PAT. APPL.
IN-33
190866

NASA CASE NO. LAR 14093-1 P. 12

PRINT FIG. 1

**NOTICE**

The invention disclosed in this document resulted from research in aeronautical and space activities performed under programs of the National Aeronautics and Space Administration. The invention is owned by NASA and is, therefore, available for licensing in accordance with the NASA Patent Licensing Regulation (14 Code of Federal Regulations 1245.2).

To encourage commercial utilization of NASA-owned inventions, it is NASA policy to grant licenses to commercial concerns. Although NASA encourages nonexclusive licensing to promote competition and achieve the widest possible utilization, NASA will provide the necessary incentive to the licensee to achieve early practical application of the invention.

Address inquiries and all applications for license for this invention to **NASA Patent Counsel, Langley Research Center, Code 143, Hampton, Virginia 23681-0001.**

Serial No.: 08/073,845
06/07/93 LaRC

NASA CASE NO. LAR-14093-1

AWARDS ABSTRACT

This invention relates to devices for testing conductive paths, such as center conductors and shields, of cables for continuity and short circuits therebetween.

The device includes at least one pair of connectors and a circuit to provide for testing of the conductive paths of the cable. Preferably, three different types of connectors are provided so that three different types of cables can be tested. The device automatically checks the cable for continuity of a center conductor, continuity of a shield, and for a short circuit between the shield and the center conductor. The circuit includes circuit paths having indicators which simultaneously indicate the results of each test (i.e., center conductor continuity, shield continuity, short circuit). In addition, a switch can be provided to place the device in different modes for testing LEDs and other equipment for continuity.

This invention enables a user to simultaneously test the center conductor and the shield of a cable for continuity and for short circuits therebetween with minimal human intervention. Unlike previous devices, neither switch actuation nor other human actions are required after the cable is attached to the device in order to perform all three tests. The device automatically and simultaneously indicates the operational condition of each circuit path of the cable being tested.

INVENTOR: Arthur Ray Hayhurst
220 West Woodland Drive
Grafton, Virginia 23692
SSN [redacted]

EMPLOYER: NASA Langley Research Center
EVALUATOR: John D. Buckley

Serial No.: 08/073,845
Filed: 06-07-93

# A DEVICE FOR TESTING CABLES

## Origin of the Invention

The invention described herein was made by employees of the U.S. Government and may be manufactured and used by or for the U.S. Government without the payment of any royalties thereon or therefor.

## Background of the Invention

### 1. Field of the Invention

This invention relates to devices for testing cables and, more particularly, relates to devices for automatically testing the continuity of center conductors and shields of a cable and for short circuits therebetween.

### 2. Description of Related Art

Conductors, such as cables and the like need to be checked for damage which is often not apparent to the naked eye. Typically, this is done by electrically testing a cable for continuity and short circuits. However, many known testing techniques are time consuming and tedious. Known techniques include, for example, manually probing the center conductor and shield of the cable. Although some cable testers indicate a fault in the cable, many do not distinguish between an open circuit in the center conductor and one in the shield. Other cable testers require the use of switches to determine whether the conductor or shield is faulty.

These known testing techniques are problematic because they are subject to human error. In addition, they can be very tedious especially when a vast number of cables have to be tested.

U.S. Patent No. 4,670,709 to Iredale discloses a battery-powered audio cable test device which can test several different types of audio cable

for shorts or opens when operated in a cable continuity mode. This device does not test center conductors and shields for continuity. Additionally, even when three prong cables are tested, the device does not specify which conductor is faulty, only that the cable is faulty.

U.S. Patent No. 4,491,781 to McClintic discloses a battery-powered tester unit for determining if a short or a break exists in either of two conductive paths in a cable. The tester includes a pair of jacks adapted to receive plugs of a cable and a pair of indicating LEDs. Each of two contacts of the first jack is connected in series with an LED, the battery and the corresponding contact of the second jack so as to create a circuit that tests continuity in both of the conductors in a cable with both of its plugs connected to the tester. This device requires that a cable be tested separately for short circuits, and then for continuity. Accordingly, excessive time may be required to fully test a cable. Additionally, it is easy to forget to perform one of the two tests, especially when many cables are being tested.

U.S. Patent No. 4,281,283 to Ross et al. discloses a portable battery-powered audio cable tester having two jacks for connecting a cable to be tested. A signal light and a push-button "short" switch are connected with a battery such that the light will switch on when a cable not having a "short" is connected to the tester and off when the short switch is opened, indicating the absence of a short. However, a position toggle switch must be actuated along with the push button "short" switch to distinguish between malfunctions due to a broken conductor, an open shield, or a short circuit.

