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[54] CABLE CONTINUITY TEST APPARATUS

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[52] **U.S. Cl.** **324/539;** 324/133; 324/541; 324/542; 379/21

[58] **Field of Search** 324/66, 133, 542, 541, 324/540, 539; 340/635, 633; 379/21

[56] **References Cited**

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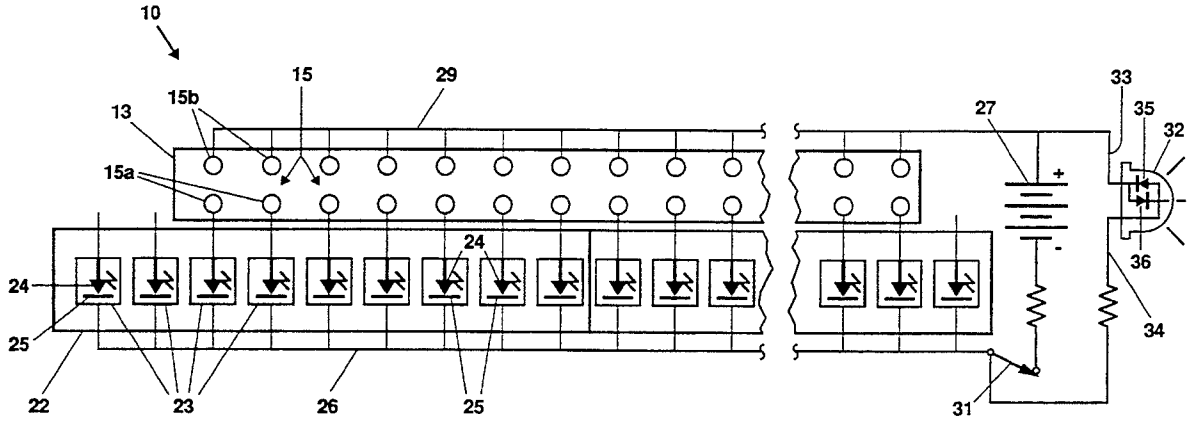
Primary Examiner—Bernarr E. Gregory

[57] **ABSTRACT**

Versatile multiconductor cable test apparatus when connected to opposite ends of the cable indicates conductor defects (shorts and opens), reversal of conductors in sequentially connected cables, and identifies the location of a defective conductor or conductors. The apparatus can be readily operated by one person, is quickly connectable to the cable and is constructed with commercially available inexpensive parts.

