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OVERLOAD PROTECTIVE SYSTEM WITH RESISTANCE OPERATED RELAY

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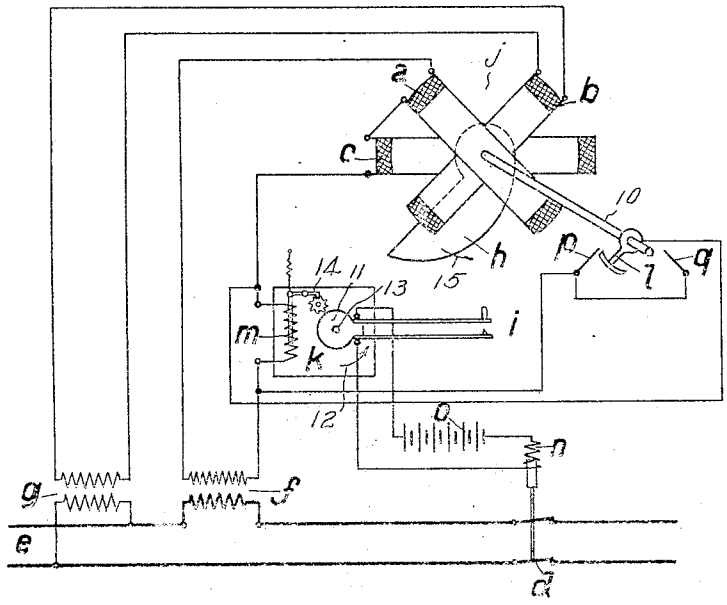

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UNITED STATES PATENT OFFICE

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OVERLOAD PROTECTIVE SYSTEM WITH RESISTANCE OPERATED RELAY

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In the case of overload protective systems which are to operate selectively, relays whose operation depends upon the magnitude of the resistance in the defective part of the line are frequently used to determine the tripping time delay. In the case of short circuits, such relays cause those switches which are nearest to the point where the short circuit occurs to operate first. As, however, the relays should of course operate only when a short circuit occurs, they are commonly used in combination with auxiliary relays operating responsively to a function of the current. When a certain pre-determined current is exceeded, such an auxiliary relay might, for example, close a circuit of the resistance dependent relay, or release a mechanical interlock of the resistance dependent relay, or put into action a delayed mechanism whose time lag is fixed by the resistance dependent relay.

All these arrangements are likely to fail in the case of a short circuit in a system on light load, which is being supplied by only a small portion of the available sources of current, if this occurs at a point remote from the source of current. In such a case it may happen that the short circuit current is not even as high as the normal current at the point where the disturbance occurred, so that the current operated i. e. overload auxiliary relays fail to operate. It is nevertheless necessary to switch out the short circuit as the line voltage in its neighbourhood is reduced to zero and consequently the current supply is disturbed in the whole district in the vicinity of the place where the short circuit occurred.

It has been found that this drawback can be avoided by using a device in which the resistance dependent relays are employed, not only to fix the time lag of the protective device, but also in place of the usual current operated auxiliary relays to set the protective device in operation. The resistance dependent relays may be provided with a second contact, in addition to the tripping contact proper, which is actuated as soon as the line resistance (upon which the action of the relay depends) has reached a certain value, and which closes the circuit and causes a relay having a definite time limit to operate. After the elapse of a time limit determined by the setting of the resistance dependent relay, this definite time limit relay is allowed to actuate the tripping contact in the well known manner.

The drawing illustrates diagrammatically one way of arranging the relays and their connections for carrying the invention into effect.

In the figure *a* and *b* are movable coils connected to each other and fixed on shaft 10, *c* is the fixed coil of a relay device *j* designed on the principle of an ohmmeter, *d* is the switch, the time lag in the operation of which is set by the relay, and which serves to cut out the line section *e*. The coils *a* and *c* are supplied by the current transformer *f* through which passes the current flowing in this section, the coil *b* being supplied by voltage prevailing in the section via the voltage transformer *g*. The supporting shaft 10 of the coils *a* and *b* carries two contact devices, viz. the cam or element *h* and the contact arm *l*.

A time limit relay device *k* comprises the member 11 carrying contacts *i* and which is rotated in the direction of the arrow 12 at a uniform rate on the pivot or spindle 13 by suitable clock mechanism or the equivalent, the latter being released, upon excitation of the electromagnet *m*, by any suitable means such as the interlock designated generally by reference numeral 14.

