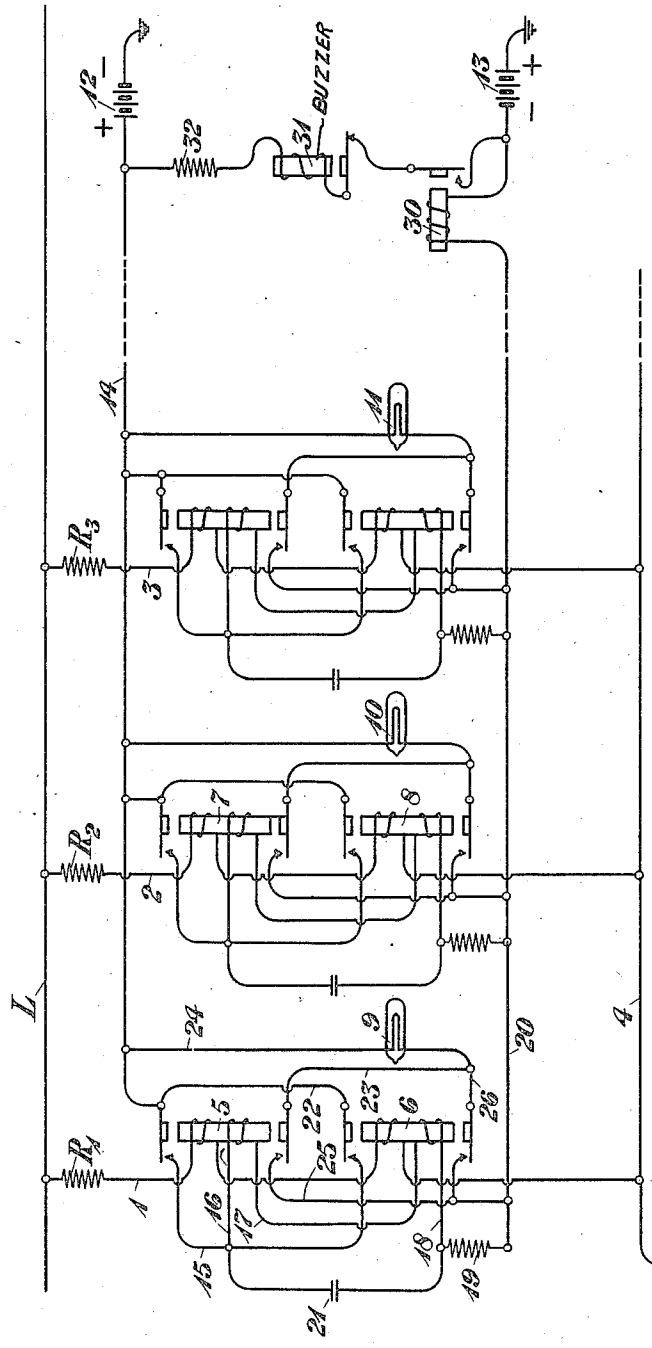
July 17, 1923. 1,461,790

M. SULTZER

MAXIMUM VOLTAGE INDICATOR

Filed May 31, 1919



INVENTOR

M. Sultzer

BY G. E. Hoag

ATTORNEY

Patented July 17, 1923. 1,461,790

UNITED STATES PATENT OFFICE.

MORTON SULTZER, OF BROOKLYN, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

MAXIMUM-VOLTAGE INDICATOR.

Application filed May 31, 1919. Serial No. 301,002.

To all whom it may concern:

Be it known that I, MORTON SULTZER, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Maximum-Voltage Indicators, of which the following is a specification.

This invention relates to a device for indicating the presence of currents in an electrical circuit, and particularly for recording the magnitudes of the voltages producing such currents, when these currents and voltages are of too short duration to be recorded by any of the ordinary types of recording meters.

According to the well known principles of electric induction, when two electrical circuits are located in close proximity to each other, a change or variation in the amount of current flowing in one of said circuits is apt to produce an electromotive force in the other circuit. Such induced voltages are apt to cause serious disturbances in the apparatus associated with such a circuit. A specific instance illustrating the above would be in the case of a telephone circuit strung along the line of an electrified railroad with ground return and exposed to the power circuits of such a system. Sudden increases of current in the power circuit due to short circuits or other trouble would induce a voltage between the telephone conductors and ground which might be sufficiently high to break down protective devices, thus in certain circumstances producing currents in the telephone wires sufficiently high to permanently magnetize iron cores, or cause fires, or seriously disturb or disarrange other delicate apparatus with which the telephone line was equipped, or cause physical injury to telephone users. Accordingly in order to prevent disturbance and destruction of apparatus associated with a circuit, it is desirable in advance to have information as to the maximum voltages apt to be induced on a circuit so inductively exposed to other electrical circuits. Furthermore, as the most destructive and injurious of such voltages are of uncertain occurrence, it is not desirable to associate with such a circuit a type of voltage measuring device requiring constant supervision, while the ordinary types of recording meters cannot be used because they fail to respond to impulses of duration as short as the duration of these most destructive voltages.