3 Claims, 6 Drawing Sheets



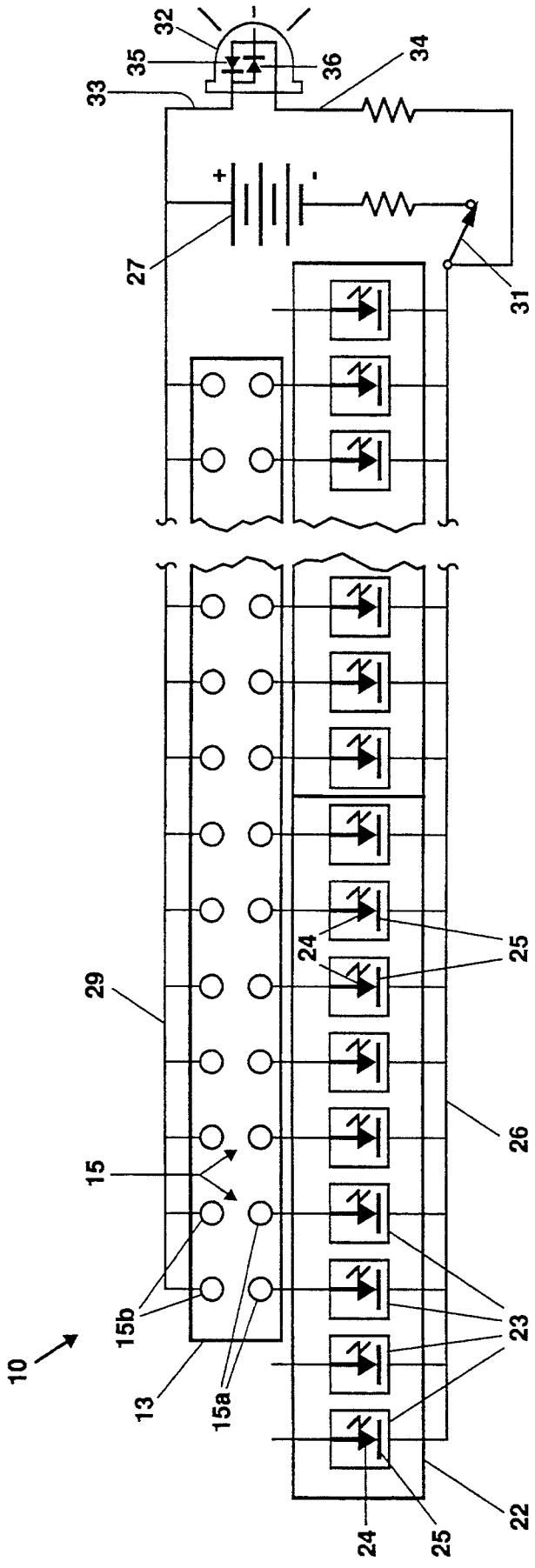


Fig 1

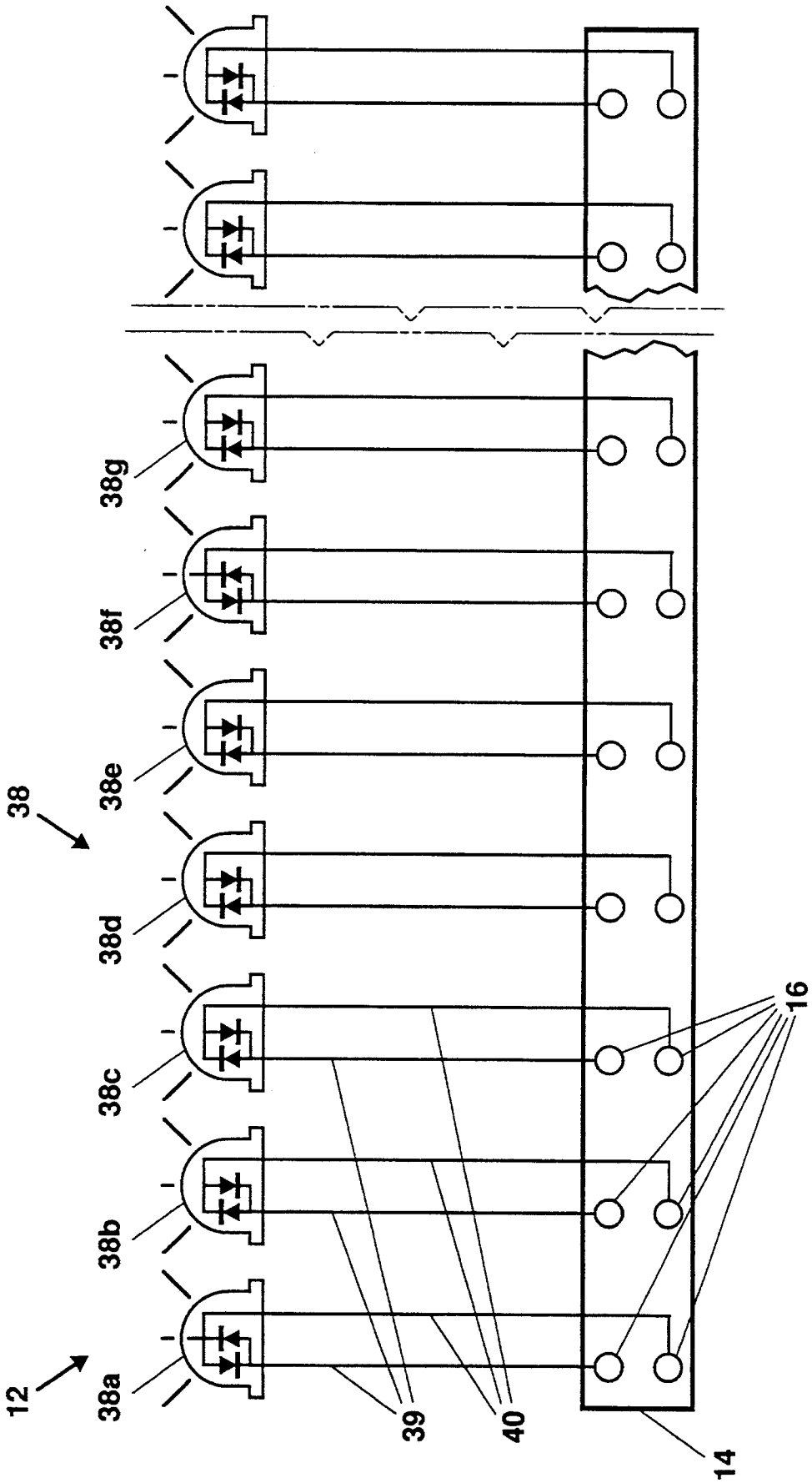


Fig 2

