March 27, 1928.

1,664,097

O. C. TRAVER

PROTECTIVE DEVICE

Filed Feb. 1, 1924

Fig. 1.

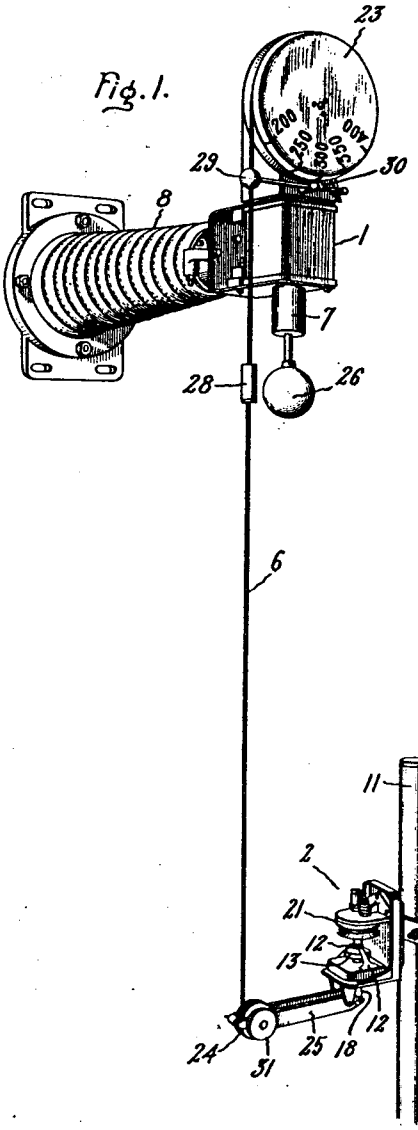
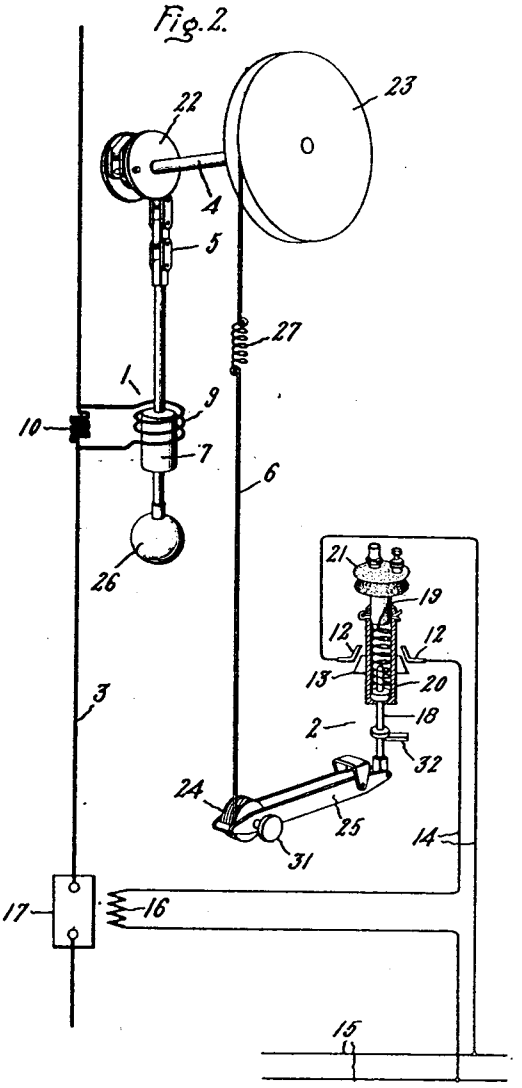


Fig. 2.



Inventor :
Oliver C. Traver,
by Alexander S. Lunt
His Attorney

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UNITED STATES PATENT OFFICE.

OLIVER C. TRAVER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

PROTECTIVE DEVICE.

Application filed February 1, 1924. Serial No. 690,098.

My invention relates to improvements in protective devices and particularly to relays for the protection of high voltage electric circuits upon the occurrence of abnormal conditions, such as excess current.

Circuit interrupters are usually controlled by relays or trip coils operative in response to abnormal circuit conditions and in the protection of alternating current circuits, the relays or trip coils are often connected to the secondaries of current transformers, which may also supply current to meters and instruments or may be of special design for circuit interrupter control only. When, however, the cost of current transformers is prohibitive because of the high voltage of the circuit to be protected, some other satisfactory but more economical arrangement must be employed. The energizing windings of the relays may, or course, be connected directly in the line circuit, but as this subjects the relays to line potential, the risk involved in inspections, tests and adjustments, particularly with the usual type of relay and especially with the line circuit alive, is very undesirable and can be avoided only by interruption of line service, which also is very undesirable. It is therefore essential to isolate the necessarily high voltage parts of the relay from the low voltage parts such as the contact controlling mechanism and also to provide personal safety for inspections and adjustments while the line circuit is alive.