It is a general feature of this invention to provide a device for indicating and recording the voltages induced on an electrical circuit, such a device being capable of being permanently associated with such a circuit and requiring no supervision other than occasional inspection. Other and further features of the invention will be clear from the following description of the operation of the invention.

The invention consists essentially of a plurality of individual units connected in parallel between the electrical circuit and ground, or, in general, between the two sides of the electrical circuit each unit being adjusted to operate on a different and definite voltage, the difference in operating voltages being obtained by series resistances of different values associated with each unit. The fundamental parts of each unit are relays which operate on short current impulses, such as currents induced on the electrical circuit. Associated with each unit and operating whenever the relays of that unit respond are visual and audible signaling means. Accordingly the number of units will operate whenever a surge of induced current is transmitted over the electrical circuit will serve as a means for measuring the voltage of such a current.

The invention may be more clearly understood from the accompanying drawing, in which is illustrated a circuit diagram embodying a preferred form of the arrangements of the invention. The line L may represent one side of an electrical circuit exposed inductively to other electrical circuits, and on which it is desired to measure the maximum voltages induced thereon. For convenience the other side of this circuit may be shown as the ground. A plurality of individual units are shown connected in parallel between the line L and ground by the conductors 1, 2 and 3. While only a specific number of individual units have been illustrated, it is understood that as many units as desired may be similarly associated with the line L. Included in the conductors 1, 2 and 3 are the resistance elements R_1, R_2, R_3, which are of different value, as, for purposes of illustration, R_1 might have a resistance of 5000 ohms, R_2 a

resistance of 10,000 ohms, R_3 a resistance of 20,000 ohms. However, the arrangements of this invention are not specifically limited to such resistance values. Included in conductor 1 are the windings of relays 5 and 6. Included in conductors 2 and 3 are the windings of relays similar to these. These relays are adjusted to operate on short current impulses, such as those due to voltages induced between line L and ground. Locking windings for the relays, such as the relays 5 and 6 of each unit, are provided associated with the batteries 12 and 13. It is pointed out that the current in the locking winding of one of the relays of the unit will produce a magneto-motive force in the same direction as that produced by a given current in the operating winding of that relay, while the current in the locking winding of the other relay will produce a magneto motive force in the opposite direction to that due to the current in the operating winding of that relay. This is so that no matter what may be the direction of the operating current through the operating windings of the relays, the magneto-motive force due to the current through one of the locking windings will always be in the same direction as the magneto-motive force due to the operating current, and hence one of the relays will always become locked up. Were it not for this feature the direction of the current through the relay wndings, if alternating, might be opposite to that of the direct current transmitted through the locking windings, with the result that opposing fluxes would be set up in the relay cores which would serve to prevent the energization and locking up of said relays. Associated with each of the locking circuits of the units is a condenser such as the condenser 21, for the purpose of completing the locking-up in case the current in the operating winding should fall to a value below that required for operation before the current in the locking winding has reached a value sufficient to lock the relay. At each of the units, and operating when one of the relays of a unit responds, is a signal lamp such as the lamps 9, 10 and 11. The operation of any of the relays of the units will furthermore operate the pilot relay 30 and the buzzer apparatus 31, which provide an audible signal indicating the operation of the apparatus.