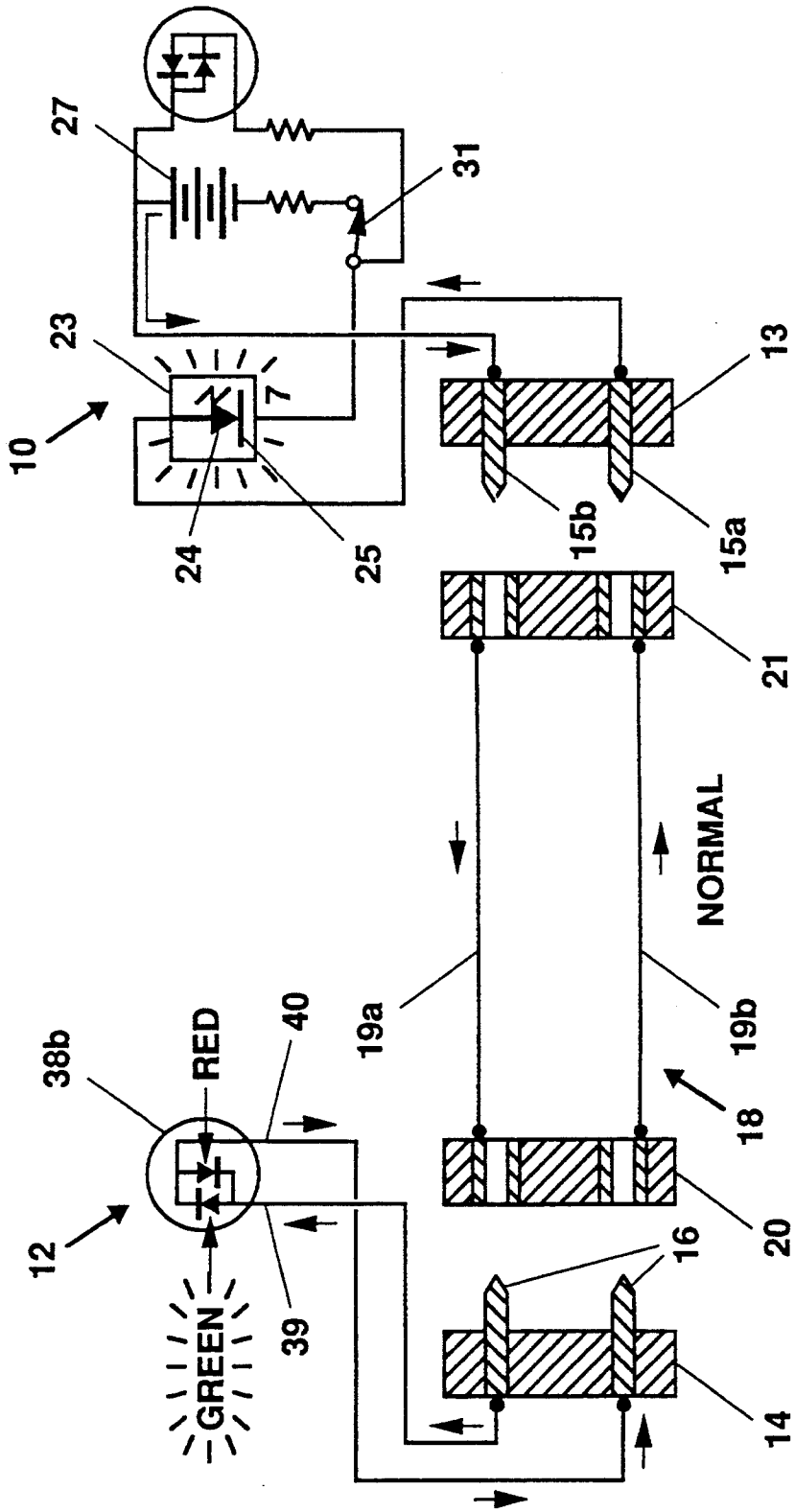

27
31
23
10
7
24
25
13
15b
15a
21
NORMAL
19a
19b
18
40
38b
RED
12
GREEN
39
16
20
14

