R. E. HELLMUND.

AUTOMATIC CIRCUIT BREAKER.

APPLICATION FILED JAN. 16, 1905.

1,123,288.

Patented Jan. 5, 1915.

2 SHEETS—SHEET 1.

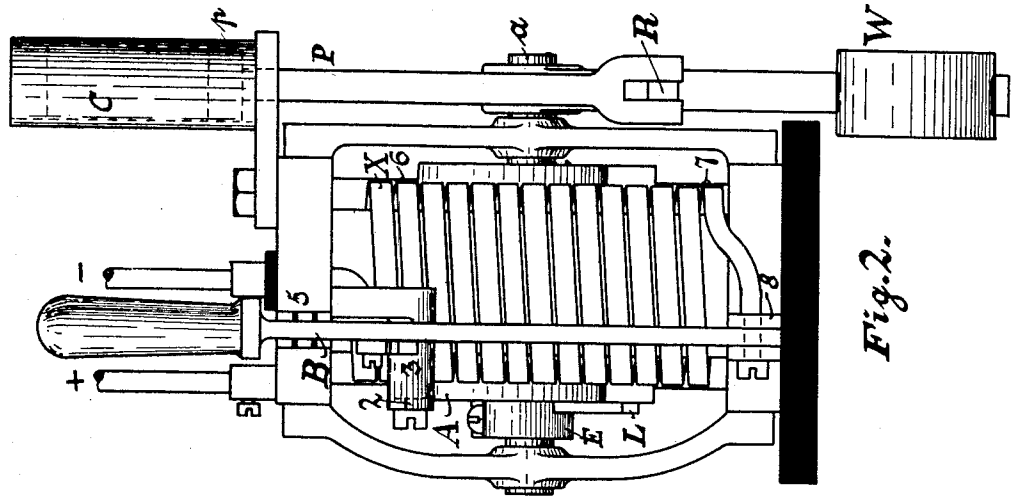


Fig. 2.

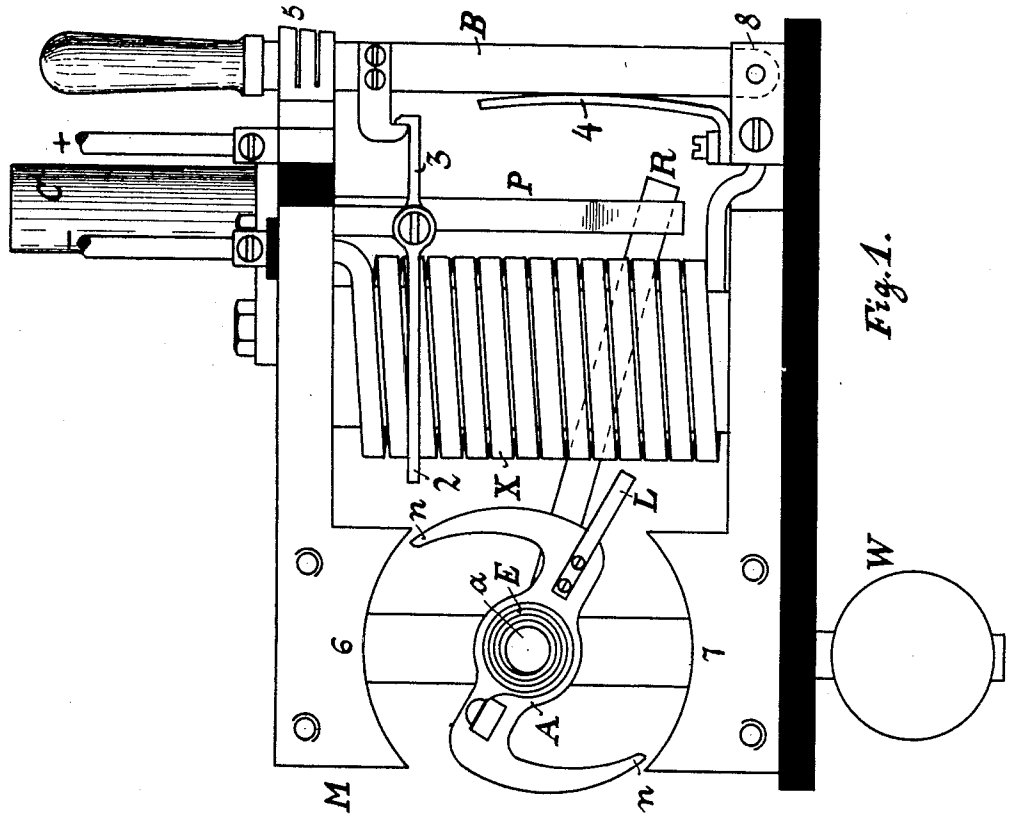


Fig. 1.

