANK B. RAE, a citizen of the United States, residing at Detroit, Wayne county, State of Michigan, have invented certain new and useful Improvements in Limit-Switches, of which the following is a specification.

My invention relates to an automatic switch device, which is adapted especially for use in electric circuits between the generator and translating devices, and is adapted to operate whenever the strength of the current passing through the device reaches a point that is dangerous to the dynamo or other parts of the circuit, and the object is to produce a current limit-switch which shall be automatic in its operation, simple in construction, and more especially to overcome the injurious and dangerous effects due to the formation of an arc when such devices are automatically operated.

To these ends my invention consists in a limit-switch constructed, arranged, and operating substantially as hereinafter set forth.

Referring to the accompanying drawings, Figure 1 is an end view of the magnets and circuit-closer. Fig. 2 is a side view of a machine embodying my invention; and Fig. 3 is a plan view showing the circuits and various details of the apparatus.

It is well known that in operating electric generators in connection with various kinds of translating devices it often happens that a current of too great strength is generated and passes through the circuit, which, if continued, would be injurious either to the generator itself or to the translating devices. It also happens that through the accidental crossing of wires, or from the effects of lightning, a current of too great strength is passed through the conductors, and numerous devices, many of them automatic in their operation, have been proposed which shall operate to break the circuit and prevent the injury to the apparatus connected therewith. One of the great objections to the use of such cut-outs or limit-switches arises from the electric arc which is formed at the moment of the breaking of the circuit, especially if it is carrying a strong current. This arc is not only dangerous to the instruments themselves, but is liable to cause fires and destroy the surrounding property.

One of the principal objects of my invention therefore is to provide a limit-switch which shall obviate this objection, and in carrying out my invention I make use of the well-known fact that magnetic lines of force acting upon an arc not only control to a great extent the direction of the arc but prevent its formation and maintenance in the field of force of the magnets.

In the embodiment of this invention I provide a suitable base X, upon which I mount two electro-magnets having soft-iron cores A A′, and these cores are provided with extended pole-pieces B B′, and are wound with a conductor included in the circuit of the generator and capable of carrying the entire current of the circuit, and the direction of the current is preferably such that the adjacent pole-pieces of the two magnets will form what may be termed a "consequent pole," while the opposite poles will be of opposite polarity. One end of the winding of each of these magnets is connected, respectively, to the binding-posts C C′, while the other ends are connected, respectively, with the connections D D′, which are secured to the outer sides of the pole-extensions B B′, and are in electric contact therewith; also, mounted upon the pole-pieces on their adjacent sides are the knife-shaped blocks G G′ of conducting material and preferably non-magnetic, and secured to these blocks on their inner sides are the spring-pieces H H′, forming between their upper ends and the knife-edged blocks G G′ a slot. Entering these slots and normally held therein is the conducting magnetic contact-piece E, made in the present instance in the form of a U, and connected to but insulated from the lever F. This lever F is loosely mounted upon a shaft I, and is held in its central position by the sleeves J, and it is held under stress of a suitable spring or equivalent device. In the present instance I have shown coiled springs K surrounding the sleeves J and connected to the lever, the opposite ends of which are secured to the plates L mounted upon the sides of the frame. These

plates are provided with means whereby they may be adjusted to regulate the tension of the spring K, and I have shown the plates provided with holes or notches *l*, into which are fitted pins M passing through the frame of the device and holding the plates in any desired position to regulate the tension of the springs, which should be sufficient to throw the lever F and its contact-piece E out of engagement with the pieces G G′ when the current is excessive, in a manner hereinafter set forth.

The lever F is provided with a rear extension F′ and with an insulating-handle U for operating it manually when desired, and there is a stop F^2 for preventing it from swinging too far backward under stress of the springs K.

Arranged upon a shaft R is a lever Q, having an extension Q′, preferably provided with a notch *q*, which is adapted to engage with a similar notch *f* on the extension F′ of the lever F. This lever Q is provided at its lower end with an armature O, which is completely embedded in an insulating material P, such as leatheroid or similar material, and connected to the lever is a spring S, with adjusting means, as a thumb-screw *s*. This insulating material is preferably of a thickness less than the thickness of the non-magnetic pieces G G′, so that when the armature is drawn in contact with the poles of the magnets the armature itself shall be nearer to the ends of the magnet than the contact-piece E is to the pole-pieces B B′, and thus a strong magnetic field will exist at this point at the moment the lever F is operated to break the circuit between the piece and the blocks G G′.