Fig 3

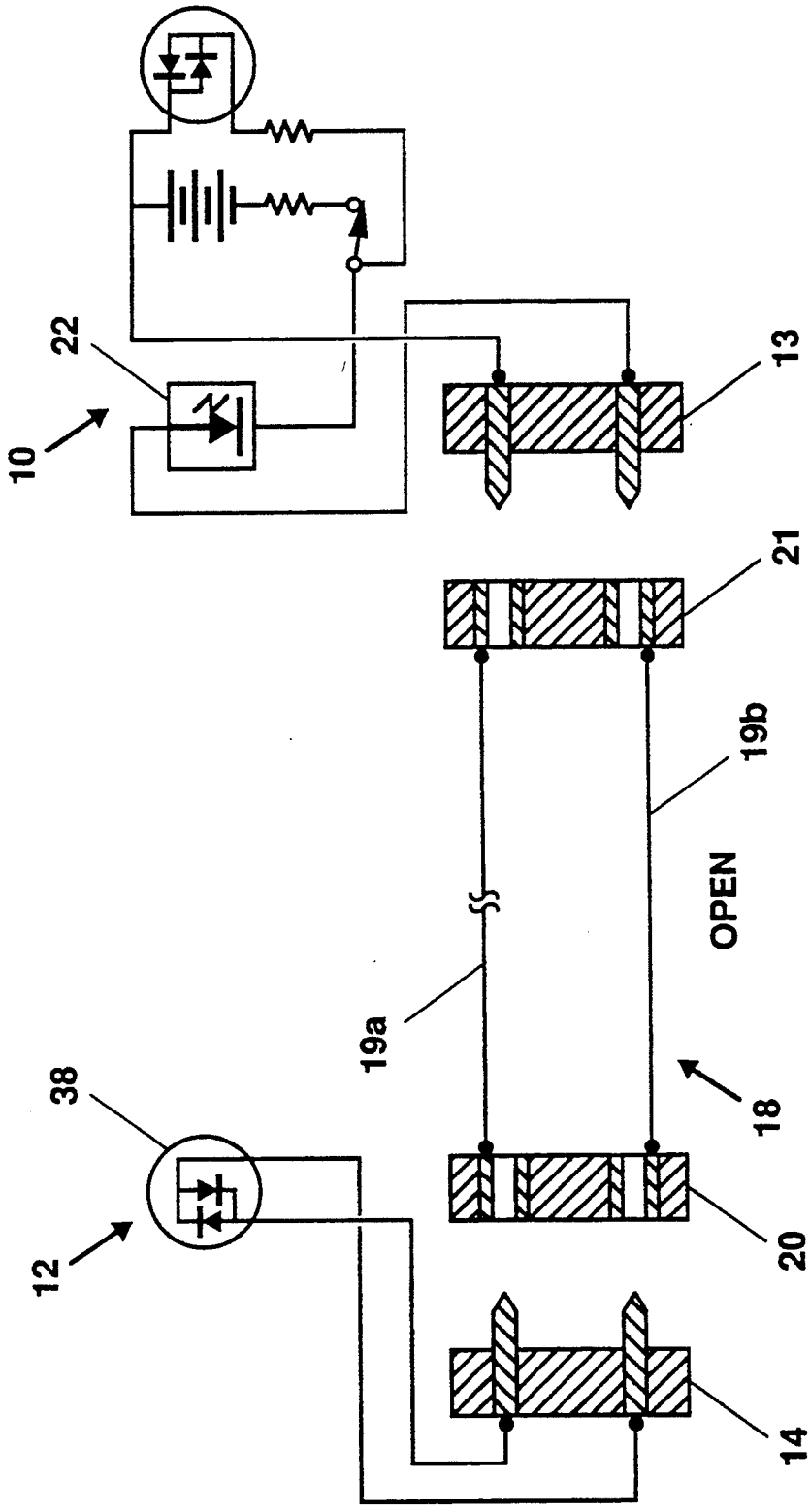


Fig 4

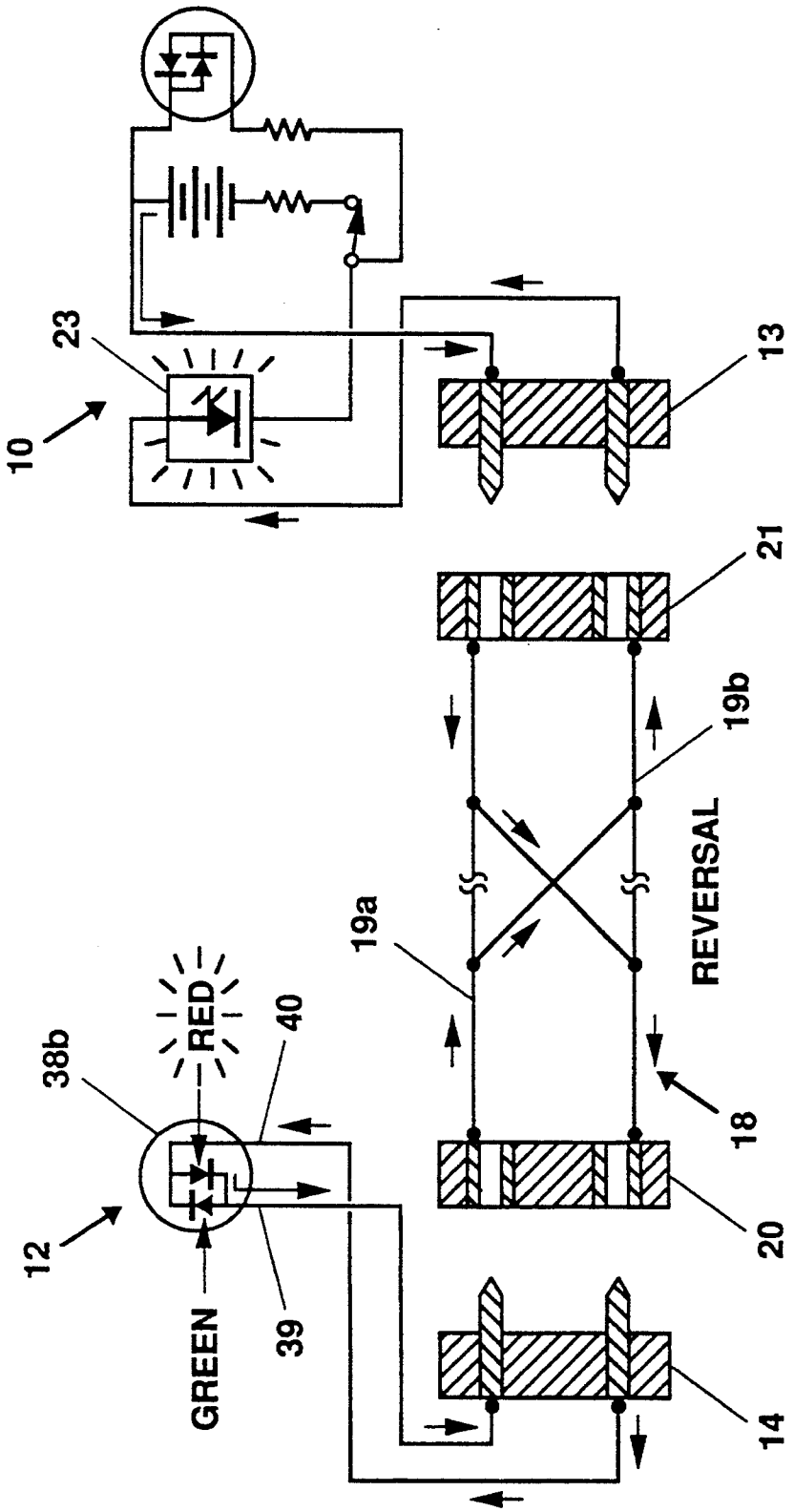


Fig 5

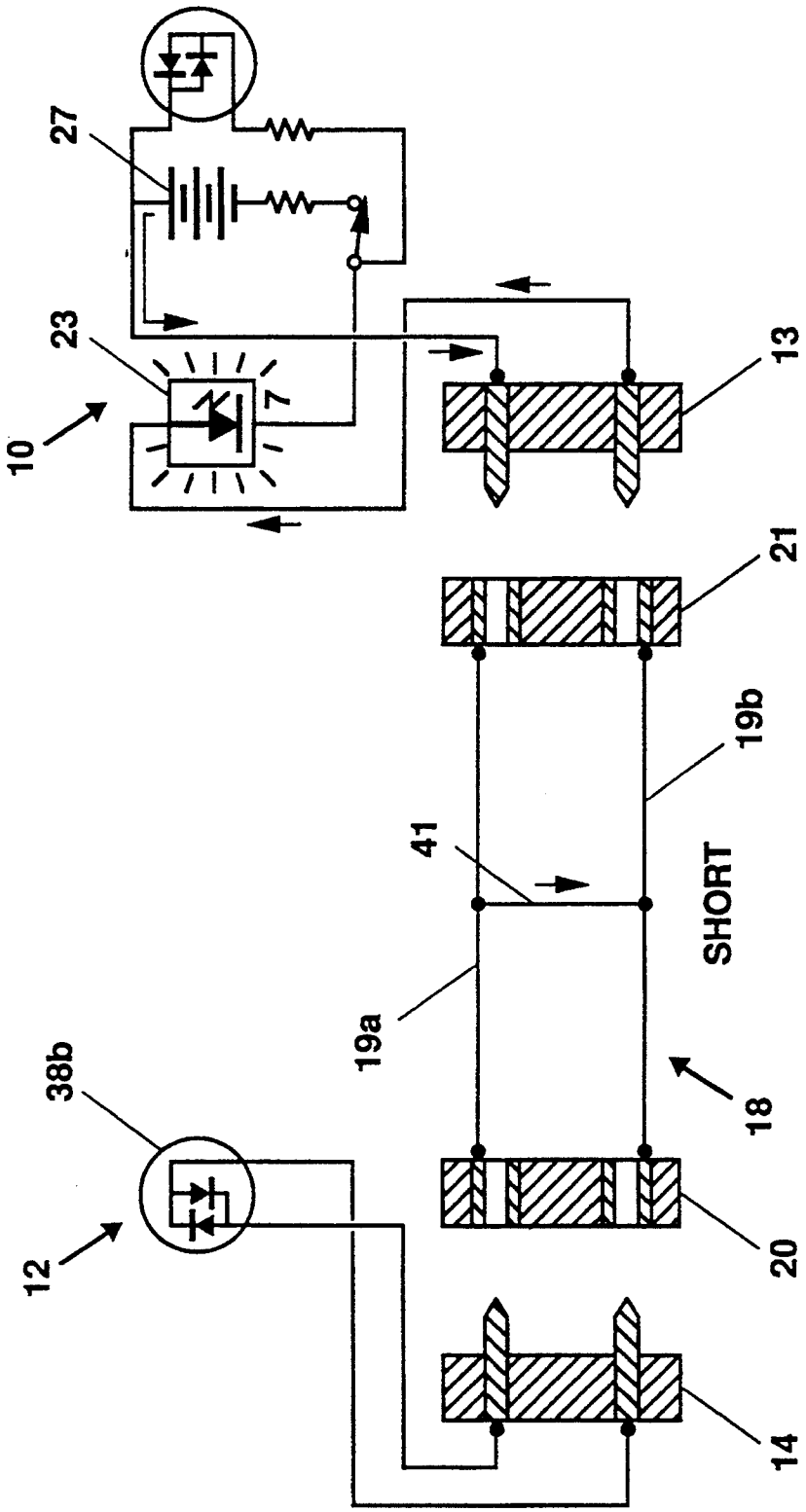


Fig 6

CABLE CONTINUITY TEST APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to electric cable test apparatus and more particularly to apparatus for testing installed multiconductor cables for abnormal conditions such as open conductors, short circuits and misconnections.

Use of complex multiunit electronic apparatus often entails operational interconnection of the units by multiconductor electric cables, such as well-known ribbon cables, often connected in tandem. During the course of installation of such cables, conductors therein may be severed or opened, shorted and/or reversed (i.e., a conductor at one end of the cable is misconnected within the cable is misconnected within the cable or from cable to cable to a conductor other than the one intended). In order to check cables to determine if such defects exist, it was previously necessary to sequentially check each individual conductor of the cable with a volt-ohmmeter or the like. Two persons frequently were required to perform these checks on system installed cables. This prior technique was slow, prone to errors, required extra manpower, and when cable ends were widely separated, communication problems between test personnel were frequent, resulting in confusion and mistakes. This invention comprehends apparatus which performs such tests without these disadvantages and drawbacks.

OBJECTS AND SUMMARY OF THE INVENTION

An object of the invention is the provision of cable test apparatus which can be used effectively by one person.

Another object is the provision of such apparatus which is lightweight and portable and facilitates fast and accurate checking of entire multiconductor cables by visual indicators.