WITNESSES:

Julius Jaegon

Herman Hess

INVENTOR

Rudolf E. Hellmund

R. E. HELLMUND.

AUTOMATIC CIRCUIT BREAKER.

APPLICATION FILED JAN. 16, 1905.

1,123,288.

Patented Jan. 5, 1915.

2 SHEETS—SHEET 2.

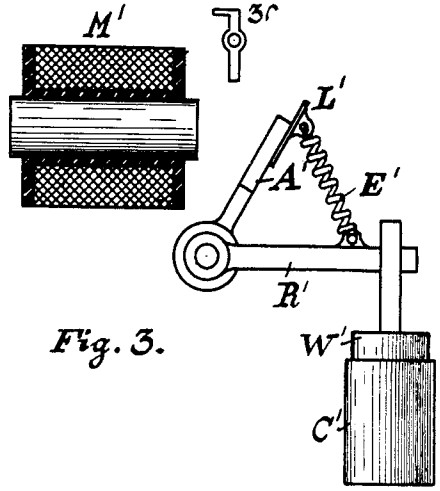


Fig. 3.

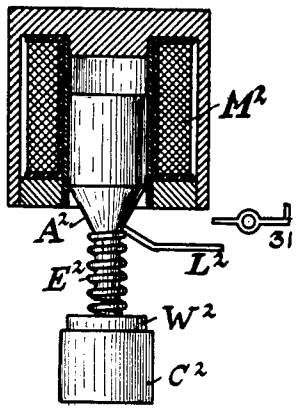


Fig. 4.

Fig. 7.

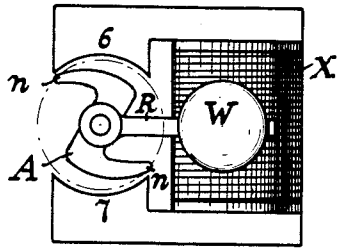


Fig. 8.



Fig. 5.

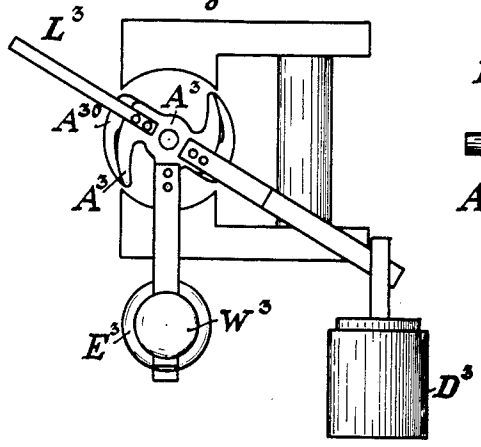
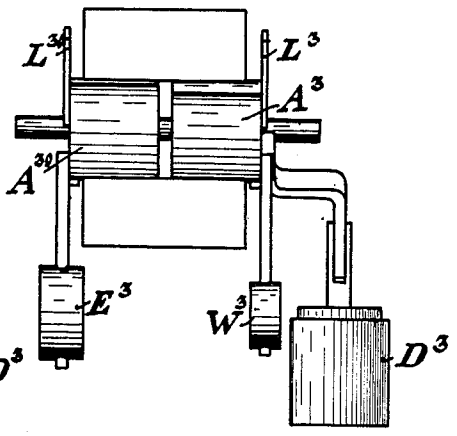


Fig. 6.



WITNESSES:

Julius Jaegen

Hermann Weiss

INVENTOR

Rudolf E. Hellmund

UNITED STATES PATENT OFFICE.

RUDOLF E. HELLMUND, OF HINSDALE, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, OF EAST PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

AUTOMATIC CIRCUIT-BREAKER.

1,123,288. Specification of Letters Patent. Patented Jan. 5, 1915.

Application filed January 16, 1905. Serial No. 241,253.

To all whom it may concern:

Be it known that I, RUDOLF E. HELLMUND, residing at Hinsdale, in the county of Dupage and State of Illinois, have invented certain new and useful Improvements in Automatic Circuit-Breakers, of which the following is a specification.

My invention refers to the construction of apparatus which are operated or released by electromagnets and more particularly to that class of apparatus, which are known under the name of automatic circuit-breakers.

