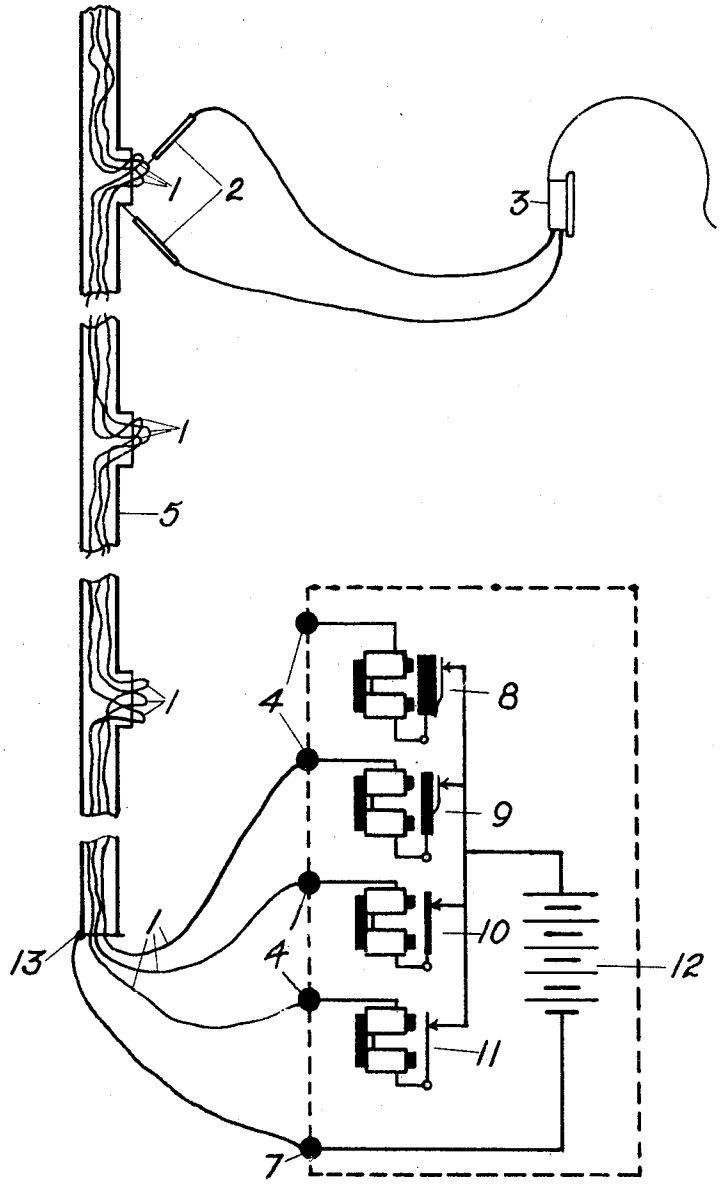
March 7, 1933. E. WOODBURY 1,900,424

ELECTRICAL TESTING

Filed Sept. 27, 1927



E. Woodbury
INVENTOR

Patented Mar. 7, 1933 1,900,424

UNITED STATES PATENT OFFICE

EUGENE WOODBURY, OF LINCOLN PARK, NEW JERSEY

ELECTRICAL TESTING

Application filed September 27, 1927. Serial No. 222,380.

This invention relates to testing and particularly to testing conductors in electrical systems for continuity and where a number of conductors are grouped together for identity.

A broad object of the invention is to provide a quick and labor saving method of identifying electrical conductors at one or more points along their lengths.

A specific object of the invention is to provide a simple, compact, and low priced apparatus for use with the above method of testing.

It is common practice to conceal electrical conductors by grouping a large number of them together in a cable, or by enclosing several conductors in a conduit. Since such conductors must often be identified at various points along their lengths in order to properly connect them to apparatus, or to other conductors, it has been a common practice in the past to cover different conductors with differently colored or marked insulation. This makes them readily identifiable, but in a great many cases it is not practicable to use insulation of different colors and in such cases it is necessary to identify the conductors by electrical tests, which are usually carried out as follows: Two testmen are located at the two terminals respectively of the conductor to be identified, one of whom connects a source of potential between the conductor and a common return, such as the conduit, while the testman at the remote point connects an indicating device, such as a buzzer, telephone or lamp, between the common return and each of the conductors in turn until he locates the live conductor. This method is disadvantageous, not only because it requires two testmen, but because only one conductor can be conditioned for identification at a time.

In accordance with this invention the objectionable features pointed out above are avoided by exciting a plurality of conductors at once with alternating or pulsating currents of distinctly different frequencies so that they may be readily distinguished apart.

My improved apparatus for, and method of, testing will now be described and explained in connection with the drawing, which shows schematically a conduit containing conductors to be identified at a plurality of points, a device in accordance with my invention, and the method of using it.

Referring to the drawing I have shown a plurality of buzzers 8, 9, 10 and 11 of conventional type, each comprising an electromagnet with a vibratory armature and a back contact for closing the electromagnet energizing circuit when the armature is in its normal position of rest. The back contacts of all the buzzers are connected to one terminal of the battery 12 and the other terminal of battery 12 is connected to binding post 7. One end of the winding on each buzzer is connected to its respective armature and the other end to one of the binding posts 4. The assembled buzzers and battery may conveniently be placed in a compact container with the binding posts 4 and 7 mounted on the exterior thereof.

