No. 897,812. PATENTED SEPT. 1, 1908.

P. BENDMANN.

INVERSE TIME LIMIT RELAY.

APPLICATION FILED JAN. 18, 1907.

Fig. 1

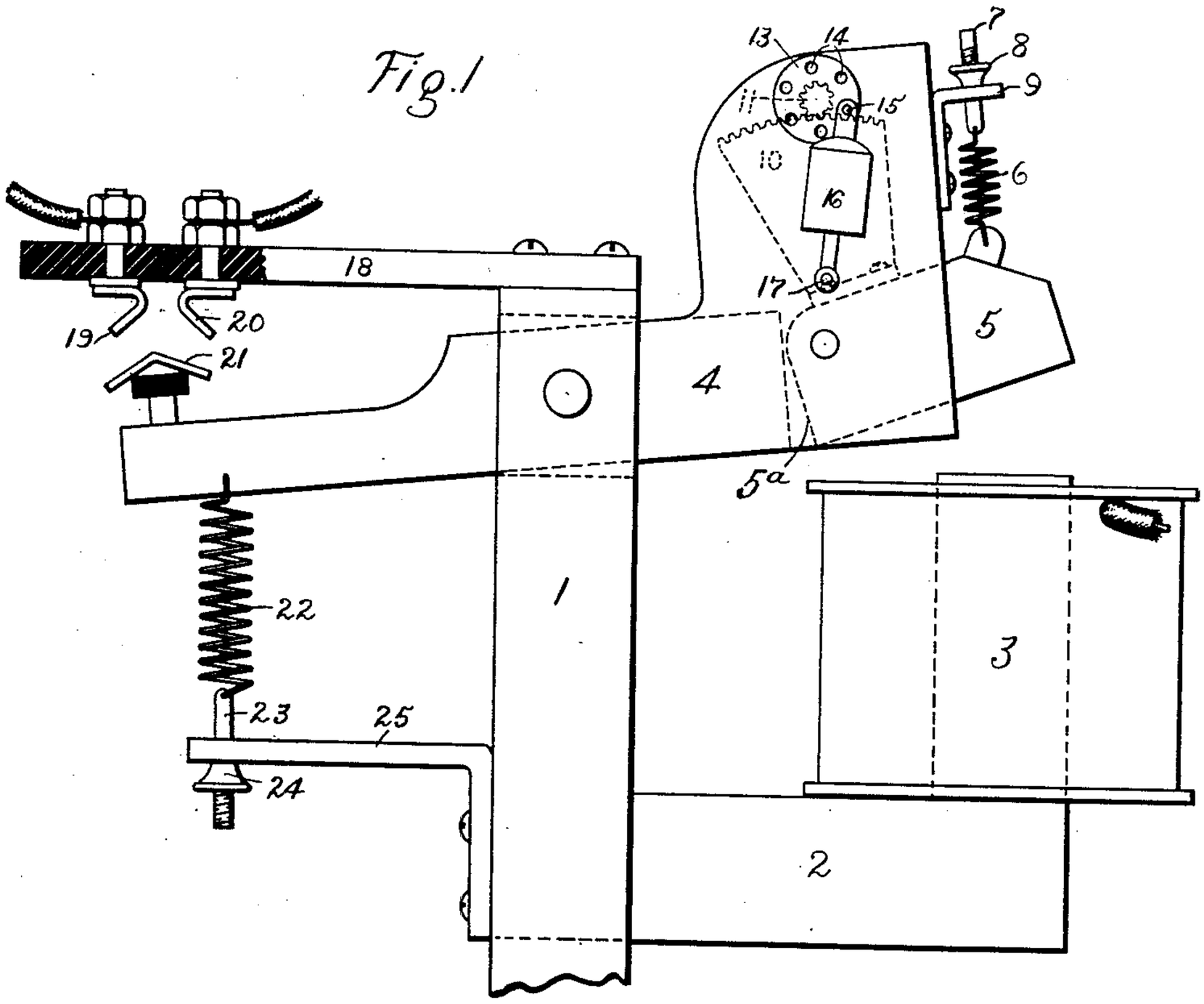
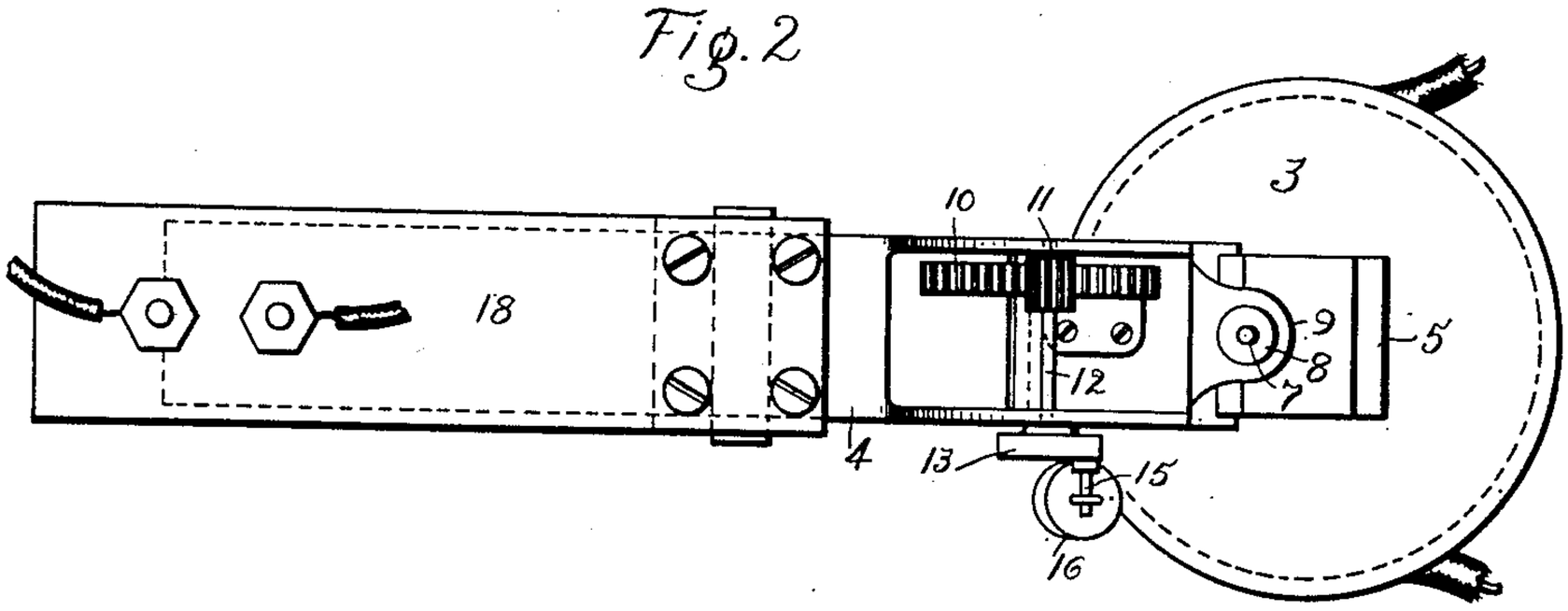