There is thus introduced a space factor which involves a mechanism for transmitting motion between the high and low voltage parts of the relay whereby motion of the movable member of the high voltage part can be transmitted to the contact controlling mechanism for operation thereof and vice-versa for adjusting the sensitivity of the relay to different predetermined conditions. Moreover, in order to avoid excessive size of relay structure and not appreciably affect the responsiveness of the relay, the motion transmitting mechanism should require only a small operating force and for safety should have high insulating properties. Furthermore, the motion transmitting mechanism should not be affected by air currents, inherent changes in length such as those due to changes in humidity, stretch, shrinkage and the like to an extent sufficient to affect either the adjustment or reliability of operation of the relay.

An object of my invention is therefore to provide an improved electroresponsive device or relay particularly adapted for use on high voltage alternating current circuits without the necessity of employing current transformers, although its use is not so limited, such that reliability of operation and facility of adjustment and inspection with a maximum of personal safety is assured.

My invention will be better understood from the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

Fig. 1 illustrates in perspective an embodiment of my invention and Fig. 2 illustrates diagrammatically an application of the embodiment of my invention shown in Fig. 1.

In general, my invention comprises electroresponsive means 1 operative upon the occurrence of an abnormal circuit condition, such as excess or over-current, to control a constant controlling mechanism 2, spaced at a safe distance dependent upon the voltage of the circuit 3 to be protected, through a motion transmitting mechanism comprising a rotatable member 4 and suitable connections 5 and 6 between said member and both the contact controlling mechanism 2 and a movable member, such as the armature 7 of the electroresponsive means 1, whereby motion can be transmitted from one to the other.

The electroresponsive means 1 is adapted for mounting on a suitably supported insulator 8 and comprises an energizing winding 9 adapted for direct connection in the circuit 3 to be protected. In order to prevent high frequency surges from breaking down the insulation of the winding 9, any well known by-pass arrangement may be used such as a resistor by-pass 10 connected across the winding 9 for high ampere capacities or a spark gap by-pass for low ampere capacities.

The contact controlling mechanism 2 is mounted on a suitable support 11 so as to be conveniently accessible for inspection and adjustment and comprises relatively movable cooperating contacts 12 and 13 which

may be arranged to control a circuit 14 connected to a control bus 15 and including the trip coil 16 of suitable circuit interrupting means, such as a circuit breaker 17 which is connected in the circuit 3 to be protected.

It may be desirable to have the movement of the contacts 12 and 13 to circuit controlling position either substantially instantaneous or time delayed and for these purposes, I may use a mechanism of the type disclosed in my Letters Patent of the United States, No. 1,532,003, dated March 31, 1925, for relay device and assigned to the same assignee as this invention. In general, this mechanism comprises a movable member, such as an operating rod 18, which upon movement in one direction is arranged to stress spring 19 carried in a casing 20 which is secured to a suitable bellows device 21, such that the energy stored in the spring 19 is slowly dissipated and the movement of the movable contact 13 carried by the casing 20 thereby delayed. The bellows device 21 is detachable as a unit from the casing 20 so that the contact controlling mechanism may be quickly and easily converted from time delayed to substantially instantaneous operation.

For transmitting movement from the armature 7 to the contact controlling means 2, I preferably provide the rotatable member 4 with two substantially cylindrical portions 22 and 23 which engage the respective connections 5 and 6 so that the armature 7 upon deenergization thereof will turn the rotatable member 4 in one direction and upon energization thereof will permit movement of the rotatable member 4 in the opposite direction. In order to reduce friction to a minimum, I preferably make both of the connections 5 and 6 flexible and arrange them for peripheral engagement with the cylindrical portions 22 and 23 respectively so that upon movement of the rotatable member 4 in either direction, the free or hanging length of one of the connections is increased and the free length of the other connection decreased by amounts proportional to the diameters of the respective cylindrical portions which they engage. The connection 5 may be, for example, a chain arranged to engage teeth on the cylindrical portion 22. The connection 6 is arranged to engage a groove in the cylindrical portion 23 and I have found that a paper cord impregnated with a suitable insulating compound has not only excellent insulating properties but is also subject to only slight changes in length due to variations in humidity.