The circuit for the operation of any buzzer may be traced from battery 12, through the back contact, armature and winding of the buzzer to one of the binding posts 4, and it is necessary to complete the circuit between the latter binding post and binding post 7, which is connected to the other pole of battery 12, in order to operate the buzzer. When this circuit is closed the buzzer will vibrate its armature at a speed, or frequency, dependent largely on the inertia of the armature and the stiffness of the armature support. In accordance with this principle of vibrating bodies the armatures of the four buzzers 8, 9, 10 and 11 are so proportioned as to vibrate at different frequencies. Thus buzzer 8 has a massive armature mounted on a flexible support so that it vibrates at a very

low frequency, whereas buzzer 11 has a very light armature mounted on a relatively stiff support so that it vibrates at a much higher frequency than does buzzer 8. Buzzers 9 and 10 have their armatures and armature supports so proportioned that they vibrate at different frequencies, which may be higher than that of buzzer 8 but lower than that of buzzer 11.

To illustrate the method of utilizing the above described apparatus a conduit 5 containing a plurality of conductors 1 which are to be identified at a plurality of points along their length, is shown in the drawing. This conduit may, for instance, run vertically in a building and have an outlet for the connection of apparatus on each floor. Furthermore it is assumed that the electrical circuit involved is of such a nature that each conductor must be connected to a definite terminal of the apparatus at each outlet.

In accordance with this invention the conductors 1 may be speedily tested and identified as follows:

The apparatus comprising the buzzers and battery, shown enclosed in the dotted line, is placed at the terminal of the conduit and the conductors 1 connected to different buzzers at binding posts 4, and the binding post 7 is connected to the metal conduit, as shown in the drawing. With the connections made as shown, if any one of the conductors is grounded on the conduit, as the result of faulty insulation, a circuit will be closed from battery 12 to the conduit (through binding post 7) through the fault in the insulation to the conductor and its associated buzzer, which immediately buzzes to inform the testman that the conductor is grounded in the conduit. If the buzzers remain quiet the testman knows at once that the insulation on the conductors is good and that he can proceed to test them for continuity and identity. To do this he first notes the order in which the conductors are connected to the buzzers. For instance if there are three conductors he may connect number one conductor to the lowest frequency buzzer, number two conductor to a higher frequency buzzer and number three conductor to a still higher frequency buzzer. The testman then proceeds to the different remote points at which the conductors are to be identified and connects an ordinary head telephone 3 between the conduit and each conductor in turn by means of the test points 2. As soon as he closes a circuit between the conduit and a conductor the buzzer associated with that conductor is operated and since the telephone 3 is in the buzzer circuit a characteristic buzzing sound is heard by the testman which immediately informs him whether he is connected to number one, number two or number three conductor. If no sound is heard the testman knows that the conductor is broken or open somewhere in the conduit. It is thus seen that as the result of performing a single operation he is apprised as to the identity and continuity of one of a group of conductors.

What is claimed is:

1. The method of identifying a plurality of electrical conductors at different points along their length which comprises applying a current which varies in magnitude at a definite time rate to one conductor and applying currents which vary at different time rates to the other conductors and causing said currents to produce different, distinctive indications at said different points along their length, whereby they may be identified.

2. The method of identifying a plurality of conductors at a remote point which comprises applying to each conductor a current which varies in magnitude at a time rate different from that of the current applied to each other conductor and causing said different currents to produce different, audible indications at the remote point.

3. The method of identifying electrical conductors which comprises applying pulsating electric currents of different, distinctive frequencies to different conductors and identifying each conductor wherever it may appear by determining the frequency of the current impressed thereon.

4. A portable test set for testing a plurality of circuits comprising a source of electric current and a plurality of contacts adapted to vibrate at different frequencies a common terminal for connection to all circuits to be tested, and a plurality of terminals for connection individually to different circuits to be tested, each contact adapted to open and close, with each vibration, a series circuit including the source of electric current, said common terminal, and one of said plurality of terminals individual to each vibrating contact.

5. A portable test set comprising an electric battery, a plurality of terminals on the exterior of said set for connection to circuits to be tested, a plurality of buzzers, each comprising an electromagnet and an armature, a back contact against which said armature normally rests, said electromagnet, armature and contact of each buzzer being connected in series and each buzzer being connected between a separate one of said terminals on the exterior of said set and one pole of the battery, the other pole of said battery being connected to another of said terminal on the exterior of said set.

6. The method of testing a plurality of normally open circuits which comprises conditioning said circuits whereby a distinctive E. M. F. will be applied to each circuit only upon closure of that circuit.

7. A portable test set comprising a plurality of circuits each including a normally inactive circuit interrupting device adapted upon closure of its associated circuit to in-

terrupt the circuit at a predetermined audible rate and at the same time to emit a distinctive sound, each circuit including in series therewith, a pair of normally open circuit terminals for connection to a circuit to be tested whereby said interrupting device is operated only when a circuit is closed between said terminals.

In witness whereof, I hereunto subscribe my name this 20 day of September A. D. 1927.

EUGENE WOODBURY.