Fig. 2



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INVERSE TIME-LIMIT RELAY.

No. 897,812. Specification of Letters Patent. Patented Sept. 1, 1908.

Application filed January 18, 1907. Serial No. 352,952.

To all whom it may concern:

Be it known that I, PETER BENDMANN, a subject of the Emperor of Germany and King of Prussia, residing at Berlin, Germany, have invented certain new and useful Improvements in Inverse Time-Limit Relays, of which the following is a specification.

This invention relates to electromagnetic controlling devices for electric circuits operated by abnormal currents in the circuit to be controlled, and more particularly to devices which open the circuit instantaneously in case of an excessive abnormal current or of severe overload upon the circuit, but which do not open the circuit until after a lapse of a definite interval of time in case the abnormal current is only moderate in amount, or in case the overload is not severe. Devices of this character have been used having an armature restrained by a retarding device, or by a retarding device and an adjustable calibrating spring. The amount of current causing the movement of the armature is varied by altering the tension of the spring or changing the adjustment of the retarding device, but the armature does not move until the current has attained such a strength that the pull upon the armature is sufficiently great to overcome the resistance of the calibrating spring. In case of a severe overload, the armature is strongly attracted, overcoming the tension of the calibrating spring and moving rapidly against the resistance of the retarding device. It is apparent, however, that in devices of this construction the amount of current causing a comparatively quick opening of the circuit, depends upon the adjustment of the calibrating spring and of the retarding device, which in turn is determined by the amount of moderate overload at which it is desired to have the circuit open. It is desirable in devices of this class to have the adjustment for moderate overload unaffected by and independent of the adjustment for excessive overload.

The object of my invention is to provide a mechanism of this class which is simple in construction and provided with adjusting means to vary the amount of current required to cause the instantaneous operation of the device without affecting the adjustment which determines the amount of current which is required to flow for a definite time interval before the circuit is opened; and also provided with adjusting means to vary the time which elapses between the occurrence of a moderate overload and the tripping of the circuit-breaker without affecting the other adjustments of the device.