One end of the connection 5 is secured to and engages the cylindrical portion 22 of the rotatable member 4 so as to be on one side thereof and the other end is secured to the armature 7. One end of the connection 6 is secured to and engages the cylindrical portion 23 so as to be on the opposite side of the rotatable member 4 and the other end is secured to a suitable biasing means comprising a weight 24 carried by a pivotally mounted member or arm 25 which is pivotally related to the operating rod 18 of the contact controlling mechanism. The movable parts are so balanced by suitably proportioning the weights and lever arms thereof that upon energization of the armature 7 sufficient to move it from its initial position, the weight 24 falls and in so doing effects the movement of the contacts 12 and 13 to circuit controlling position. Upon energization of the winding 9 below a predetermined value, the armature 7 returns to its initial position resetting the contact controlling mechanism. For balancing purposes, the armature 7 may be provided with a biasing member such as a weight 26, which may be, for example, of aluminum and is preferably spheroidal so as to act as an electrostatic shield. The connection 6 is preferably provided with a shock absorbing means, such as a spring 27 located intermediate the rotatable member 4 and the weight 24 so as to reduce the effect of shocks attendant upon sudden movements of the armature 7. The spring 27 may be located adjacent the rotatable member 4 and may be housed in a casing 28 of small weight. A suitably supported guide 29 through which the connection 6 can freely move may also be provided.

The rotatable member 4 carries a conspicuous graduated scale preferably on the cylindrical portion 23 which can be conveniently read at a distance to ascertain the setting or responsiveness of the relay, one of the guide supports 30 serving as an index or pointer. In order that the position of the armature 7, that is to say, the pick-up point or sensitiveness of the relay can be changed conveniently and without personal risk when the circuit of the relay is alive, the weight 24 is preferably provided with a helical groove in which the lower end of the connection 6 is wound and a clamping screw 31 is provided for holding the weight 24 in any desired position so that the length of the connection 6 may be changed as desired. This adjusting means together with the conspicuously visual scale thus affords a maximum of personal safety from the line voltage when inspections and adjustments are necessary.

While it is possible to obtain a suitable insulating material for the connection 6 such that variations in humidity change the length of the connection only slightly, nevertheless it is desirable to minimize the effect of these slight changes on the position of the armature 7, that is to say, the sensitiveness of the relay, so as to render the control of the contact controlling mechanism substantially

independent of variations in humidity. For this purpose, I preferably make the diameter of the cylindrical portion 23 of the rotatable member 4 relatively large as compared with the diameter of the cylindrical portion 22 so that for any change in length of the connection 6 the corresponding change in length of the connection 5 will be very small, since the changes in the free lengths of the connections will be proportional to the diameters of the respective cylindrical portions. Moreover, since the connection 6 is relatively light in weight, it possesses relatively little inertia and, since it presents but small surface to the air there is substantially no tendency for air currents to affect the adjustment of the relay. Furthermore, drift or sway of the connection 6 due to air currents cannot affect operation of the contact controlling mechanism because of the counterbalanced arrangement of the movable parts and also because such drift tends to pull downward on the operating rod 18 and downward movement thereof is prevented by suitable means such as a stop 32 which establishes, for a given free length of the connection 6, the initial position of the armature 7. In addition, the flexibility of the connection 6 affords considerable latitude in the arrangement of the contact controlling mechanism with respect to the electroresponsive means 1. For example, in a practical embodiment of my invention the maximum inclination from the vertical of the connection 6 is about fifteen degrees and as the length of the connection 6 would be in practice relatively large, a wide range for positioning the contact controlling mechanism is available.

While I have shown and described only one embodiment of my invention, I do not desire to be limited to the exact arrangement shown and described but seek to cover in the appended claims all those modifications that fall within the true 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 device of the class described, circuit controlling mechanism, electroresponsive means spaced therefrom for controlling the operation thereof comprising a member adapted to be moved from an initial position, a connection between said mechanism and said member, and means for minimizing the movement of said member from initial position due to inherent changes in the length of said connection.

2. In a device of the class described, circuit controlling mechanism, electroresponsive means spaced therefrom for controlling the operation thereof, a flexible insulating connection between said mechanism and said electroresponsive means, and means whereby the control of said mechanism by said electroresponsive means is rendered substantially independent of inherent changes in the length of said connection.

3. In a device of the class described, circuit controlling mechanism, electroresponsive means spaced therefrom for controlling the operation thereof comprising a member adapted to be moved from an initial position, a flexible connection between said mechanism and said member subject to change in length with variations in humidity, means for minimizing the movement of said member from initial position due to changes in the length of said connection caused by variations in humidity, and means associated with said mechanism and adapted to be operated to change the initial position of said member.

4. In a device of the class described, circuit controlling mechanism, electroresponsive means spaced therefrom for controlling the operation thereof comprising a movable member, a rotatable member comprising a plurality of cylindrical portions of relatively large and small diameters, a flexible connection between said movable member and said small diameter cylindrical portion arranged for peripheral engagement therewith, and a flexible connection between said circuit controlling mechanism and said large diameter cylindrical portion arranged for peripheral engagement therewith.