The invention may be more fully understood from the following description of its operation:

If a difference in potential due to induction from a neighboring power circuit exists between the line L and ground current will flow over the following path: from the line L, through resistance R_1, through one of the windings of relay 5 and through one of the windings of relay 6, to the conductor 4, to ground. If this current is of sufficient magnitude notwithstanding the resistance R_1, the relays 5 and 6 will be operated. Upon the operation of relay 5 the following locking circuit will be closed about the relays 5 and 6 from ground and positive battery 12, conductor 14, upper armature and contact of relay 5, conductors 15 and 16, lower winding of relay 5, conductor 17, lower winding of relay 6, conductor 18, resistance 19, conductor 20, winding of relay 30, to negative battery 13, and ground. As has been formerly pointed out, due to the difference in direction of the two locking windings, the closing of this circuit will lock up either the relay 5 or the relay 6; depending upon whatever may have been the direction of the peak of the alternating operating current induced on line L. Upon the operation and locking up of the relay 6 the following circuit will be closed: from ground and positive battery 12, conductor 14, conductor 24, filament of signal lamp 9, conductor 26, armature and lower contact of relay 6, conductor 20, winding of relay 30, to negative battery 13, and ground. If the relay 5 has been locked up in place of the relay 6, this last mentioned circuit would have been completed from the filament of signal lamp 9, over conductor 23, lower armature and contact of relay 5, over conductor 25 to the conductor 20. The closing of this circuit will operate the signal lamp 9 which will indicate the operation of the unit associated therewith, thereby indicating that the current induced on the line L was of sufficient magnitude to operate this unit. At the same time, the closing of either of the two last mentioned circuits will operate the pilot relay 30 which will pull up its armature and close a circuit; from positive battery 12, through resistance 32, through the buzzer apparatus 31, to negative battery 13; thereby starting the buzzer apparatus into operation, whereby an audible signal will be given indicating the operation of one or more of the units.

If the voltage induced on the line L was of sufficient magnitude to overcome a resistance greater than R_1, such, for example, as the resistance R_2, the second unit would be operated as well as the first unit. This would be indicated by the operation of the signal lamp 10 associated therewith. If the voltage of the induced current were of still greater magnitude, such that it would overcome not only the resistance R_1 and the resistance R_2, but also the resistance R_3, the third unit would be operated also. This would be indicated by the operation of signal lamp 11 associated therewith. As the operation of each of the units is substantially the same as that already described for the first unit, no further discussion thereof will be given. Accordingly, from experi-

mental data a relationship may be established between the number and resistance of the units operated and the induced voltage needed to operate such units, which relationship will serve as a means for measuring such voltage.

It is pointed out that as many units as desired may be associated with the apparatus, and that the device is not limited to nerely the three units specifically illustrated.

Furthermore, the device is not limited to use with telephone circuits alone, but is suitable for use with many types of electrical circuits, and while the arrangements have been herein specifically illustrated in a form deemed desirable it is understood that they are capable of embodiment in many and widely varied forms without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. A voltage indicating device for a transmission line including a plurality of resistance elements of different values connected to said line, individual units connected with each of said resistance elements, each of said units including two relay means each having an actuating winding responsive to currents transmitted over the line and a locking winding, said locking windings being so related to said actuating windings that the former windings will not magnetically oppose the latter windings of both relays at the same time, and signaling means controlled by either of said relays.

2. A voltage indicating device for a transmission line including a plurality of resistance elements of different values connected to said line, individual units connected with each of said resistance elements, each of said units including two relay means each having an actuating winding responsive to currents transmitted over the line and a locking winding, the locking winding for one of said relays being so related to its actuating winding to lock up said relay when the current from said line is transmitted through said relays in one direction, the locking winding for the other of said relays being so related to its actuating winding to lock up said relay when the currrent from said line is transmitted through said relays in the other direction, and a signaling means operated by either of said relays.

3. A voltage indicating device for a transmission line including a plurality of resistance elements of different values connected to said line, individual units connected with each of said resistance elements, each of said units including two relay means each having an actuating winding responsive to currents transmitted over the line and a locking winding, said locking windings being so related to said actuating windings that the former windings will not magnetically oppose the latter windings of both relays at the same time, signaling means controlled by either of said relays, a pilot relay associated in common with all of said units and operated whenever any of said relays in any of said units are operated, a buzzer, and means controlled by said pilot relay for closing a circuit for said buzzer.

4. A voltage indicating device for a transmission line including a plurality of individual relay units connected in parallel between said line and the ground, each of said units being responsive to potentials of different magnitudes between the line and the ground, signaling means individual to and controlled by each unit, and signaling means common to all of said units and controlled by either one of said units.

5. A voltage indicating device for a transmission line including a plurality of individual relay units, means for connecting said relay units in parallel with the transmission line, each of said connecting means including a resistance element of different value whereby each of said relay units will be responsive to potentials of different magnitudes impressed on said line, and signaling means common to all of said units and controlled by either one of said units.

In testimony whereof, I have signed my name to this specification this 28th day of May, 1919.

MORTON SULTZER.