My invention consists of an electromagnet, the excitation of which varies as the current in the circuit to be controlled, an armature for the magnet, a member moved by the armature to open the circuit, and means for controlling the rate of movement of the armature connecting the armature and the member, so that the first part of the movement of the armature takes place against the resistance of the controlling means only, while during the latter part of its movement, when close to the electromagnet where the pull upon the armature is great, the armature moves the member to open the circuit. The initial movement of the armature, therefore, takes place against the resistance of the retarding means only, and the member is not moved by the armature until it is in the most effective relation to the electromagnet. If a very great pull is exerted upon the armature, sufficient force is transmitted to the member through the retarding means to move the member and open the circuit before the retarding means has time to act. An adjustable restraining means, such as a spring, may be added to the armature so that the amount of current required to cause the initial movement of the armature may be varied, and an adjustable restraining means may be attached to the member so that the amount of force required to move the member to open the circuit may be altered.

My invention also consists more specifically of an electromagnet, an armature moved by said magnet upon the occurrence of abnormal current or excessive overload to open the circuit, a second armature also moved to open the circuit by the same electromagnet upon the occurrence of a moderate abnormal current, and means for controlling the rate of movement of the second armature so that the time between the occurrence of a moderate overload and the tripping of the circuit-breaker may be varied.

My invention furthermore comprises means whereby the resistance of each armature to the pull of the electromagnet may be varied without affecting the adjustment of the other armature.

My invention also consists in mounting one armature upon the other, the armatures

forming part of the magnetic circuit of the electromagnet; and in various features of construction more specifically pointed out in the appended claims.

The invention will best be understood by reference to the accompanying drawings, in which

Figure 1 is a side view of a time-limit relay embodying my invention; and Fig. 2 is a plan view of the relay shown in Fig. 1.

The invention is shown in the drawings in the form of a relay having a framework consisting of a vertical member 1 and a horizontal member 2, these members being formed of iron or similar magnetic material. On the end of the member 2 is supported an electromagnet 3 which is so connected to the circuit which is to be controlled that the flux flowing through the core of said magnet and through the members 1 and 2 varies with the amount of current in said circuit. A movable member 4 is pivotally mounted at the upper end of the vertical member 1, and on this member is pivotally mounted an armature 5. The movable member 4 may be made of magnetic material, in which case it also acts as an armature, and with armature 5, together with the core of the electromagnet and the members 1 and 2 of the frame, a magnetic circuit is formed which is almost closed. One end of a spiral spring 6 is secured to a lug upon the armature 5, the other end being secured to a bolt 7 upon which is threaded an adjusting nut 8 engaging a bracket 9 carried by the member 4. By means of the bolt 7 and the nut 8, the tension of the spring 6 may be varied, thereby altering the amount of force which is required to cause the initial movement of the armature 5 toward the electromagnet 3. A wing 10 in the form of a portion of a gear-wheel and having teeth upon the rim thereof, is secured to the armature 5, the teeth engaging with a pinion 11 keyed to a shaft 12 rotatably mounted upon the member 4. To one end of the shaft 12 is secured a disk 13 having a number of holes 14 near the circumference thereof. A pin 15 inserted in one of the holes 14 carries a retarding device 16, for controlling the rate of movement of the armature 5, shown in the form of a dash-pot, but which may be any similar device which will accomplish the same purpose. As shown in the drawing, the dash-pot 16 is carried upon the pin 15 and the piston of the dash-pot is secured to a pin 17 carried by the member 4. The movement of the armature 5 toward the electromagnet 3 about its pivot causes a movement of the wing 10, and a rotation of the pinion 11 and disk 13. This movement is resisted by the dash-pot 16 and the rate of movement depends upon the degree of vacuum caused in the dash-pot by a given movement of armature 5. The resistance which the dash-pot opposes to the movement of the armature 5 may be varied by inserting the pin 15 in different holes 14 in the disk 13, since, if the pin is in the hole nearest the dash-pot when the armature 5 begins to move, the armature can move through nearly its entire travel before the vacuum produced in the dash-pot is enough to seriously retard the movement.

On the upper end of the member 1 is mounted a plate 18, preferably of fiber or similar insulating material, carrying contacts 19 and 20. A bridging contact 21 coöperates with the contacts 19 and 20 and when in engagement therewith, closes the circuit of the trip-coil of the circuit-breaker or similar device by means of which the circuit to be controlled is opened. A calibrating spring 22 has one end attached to the member 4 and the other end to a bolt 23 carrying an adjusting nut 24 supported by a bracket 25. By means of the adjusting nut 24 the tension of the spring 22 may be altered, thereby altering the amount of force required to move the member 4, and the amount of current in the main circuit required to cause that circuit to open instantaneously. It will be observed that the spring 22 may be calibrated entirely independently of the spring 6, and that the adjustment of one of these springs does not in any way affect the adjustment of the other.