5. In a device of the class described, circuit controlling mechanism, electroresponsive means spaced therefrom for controlling the operation thereof comprising a movable member, a rotatable member comprising a plurality of cylindrical portions of relatively large and small diameters, flexible connections between both said circuit controlling mechanism and said movable member and said rotatable member arranged for peripheral engagement with the cylindrical portions thereof so that upon movement of said movable member the free length of one of said connections is decreased and the free length of the other connection increased by amounts proportional to the diameters of the respective cylindrical portions.

6. In a device of the class described, high tension electroresponsive means comprising a rotatable member, an electroresponsive member arranged upon deenergization thereof to turn said rotatable member in one direction and upon energization thereof to permit movement of said rotatable member in the opposite direction, and low tension circuit controlling mechanism comprising relatively movable cooperating contacts, biasing means and a flexible insulating connection between said rotatable member and said biasing means arranged to turn said rotatable member in said opposite direction upon energization of said electroresponsive member whereby to effect the movement of said contacts

to circuit controlling position and means for rendering the control of said mechanism by said electroresponsive member substantially independent of inherent changes in the length of said connection.

7. In a device of the class described, high tension electroresponsive means comprising a rotatable member, an electroresponsive member arranged upon deenergization thereof to turn said rotatable member in one direction and upon energization thereof to permit movement of said rotatable member in the oposite direction, and low tension circuit controlling mechanism comprising relatively movable cooperating contacts, biasing means and a flexible insulating connection between said rotatable member and said biasing means arranged to turn said rotatable member in said opposite direction upon energization of said electroresponsive member whereby to effect the movement of said contacts to circuit controlling position, means for rendering the control of said mechanism by said electroresponsive member substantially independent of inherent changes in the length of said connection, and means for delaying the movement of said contacts to circuit controlling position.

8. In a device of the class described, high tension electroresponsive means comprising a rotatable member, an electroresponsive member arranged upon deenergization thereof to turn said rotatable member in one direction and upon energization thereof to permit movement of said rotatable member in the opposite direction, and low tension circuit controlling mechanism comprising relatively movable cooperating contacts, biasing means and a flexible insulating connection between said rotatable member and said biasing means arranged to turn said rotatable member in said opposite direction upon energization of said electroresponsive member whereby to effect the movement of said contacts to circuit controlling position, means associated with said rotatable member for rendering the control of said mechanism by said electroresponsive member substantially independent of inherent changes in the length of said connection and means for limiting the movement of said rotatable member in said one direction.

9. In a device of the class described, high tension electroresponsive means comprising a rotatable member, an electroresponsive member arranged upon deenergization thereof to turn said rotatable member in one direction and upon energization thereof to permit movement of said rotatable member in the opposite direction, and low tension circuit controlling mechanism comprising relatively movable cooperating contacts, biasing means and a flexible insulating connection between said rotatable member and said biasing means arranged to turn said rotatable member in said opposite direction upon energization of said electroresponsive member whereby to effect the movement of said contacts to circuit controlling position, means associated with said rotatable member for rendering the control of said mechanism by said electroresponsive member substantially independent of inherent changes in the length of said connection, means for limiting the movement of said rotatable member in said one direction, and means adapted to be operated to change the extent of movement of said electroresponsive member whereby the position assumed thereby upon deenergization thereof can be varied so as to vary the responsiveness of said electroresponsive means.

10. In a device of the class described, high tension electroresponsive means comprising a rotatable member, an electroresponsive member arranged upon deenergization thereof to turn said rotatable member in one direction and upon energization thereof to permit movement of said rotatable member in the opposite direction, and low tension circuit controlling mechanism comprising relatively movable cooperating contacts, biasing means and a flexible insulating connection between said rotatable member and said biasing means arranged to turn said rotatable member in said opposite direction upon energization of said electroresponsive member whereby to effect the movement of said contacts to circuit controlling position, means associated with said rotatable member for rendering the control of said mechanism by said electroresponsive member substantially independent of inherent changes in the length of said connection, means for limiting the movement of said rotatable member in said one direction, means adapted to be operated to change the extent of movement of said electroresponsive member whereby the position assumed thereby upon deenergization thereof can be varied so as to vary the responsiveness of said electroresponsive means, and means associated with said rotatable member for indicating the responsiveness of said electroresponsive means for the respective positions of said electroresponsive member.

In witness whereof, I have hereunto set my hand this 30th day of January, 1924.

OLIVER C. TRAVER.