Still another object is the provision of such test apparatus which is economical to construct with readily available standard components and which is simple to maintain.

These and other objects of the invention are achieved with apparatus comprising a short detector and a reversal detector detachably connectable to opposite ends of a multiconductor cable or cables. The reversal detector comprises a plurality of multi-color light emitting diodes (LEDs) connected by a pin connector to one end of the cable so that each cable conductor is connected to an LED. The short detector is likewise connected the other end of the cable and has a plurality of bargraph display elements connected to the cable conductors, respectively, and an energy source (battery) connected to the conductors. The combination of energization (or lack thereof) of the LEDs and bar display elements instantly provides visual indications to the operator of the condition of the cable.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan schematic view of the short detector portion of the tester apparatus embodying this invention.

FIG. 2 is a plan schematic view of the reversal detector portion of the tester apparatus embodying this invention.

FIG. 3 is a schematic view of the apparatus of this invention connected to one pair (of a plurality of pairs) of cable conductors showing operation of the apparatus when there are no defects in the cable.

FIGS. 4, 5 and 6 are views similar to FIG. 3 showing operation of the test apparatus for conditions of an open conductor, reversal of conductors and shorted conductors, respectively, in the cable.

DESCRIPTION OF PREFERRED EMBODIMENT

FIGS. 1 and 2 illustrate a short detector **10** and a reversal detector **12** having male pin blocks **13** and **14**, respectively, which are connectible to corresponding female connector blocks at opposite ends of a multiconductor cable **18**, see FIGS. 3–6 inclusive, to be tested. By way of example and not of limitation, pin blocks **13** and **14** have **25** pairs of pins **15** and **16**, respectively. For clarity of illustration, cable **18** is represented in FIGS. 3–6, inclusive, by a single pair **19***a* and **19***b* of wires instead of the 25 pairs actually comprising the test cable, the connector blocks at opposite ends of wires **19***a* and **19***b* indicated by reference characters **20** amd **21**, respectively.

Short detector **10** comprises three 10-element light emitting diode (LED) bargraph displays to accommodate a 25 wire pair cable, one of the displays being indicated at **22** in FIG. **1** and having ten diode eleemnts **23**. Each diode has an anode **24** and a cathode **25**, the latter being connected by line **26** to the negative terminal of a direct current energy source such as battery **27**. Anodes **24** of LEDs **23** are connected to one pin **15***a* of each pair of pins **15** on block **13** and the other pin **15***b* of each pair of pins **15** is connected by a common line **29** to the positive terminal of battery **27**. A switch **31** is provided between line **26** and battery **27** to permit deactivation of the apparatus when not in use. Tri-color LD **32** is connected across lines **26** and **29**. The color of light emitted by LED **32** (only two colors re used in the practice of this invention) indictes the correctness of battery polarity orientation, i.e., green indicates proper battery polarity and red indicates reversal. LED **32** has two terminals **33** and **34** connected across battery **27** and two diodes **35** and **36** reversely connected across terminals **33** and **34** so that the direction of current passing through LED **32** is indicated by the color emitted thereby. LED **32** as well as diodes **23** are commercially available components sold at electronics chain stores such as Radio Shack.

Reversal detector **12**, see FIG. **2**, is connected to the end of multiconductor cable **18** opposite from that to which short detector **10** is connected and comprises a plurality of tri-color LEDs **38**, each having two terminals **39** and **40** and connected to a pair of pins **16** in pin block **14**. LEDs **38** are identical to LED **32** in construction and operation and like the latter use only two of three colors in this invention. In order to facilitate location of defective location of defective conductors in a multiconductor cable, the positions of electrodes in LEDs **38** at predetermined locations in the entire set are reversed relative to positions of those electrodes in the remaining LEDs **38**. For example, electrodes in LEDs **38***a* and **38***f* in the group of LED **38***a*–**38***g*, inclusive, in FIG. **2** are polarity reversed as compared to the remainder of the LEDs in that group. If the pair of cable conductors to which LED **38***d* is connected are defective, i.e., reversed, LED **38***d* emits red light indicating that the defective conductor pair, is the third pair from the pair connected to LED **38***a*. By reversing the polarity of electrodes in, say, every fifth LED (as shown), iden-

tification of the location of a defective conductor pair in the cable is facilitated.