The relay device *j* is responsive to the impedance of the line section *e*, and upon occurrence of fault such as a short-circuit operates to rotate or adjust the angular position of the element or cam *h* in the direction of the arrow 15 and in amount inversely proportional to the impedance, or in other words, inversely proportional to the distance from the switch or breaker *d* to the point of the fault. As the point of the fault approaches breaker *d*, therefore, the element or cam *h* will be positioned correspondingly further to the right to permit of engagement of contacts *i* with the cam within a correspondingly smaller period of time from the instant of releasing action of interlock 14, in the manner and for the purpose hereinafter explained.

The contact arm *l* may either lie against the spring supported contact *q*, or the spring supported contact *p*, or be allowed to move freely in the space between the two contacts. Under normal line conditions, the relay is either in the position where the contact *l* touches the opposite contact *p* (with current in positive direction), or in the position where the contact *l* touches the opposite contact *q* (with reverse current). Consequently one of the two parallel connected contacts *p* and *q* is always closed. If, however, a short circuit occurs, the resistance dependent relay device *j* moves to a position where the contact *l* does not touch either of the two counter-contacts *p* and *q*, as shown, and changes the angular position of cam *h* to the right by an amount inversely proportional to the resistance, or inversely proportional to the distance between the breaker and the point of short-circuit or other fault. Thus the electro-magnet *m* is inserted in the circuit of the current transformer *f*. The electro-magnet then releases the interlock 14 of the time limit relay device *k*, thereby causing an arm with the two contacts *i* to move towards the cam *h*. As soon as this pair of contacts touches the rim of the cam, it closes the circuit of the current supply *o* over the tripping coil *n*, thereby tripping the switch *d*.

From the foregoing it will be seen that an improved protective system has been provided wherein the time elapsing between the occurrence of the short-circuit or other fault and the opening of the breaker is directly proportional to the distance between the latter and the point of the fault, such time being controlled by varying the angular position of the rotary element or cam *h*.

What I claim is:—

1. A selectively acting protective device including a resistance dependent relay and a delay action relay characterized by the fact that the resistance dependent relay both sets into operation and regulates the time lag of the delayed action relay.

2. In a protective system, the combination of a line, a protective relay device for said line comprising a relay element responsive to the line impedance, and a time-delay element, said impedance-responsive element controlling the initiation of the action of said time-delay element and the time lag of said time-delay element.

3. A protective relay device comprising an impedance-responsive relay element, and a time-delay relay element, said impedance responsive element controlling the initiation of the action of said time-delay element and the time delay effected thereby.

4. In a protective relay device, control circuit terminals, a time-delay action relay element for operating said control circuit terminals, and an impedance-responsive relay element for initiating the action of said time-delay relay element, said impedance-responsive relay element controlling the time elapsing between the initiation of the action of said time-delay element and the carrying out of its action on said control circuit terminals.

5. In a protective system, the combination of a line, a control circuit therefor, a protective relay device for operating said control circuit, an element responsive to the impedance of said line for initiating the action of said relay device on occurrence of predetermined line impedance conditions, and means responsive to said impedance as determined by said element for determining the time lag required to carry out the control operation of said relay device on said control circuit.

6. In a system of the character described, an electrical transmission line, a circuit breaker therefor, a time-delay element, an actuating element for initiating movement of the time-delay element to control actuation of said circuit breaker, and means for determining the length of time during which said time-delay element moves from the moment of initiation of its movement to the carrying out of the same, the operation of said actuating element and said means being responsive to the ratio of the line voltage to the line current, and the rate of movement of the said time-delay element being independent of said actuating element and said means.

7. In combination, a relay including relatively movable cooperating members, and means for controlling said members including an ohmmeter, a timing element, and ohmmetrically controlled means for controlling the starting of said timing element.

8. In a system of the character described, an electrical transmission line, a circuit breaker therefor, a time-delay element, an element operable to control initiation of movement of said time-delay element to control actuation of said circuit breaker, means for determining the length of time during which said time-delay element moves from the moment of initiation of movement thereof to the carrying out of the same, and an element actuated responsive to and in dependence solely on the ratio of voltage to current of said line for operating said means and for causing operation of the second said element.

9. In a system of the character described, an electrical transmission line, a circuit breaker therefor, a time-delay element, an element operable to control initiation of movement of said time-delay element to control actuation of said circuit breaker, means for determining the length of time during which said time-delay element moves from the moment of initiation of movement thereof to the carrying out of the same, and an element actuated responsive to and in dependence solely on the ratio of voltage to current

of said line operable responsive to energy flow in said line in a predetermined direction only to operatively actuate said means and operable independently of direction of energy flow in said line to cause operation of the second said element.

In testimony whereof I have signed my name to this specification.

ERNST HERMANN FREY.