The operation of the device is as follows: When an abnormal current of moderate amount flows in the main circuit, the electromagnet 3 is energized sufficiently to move the armature 5 against the tension of the spring 6, the armature 5 therefore approaching the electromagnet 3 at a rate which depends upon the adjustment of the dash-pot 16. As the armature 5 approaches the electromagnet 3, the force exerted upon it becomes greater and the magnetic circuit becomes more nearly closed. As the armature nears the end of its travel, the shoulder 5^a engages a corresponding shoulder upon the member 4 whereby the armature and member are locked together, and when the armature 5 is in this position, the pull of the electromagnet 3, although due only to a moderate overload upon the circuit, is sufficiently great to move the member 4 against the tension of the spring 22, thereby bringing the bridging contact 21 into engagement with the contacts 19 and 20, closing the circuit of the trip-coil of the circuit-breaker and thereby opening the main circuit. If, however, an abnormal current of excessive amount, due to excessive overload, flows in the main circuit, the pull exerted by the electromagnet 3 upon the armature 5 is sufficiently great when transmitted through the retarding device 16 to cause the member 4 to overcome the spring 22 and instantaneously move toward the electromagnet 3, closing the trip-circuit and opening the main circuit, al-

though under these conditions armature 5 does not have time to move to the end of its travel and lock with the member 4 before the main circuit is opened. When the member 4 is made of iron or similar magnetic material, it also acts as an armature, and when an excessive abnormal current occurs the instantaneous opening of the circuit is due to the pull of the electromagnet 3 upon the armature 4 as well as upon the armature 5, the pull upon the two armatures quickly overpowering the spring 22.

It is apparent that my invention may be embodied in many other forms than that shown on the drawings which is merely for the purpose of illustration, and I, therefore, do not wish to be restricted to the form of embodiment of my invention shown and described, but intend to cover by the claims all changes and modifications which are within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. In a circuit-controlling device, the combination with means for establishing a magnetic field, of an armature, a member moved by said armature near the end of its travel to open the circuit, and means connecting said member and said armature for controlling the rate of movement of the armature.

2. In a circuit-controlling device, the combination with an electromagnet, of an armature, a member moved by said armature near the end of its travel to open the circuit, an adjustable restraining means for said member, and means connecting said member and said armature for controlling the rate of movement of the armature.

3. In a circuit-controlling device, the combination with an electromagnet, of an armature, a member moved by said armature near the end of its travel to open the circuit, adjustable restraining means for said armature, and means connecting said member and said armature for controlling the rate of movement of the armature.

4. In a circuit-controlling device, the combination with an electromagnet, of an armature actuated thereby upon excessive abnormal current to break the circuit, a second armature actuated by said electromagnet on moderate abnormal current and moving the first armature to open the circuit near the end of its travel, and means to control the rate of movement of the second armature.

5. In a circuit-controlling device, the combination with an electromagnet, of an armature moved thereby to open the circuit on excessive overload, a second armature moved thereby on moderate overload, means for connecting said second armature near the end of its travel to the first armature to move it and open the circuit, and a retarding device to control the rate of movement of said second armature.

6. In a circuit-controlling device, the combination with an electromagnet, of an armature moved thereby to open the circuit upon excessive abnormal current, adjustable restraining means for said armature, a second armature moved thereby upon moderate abnormal current and moving the other armature to open the circuit near the end of its travel, adjustable restraining means for said second armature, and a retarding device for controlling the rate of movement of said second armature.

7. In a circuit-controlling device, the combination with an electromagnet, of an armature moved thereby to open the circuit upon excessive abnormal current in the circuit, a second armature moved thereby upon moderate abnormal current and moving the other armature near the end of its travel to open the circuit, and means connecting said armatures to control the rate of movement of the first armature.

8. In a circuit-controlling device, the combination with an electromagnet having an approximately closed magnetic circuit, of an armature forming part of said magnetic circuit moved by said electromagnet upon excessive overload to open the electric circuit, a second armature forming part of said magnetic circuit and moved by said electromagnet upon moderate overload to engage said first armature near the end of its travel to move said first armature to open the circuit, and means for controlling the rate of movement of said second armature.

9. In a circuit-controlling device, the combination with an electromagnet, of a pivoted armature moved thereby upon excessive overload to open the circuit, a second armature moved by said electromagnet upon overload pivoted to the first and locked thereto near the end of its travel, thereby moving the first armature and opening the circuit, and a retarding means to control the rate of movement of said second armature.

10. In a circuit-controlling device, the combination with an electromagnet included in said circuit, of a pivoted armature moved by excessive overload, adjustable restraining means therefor, a second armature pivoted to the first and moved by moderate overload upon the circuit, a stop upon said first armature engaged by the second armature near the end of its travel, whereby the first armature is moved to open the circuit, and a time-limit device connecting said armatures for controlling the rate of movement of said first armature.

In witness whereof, I have hereunto set my hand this 31st day of December, 1906.

PETER BENDMANN.

Witnesses:
JULIUS RUMLAND,
KARL KRICKEBEN.