In its normal position the lever F, carrying the contact-piece E, is in a position (shown in Figs. 1 and 3) in which the extremities of the contact-piece E are fitted into the slots between the plates G G′ and their respective springs H H′, and the rear extremity of the lever F is engaged by the projection Q′ of the lever Q, locking the lever in this position. The lever Q, as before stated, is held by the spring S, and this is adjusted in accordance with the strength of the current to be carried in the circuit without disruption. The current under these conditions will circulate, for instance, by the way of the binding-post C, through the winding upon the core A, connector D, extended pole-piece B, through the contact plate and spring G and H to the contact-piece E, thence through the opposite spring and plate H′ G′ to the extended pole-piece B′, the connector D′, and circuit of the magnet A′ to the binding-post C′. Under these conditions the coils of the magnets now form a magnetic system in which the pole-pieces opposite the armature O are of opposite polarities, there being what may be called a "consequent pole" at the pole-extensions D D′ and contact-piece E, this latter forming practically a back armature for the cores, although the interposition of the pieces G G′ act to break the complete magnetic circuit. Under these conditions the space between the ends of the magnets and the armature O is greater than the thickness of the pieces G G′, and consequently the magnetic field between the armature and the magnets will be stronger than between the pole-pieces B B′ and the contact-piece E, and the tension of the spring S is adjusted for the desired strength of current in ampères that the apparatus is designed to control. If, for any reason, the current passing through this circuit exceeds in strength the amount desired the armature O is attracted by the magnets A A′ against the force of the spring S, thus moving the lever-extension Q′ away from the extension F′ of the lever F, allowing the springs K to act upon the lever to throw it into the position shown in Fig. 2, thus interrupting the circuit between the pole-extensions B B′. It will be observed that at the instant this break occurs and while the armature O is held up close against the adjacent poles of the magnets A A′ the strongest magnetism will exist at the opposite ends of the magnets at their polar-extensions B B′, so that when the break in the circuit occurs at this point any arc that may be formed thereby between the contact-piece E and the contacts G H G′ H′ will be in a strong magnetic field, the lines of force of which are pulled out by the contact-piece E in the direction of its movement. It will thus be understood that on the passage of the strong current the pull exerted by the magnets on the armature O overpowers the pull of spring S, and the armature O, being attracted, completes the magnetic circuit of the magnets through said armature, and this operating to release lever F thereby breaks the magnetic circuit across G H G′ H′; but just before this break occurs the approach of the armature O to the poles of the magnets A A increases the field of force across G G′, and this field is at its maximum the moment the breaking occurs and causes the extinguishment of any spark which may be produced. In other words, as the armature O approaches the cores of the magnet the strength of free magnetism at these ends of the cores is lessened until armature O is nearest to them, and then the free poles of the magnets are practically changed to the ends G G′, where a very intense field is produced, as previously stated, at the moment of breaking. I have found in this construction little or no arc is formed in this strong magnetic field, and whatever arc is formed by the action of the apparatus is immediately disrupted or extinguished without doing damage to the apparatus.

While I have thus described the preferred embodiment of my invention, it is evident that the details of construction and arrangement of parts may be varied by those skilled in the art without departing materially from the spirit of my invention, and I therefore do

not limit myself to the precise construction and arrangement shown.

What I claim is—

1. In a limit-switch, a circuit-breaker normally held within the field of force of a magnet the poles of which are included in the circuit, substantially as described.

2. In a limit-switch, the combination, with the poles of a magnet included in the circuit, of a circuit-breaker normally in electric contact with the poles within their field of force, mechanism controlling the movement of the circuit-breaker, the arrangement being such that when the circuit is broken the field of force is at its maximum, substantially as described.

3. In a limit-switch, the combination, with the magnets having pole-pieces included in the electric circuit, of a circuit-breaker in electric connection with the pole-pieces and within their field of force, and an armature-lever controlling the circuit-breaker and controlled by the magnets, substantially as described.

4. In a limit-switch, the combination, with the magnets having pole-pieces included in the electric circuit, of a circuit-breaker in electric connection with said pole-pieces and in their field of force, a lever carrying said contact-piece, an armature-lever normally engaging said contact-piece, the armature of which is operated by the magnets, and a spring for regulating the operation of the armature-lever, substantially as described.

5. In a limit-switch, the combination, with the magnets the coils of which are included in the circuit, the said magnets being provided with pole-pieces also included in the circuit, of a circuit-breaker connecting the pole-pieces, an armature-lever controlling the circuit-breaker, and an insulated armature carried by said armature-lever, substantially as described.

6. In a limit-switch, the combination, with the magnets the coils of which are included in the circuit, the said magnets being provided with pole-pieces also in the circuit, of a contact-breaker connecting the pole-pieces, and an armature controlling the contact-breaker arranged to be operated by said magnets when the current is excessive, whereby at the moment of breaking the circuit the field of force of the extended pole-pieces is at its maximum, substantially as described.

7. In a limit-switch, the combination, with the magnets having extended pole-pieces included in the circuit, of a contact-piece connecting the pole-pieces, non-magnetic plates between the pole-pieces and the contact-piece, an armature-lever controlling the circuit-breaker, and an armature connected therewith and surrounded by an insulating material and operated by the magnets, the thickness of the insulating material being less than the thickness of said non-magnetic pieces, substantially as described.

8. In a limit-switch, the combination, with the magnets having pole-pieces included in the circuit, of a circuit-breaker connecting the pole-pieces, a lever carrying the circuit-breaker, adjustable springs normally holding said lever under tension, a lever controlling said circuit-breaker, and a lever the armature of which is controlled by the magnets, substantially as described.

9. In a limit-switch, the combination of the magnets the coils of which are included in the circuit, the said magnets being provided with polar extensions also included in the circuit, non-magnetic plates secured to said pole-pieces, springs secured to the plates, and a circuit-breaker connecting said poles and fitting in the space between said springs and plates, substantially as described.

10. In a limit-switch, the combination, with the magnets, of a circuit-breaker constituting the neutral part of the magnets under normal conditions, and an armature constituting the neutral part of the magnets when the circuit is broken, substantially as described.

11. In a limit-switch, the combination, with the magnets and circuit-breaker constituting the neutral portion of the magnetic system under normal conditions, of an armature controlled by the magnets, the arrangement being substantially as described, whereby the approach of the armature to the free poles of the magnets increases the field of force at the circuit-breaking portions of the magnetic system, substantially as described.

12. In a limit-switch, the combination, with the magnets, of a circuit-breaker closing the poles of the magnets and an armature controlled by the magnets and operating to close the magnetic circuit at the other end when it is broken by the operation of the circuit-breaker under abnormal conditions, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FRANK B. RAE.

Witnesses:
D. W. BRADFORD,
HENRY F. DE B. CAMERON.