The object of my invention is to provide a simple apparatus of this kind, which will operate tardily upon certain conditions of electrical current, and instantly upon different conditions of current in the operating circuit. These differences may be classed in a great many divisions, for instance: 1. An automatic circuit-breaker tardily operated on an excessive overload and rapidly operated on a greater overload. 2. An automatic circuit breaker tardily operated on a certain underload and rapidly operated on an underload of less value. 3. An automatic circuit-breaker tardily operated on a certain underload and rapidly operated upon a certain amount of reversed current.

In the specification following I have described a circuit-breaker to fulfil the condition first enumerated. It will be obvious to one skilled in the art, that the second, third and any other condition may be fulfilled in a similar way.

A further object of my invention is to provide an apparatus of the kind described above with simple means to bring all parts of the apparatus back to a certain zero position, if the conditions of current, for which the apparatus is tardily operated discontinue before the operation of the apparatus is completed.

A third object of my invention is to provide an apparatus of the kind with a form of electromagnet, which is especially adapted for the purpose; and a fourth object of my invention are novelties in construction as fully described and claimed in the following claims and specification.

The herein described releasing device may also be used for other kinds of electromagnetic operated devices than circuit-breakers.

To fulfil the first condition above set forth, I construct an automatic circuit-breaker, that will be instantly released upon an immediately dangerous and excessive overload, but in case of an overload not so excessive as to immediately jeopardize the installation the circuit-breaker will be released in a tardy manner, so as to give the condition causing the overload a chance to be removed before the circuit is broken.

Most of the circuit-breakers now in use are open to the serious objection that they operate on an excessive overload and on an overload barely above that for which they are set, without distinction. If the overload be such as to produce a magnetic field of a little greater strength than the retarding force of the spring or weight which prevents the operation of the circuit-breaker, the circuit is just as emphatically broken as it would be, if an excessive and very dangerous overload were to take place. Several constructions, which are designed to prevent this last objection are too complicated in their operation, since several coils and circuits are required for their operation. Some of these constructions are also objectionable, because they operate under any condition in conjunction with a damping device and although the action of the same is regulated for different conditions, it never allows a rapid operation of the device in case of necessity. Again other constructions are not satisfactory, because the magnetic armature will, if advanced by a slight overload of short duration, remain in its advanced position and another slight overload of short duration, which occurs some time later will advance the armature farther and cause the device to operate, while this is not desirable.

The apparatus of my invention, while in no wise preventing the immediate breaking of the circuit upon a very dangerously excessive overload, permits a slight overload such as it would be unwise to maintain constantly to exist for an interval of time without causing an interruption of the current flow; it also permits slight overloads to exist repeatedly, if they do not occur within a

too short time interval after each other such as to be dangerous for the circuit.

In the accompanying drawings I have illustrated several devices, by which this result is obtained according to my invention.

Figure 1. is a side elevation, partly in section of my preferred form of apparatus; Fig. 2. is a front view thereof; Fig. 3. is a diagrammatic view of a modified form; Fig. 4. is a diagrammatic view of a still further modified form; Fig. 5. is a side view of enough of a circuit-breaker to illustrate a form having two armatures; Fig. 6. is a front view of Fig. 5. Fig. 7. is a side view illustration of the improved electro-magnet by the use of which the action of my device is considerably improved; Fig. 8. is a diagrammatic view of a modification of the same.

The object of my invention as herein set forth, I accomplish by providing for the movable armature, which is to release the circuit-breaking switch, two means of retarding the motion of the armature. These means have different forces of retardation; one of them, the lesser, acts in conjunction with a damper, and hence is caused when moved, to be slowly but progressively advanced. The element of retardation, which acts in conjunction with the damper may be for instance a weight or a spring. The other element with the greater force of retardation comprises a weight or a spring with a retarding force of such a magnitude that it is not affected unless the current passing through the device is exceedingly dangerous, in which case the armature will be strongly actuated, the spring extended or the weight moved irrespective of all damping influences, and the circuit will be immediately broken.

One or both of the retarding elements are provided and arranged so that the retardation shall increase as the armature moves progressively forward, a motion which will generally be attended by a greatly accelerated magnetic pull. This feature is most essential to move the armature from any advanced position backward to its zero position, if a small overload ceases, before the releasing member has advanced far enough to release the device.