Operation of the test apparatus is better understood by reference to FIGS. 3–6, inclusive, for operating conditions wherein cable **18** is normal (i.e., functioning properly), or has conductors **19***a* and **19***b* that are open, reversed or shorted. Referring to FIG. **3**, short detector **10** is connected to one end (right end, as viewed) of normally functioning cable **18** by pins **15** in block **13**. Similarly, reversal detector **12** is connected through pins **16** of block **14** to the opposite end of cable **18**, with switch **31** of battery **27** closed, current flows from the positive terminal of the battery through pin **15** and wire **19***a* to pin **16** and terminal **39** of LED **38***b* of reversal detector **12**. The return path is through terminal **40** of LED **38***b*, pin **16**, conductor **19***b*, and pin **15***a* to anode **24** of diode element **23**. With this polarity of energization, LED **38***b* emits green light as shown and bargraph element lights up, all indicating a normal condition and a properly functioning cable. Since bargraph display **22** and LEDs **38** are plainly visible even at a considerable distance, only one operator is needed to conduct this and the other tests explained below.

FIG. **4** illustrates a cable condition in which conductor **19***a* of cable **18** is open. The effect of this open circuit is to break the path of current flow through bargraph display **22** and LEDs **39** so that no light is emitted from these indicators, signalling an open circuit.

FIG. **5** shows a cable condition in which the effective positions of conductors **19***a* and **19***b* between the cable ends are reversed. This condition is more likely to occur through installation error when several cables are connected on tandem. As a result, current flow through the conductors is reversed from one cable end to the other, causing a reversal of energization polarity of reversal detector LED **38***b* so that it emits red light instead of green. In the example shown in FIG. **5**, the double reversal of the flow of current through conductors **19***a* and **19***b* results in no change in polarity of energization of bargraph display element **23** which accordingly emits light. Therefore, red light emission from LED **38***b* of reversal detector **12** accompanied by light emission from bargraph display element **23** indicates a reversal of cable conductors.

The final abnormal condition of a multiconductor cable is that of a short circuit between a pair of conductors as illustrated in FIG. **6**. In this case, current from battery **27** is diverted by the short, indicated at **41**, from conductor **19***a* to conductor **19***b* and does not reach reversal detector **12**. Accordingly reversal detector LED **38***b* is not energized and does not emit any light. However, the diode elements, **23** of bargraph display are properly energized and do emit light as indicated. Therefore illumination of bargraph display **22** and no illumination of diodes **38** n reversal detector **12** indicates a short circuit in cable **18**.

In addition to the utility of the test apparatus embodying this invention to running checks on ribbon cables, it is equally advantageous when used in testing other multiconductor devices such as shielded multiconductor cable assemblies, individually shielded multiconductor assemblies, printed wiring assemblies, and similar assemblies through use of a proper interfacing adapter.

What is claimed is:

1. Test apparatus for multiconductor cable having a plurality of pairs of coextensive conductors, each of said conductors being connected at opposite ends to connectors, said apparatus comprising:

a short detector connected to one end of the cable and a reversal detector connected to the other end of the cable;

said short detector comprising a plurality of bargraph display elements, said elements having anodes and cathodes, said cathodes respectively connected across said pairs of conductors, said detector also having a direct current source with a positive terminal and a negative terminal, said positive terminal being connected to first conductors of each of said pairs of conductors, said negative terminal being connected through the cathodes and anodes of said display elements to the second conductors of each of said pairs of conductors, each of said elements emitting light when energized by electric current passing therethrough from anode to cathode;

said reversal detector comprising a plurality of light-emitting diodes (LEDs), each LED having first and second terminals and each LED being capable of emitting light in open of at least two colors depending on the direction of flow of electric current through said LED, the first of said LED terminals being connected to said first conductors and the second of said LED terminals being connected to said second conductors whereby light at a first color from an LED indicates reversal of an associated pair of conductors in said cable and light at a second color indicated correct orientation of the associated pair of conductors;

the combination of energization or lack of energization of said elements and said LEDs together with the color of light emitted by said LEDs providing indications of open, reversal, shorted or normal conditions of identified conductors in said cable.

2. Apparatus according to claim **1** in which several LEDs at equally spaced intervals throughout said plurality of LEDs are reversely connected to said said conductors whereby normally to produce light having a color different from that of the remaining LEDs for facilitating location of defective conductors.

3. Apparatus according to claim **1** in which each of said conductors is connected at opposite ends to female connectors, said LEDs and said display elements being connected to male connectors.

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