In Figs. 1 and 2, I have shown an automatic circuit breaker comprising a magnet M, a rotary armature A of S-shape, loosely mounted on a shaft *a*, on which shaft a weight W is keyed, while between the armature and shaft *a* a spring E is secured, of greater retardation than the weight W. A lever arm L on the armature serves to trip the end 2 of the pivoted lever 3, which is adapted to release the contact blade B, so that the spring 4 may throw the blade out of contact with the clip 5. A dashpot C, a piston *p* and piston rod P serve as a damper to the shaft's rotation. A lever R keyed to the shaft and engaging the piston rod, serves to connect the damper and shaft. Current passing through this device may enter by contact at the clip 5, traverse the blade B, clip 8 and coil X of the circuit breaker magnet and pass out into the conductor. The S-shaped armature I preferably form with eccentric faces, the eccentric curve being such that the noses *n* of the armature shall always occupy a position nearer to the poles 6; 7; than any other portions of the armature's face. The operation of this device on slight overload is to rotate the armature A, spring E and shaft *a* as one element, the weight W being raised on its radial arm, its moment increasing as it approaches the horizontal, thus increasing the retardation of the weight as the armature rotates. A perfectly concentric armature face would cause acceleration of the magnetic pull, as the armature more closely approaches the field. To counteract this tendency toward magnetic acceleration and as an aid to the increasing moment of the weight, I form the armature as shown, so that it will occupy a position indicated on Fig. 7; when it has received its maximum motion. This motion results in producing an air gap gradually increasing in dimension toward the rear side of the armature pole, inserting an increased magnetic resistance there to counteract the effect of the increased amount of armature iron placed in the direction of the lines of the force of the field. A momentary increase of current, which would be great enough to lift the weight W, but not great enough to operate the spring E remarkably, would not cause release of the blade B since the weight cannot move quickly, its motion being checked by the dashpot C. A continued existence of such a small increase of current, however, will cause a slow and progressive movement of the armature to a position where the lever L strikes lever 3 and will release the blade B and break the circuit. In contradistinction to this an excessive increase of current will cause a quick extension of the spring E and a quick movement of the armature to a position where the lever L strikes lever 3 and will release the blade B and break the circuit.

I have shown in Fig. 3; an ordinary magnet M^1 and an armature A^1 pivoted at its lower end and provided with a tripping rod L^1 to operate a releasing catch lever 30. The armature is connected by a strong spring E^1 with a lever R^1 having a weight W^1 hung in its dashpot C^1. On excessive overload the spring is extended very much and the armature operates the releasing device immediately; on slight overload the spring is extended only a small amount and the weight W^1 and the dashpot are caused to retard the armature for the rest of its

way. In this simple device, in which the spring E^1 is the only retarding element with an increasing force of retardation the action of same is easily understood. It is obvious that the spring will be always so much extended that its coefficient of tension is equal to the magnetic pull. It is therefore indifferent in which position the armature happens to be when an overload ceases; in any case the retarding force of the spring will be greater than the magnetic pull at the moment when the same decreases. Thus the spring will be able to move the armature backward.

In Fig. 4; a solenoid M^2 is shown; a core armature A^2 of material weight is connected by a strong spring E^2 with a weight W^2 in the dash-pot C^2; a rod L^2 is adapted to trip the releasing catch lever 31. The operation is very similar to that of the device of Fig. 3; the only difference being, that the acceleration of the magnetic pull is retarded by gradually increasing the lower air gap while the resistance of the upper air gap decreases. In order to accomplish this purpose, the lower end of the armature A^2 is formed conically and therefore the average distance between the lower end of the core and the lower end plate of the stationary iron parts of the cylindrical magnet will increase as the armature moves upwardly. On light overload the core A^2, the spring E^2 and the weight W^2 will move slowly under the retarding influence of the dash-pot and the switch will be released only if the overload continues for a long time. In case of a heavy overload, however, the spring E^2 will be extended and the switch will be released immediately on account of the quick upward motion of the core.

In Figs. 5 and 6, I have shown two S-shaped armatures, each carrying independent weights of different sizes, the weight W^3 retarding the armature A^3 in conjunction with the damper D^3, while the greater weight E^3 is secured to the armature A^{30}. These two armatures are provided with tripping levers L^3 and L^{30}, respectively. On slight overload the armature A^{30} with the larger retarding weight E^3 is not affected perceptibly, but the armature A^3 is rotated. If the overload is of long enough duration, the tripping lever L^3 will open the switch in the manner hereinbefore described. If the overload is so excessive as to be immediately dangerous, the armature A^{30} and weight E^3 will be instantly rotated to operate the tripping lever L^{30} to cause it to break the circuit in the manner hereinbefore described.

In Fig. 8, I have shown how eccentric pole faces and a concentric armature might be used. This is an obvious reversal of the construction shown in Figs. 1, 2, 5, 6 and 7.

In the specification herein set forth, and in the following claims, I have especially referred to apparatus which are controlled by certain conditions of electrical current. It is obvious to one skilled in the art, however, that apparatus which are controlled by certain conditions of electrical potentials may be worked on the same principles and that they are at same time covered in the following claims in so far as any change of a potential at the operating coils also causes a change of current in the operating coils.

What I claim as my invention is:

1. An automatic circuit breaker having a magnet, an armature, a weight, a dash-pot and a spring adapted to retard the motion of said armature, said spring being interposed between the weight and the armature.

2. In an automatic circuit-breaker, the combination with a latch and a tripping device, of two mechanically connected but relatively movable restraining members for said tripping device, and a damping device operatively connected to one of said restraining members.

3. In an automatic circuit-breaker, the combination with a latch and a tripping device, of two mechanically connected but relatively movable restraining members for said tripping device that act jointly to permit a slow progressive movement of the tripping device and one of which acts independently to permit a rapid movement thereof.

4. In an automatic circuit-breaker, the combination with a latch and a tripping device, of two mechanically connected but relatively movable members adapted to retard said tripping device, said members being adapted for joint slow progressive movement and one of them being adapted for rapid independent movement and for changing its force of retardation as the tripping device changes its position.

5. The combination with a spring-actuated but normally locked device, and a magnet, of an armature for said magnet having a tripping device, two operatively connected but relatively movable restraining members for said armature which oppose the pull of the magnet.

6. The combination with the tripping device of an automatic circuit-breaker, and an electro-magnet designed to move the tripping device, of two mechanically connected means of different characteristics for opposing the movement of said tripping device, and a damper acting in conjunction with one of said opposing means

7. The combination with a normally locked device, and a spring for operating the same, of a magnetizable member, a single magnetizing coil for said member, two connected members adapted to retard the

movement of the magnetizable member under certain conditions of current in said coil and one of said connected members being adapted to permit a rapid movement of said magnetizable member under different conditions of current in said coil.

8. In an automatic circuit-breaker, the combination with a latch and a tripping device, of a rotatively movable armature for actuating said tripping device, and two connected means adapted to retard the rotation of the armature and to permit a slow progressive movement and one of them being adapted to permit a rapid movement.

9. An automatic circuit-breaker, having a magnet, an armature, a weight, a damper and a spring adapted to retard the motion of said armature, said spring being interposed between the weight and the armature.

10. An automatic circuit-breaker, having a magnet, a rotatively movable armature, a shaft on which said armature is loosely mounted, a spring between the armature and its shaft, a weight rigidly connected to the shaft and a damper for said weight.

11. In an automatic circuit-breaker, the combination with a latch, a tripping device, a magnet and an armature, of two mechanically connected means for constantly opposing the movement of the armature, and a damper for retarding the movement of one of said mechanically connected opposing means.

12. A rotatively movable armature for an automatic circuit-breaker, and a magnet therefor, in combination with two connected devices for retarding the movement of the armature, one device comprising a weight and a damper, and the other being a spring interposed between said armature and said weight.

13. A rotatively movable armature for an automatic circuit-breaker, and a magnet therefor, in combination with a shaft for the armature that may turn independently thereof, a spring interposed between the shaft and the armature, a weight rigidly connected to the shaft, and a damper adapted to operate in conjunction with the weight.

14. In an automatic circuit-breaker, an armature under the influence of electrical current, two mechanically connected members designed to exert a retarding force upon said armature in the same direction to cause a slow progressive movement thereof and one of said members being adapted to permit a rapid movement of the same, and retarding means designed to work in conjunction with one of the said members.

15. The combination with a normally locked device, and a tripping device, of two mechanically connected restraining members designed to oppose the operating movement of the tripping device, and a damping device, said restraining members working in conjunction with the damping device and being adapted for slow progressive movement of the tripping device and one of the restraining members acting independently of any damping influence.

16. An automatic circuit-breaker having a magnet, a pivotally mounted armature, a weight, a dash-pot and a spring adapted to retard the motion of said armature, said spring being interposed between the weight and the armature.

17. A rotatively movable armature for an automatic circuit-breaker, and a magnet therefor, in combination with a shaft for the armature that may turn independently thereof, a resilient member interposed between the shaft and the armature, a weight rigidly connected to the shaft, and a damper adapted to operate in conjunction with the weight.

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

RUDOLF E. HELLMUND.

Witnesses:
JULIUS JAEGER,
HERMAN WEIS.