U.S. Patent No. 4,553,085 to Canzano discloses a coaxial cable tester device having a transmitter unit and a receiver unit, each with two coaxial connectors. The cable tester device determines whether a cable is defective, whether the defect is an open circuit or a short circuit and in which cable conductor the defect occurs. This system is bulky and also requires the manipulation of a switch and multiple cable connection sequences in order to test for conductor and shield continuity, and for a short circuit.

Summary of the Invention

It is an object of the invention to provide a device to simultaneously test a plurality of circuit paths of a cable for continuity and for short circuits therebetween, and to provide the user with an indication of the operational condition of the tested circuit paths.

It is another object of the invention to provide a device which is compatible with many types of cables to be tested.

It is a further object of the invention to provide a cable test device which can also be used to test other conductors or components for continuity.

The present invention accomplishes the foregoing and other objects by providing a device which automatically tests cables upon electrical coupling of the device and a cable. The device is electrically coupled via connectors to the ends of the cable. At least three different types of connector pairs may be provided so as to accommodate varying cable ends. The connectors provide for an electrical contact with the conductive paths of the cable. The connectors are coupled to a circuit. The circuit automatically tests conductive paths of an electrically coupled cable. The circuit detects whether the conductive paths are open and whether there is a short between two conductive paths of the cable. The circuit includes indicating devices to simultaneously indicate whether each conductive path is open and whether there is a short circuit between the conductive paths of the cable.

The device can include a switch electrically connected to the circuit so that equipment in addition to cables can be tested with the device.

Brief Description of the Drawings

The invention will be described with reference to the following drawings in which like reference numbers refer to like elements, and wherein:

Fig. 1 is a top view of a cable tester in accordance with one preferred embodiment of the invention; and

Fig. 2 is a schematic circuit diagram of the Fig. 1 cable tester.

## Detailed Description of Preferred Embodiments

Fig. 1 is a top view of a cable tester 50 in accordance with an illustrative embodiment of the invention. At least one pair of connectors 14 is provided for electrically coupling a cable 34 to tester 50. Preferably, a plurality of different types of connectors 14 are provided so that tester 50 can be used to test different types of cables. The tester 50 in Fig. 1 includes three pairs of connectors 14. The three different types of connectors can be, for example, a BNC (bayonet null connector), a phono plug and an F-type connector. However, other types of connectors could be provided. Each connector pair can be comprised of two female connectors, two male connectors, or one female and one male connector.

Referring to Fig. 2, a first connector pair 14a, 14a', a second connector pair 14b, 14b', and a third connector pair 14c, 14c' are provided. As discussed above, each cable 34 includes a center conductor and a shield which need to be tested for continuity. It is also desirable to test for short circuits between the center conductor and the shield which can be located, for example, within the wire portion 35 or within the plugs 33a, 33b of cable 34. One pair of connectors connects current paths of tester 50 with the respective center conductor and shield of a cable 34 to be tested. In accordance with a preferred embodiment of the invention, in which two conductive elements (i.e., center conductor and shield) of a cable are tested, each connector 14 has two contacts 22 and 24. Contact 22 is electrically coupled to the center conductor of cable 34 when cable 34 is attached to a connector 14. Contact 24 is electrically coupled to the shield of the cable 34 being tested.

Tester 50 includes power source 36. In accordance with a preferred embodiment of the invention, power source 36 includes two batteries 18 and 20 which are, for example, 9V batteries. Batteries 18 and 20 are capable of supplying current simultaneously to a plurality of current paths within tester 50.

In accordance with the present invention, the continuity of the center conductor and of the shield, and the presence of short circuits therebetween are simultaneously detected and indicated by tester 50. Accordingly, three separate indicators are provided. In the preferred embodiment, the three separate indicators are light emitting diodes (LEDs) 2, 4, 6. However, it is possible to use indicators other than separate LEDs to indicate the results of the tests performed by tester 50. For example, a buzzer system capable of producing three distinguishable tones could also be provided. Similarly, a visually detectable indicator system other than three separate lights could also be employed. The main requirement is that the indicator be capable of separately indicating the results of at least three different tests, preferably simultaneously.

It is preferable to provide a resistor 16 for each LED 2, 4, 6 to control the LED current. For example, 470 Ohm resistors could be used.

The conductors within tester 50 establish current paths with the center conductor and shield of cable 34 so that, when plugs 33a, 33b of cable 34 are attached to an appropriate pair of connectors 14:

(a) LED 2 lights to indicate that the center conductor of cable 34 has continuity (i.e., is not open);

(b) LED 4 lights to indicate that the shield of cable 34 has continuity; and

(c) LED 6 only lights if there is a short circuit between the center conductor and the shield of cable 34.

The current flow paths for each LED 2, 4, 6 in the cable test mode are as follows. In order to test the center conductor of cable 34, current flows

from contact 22 of connector 14a, 14b, or 14c (depending on which connector the cable is connected) through path 40, LED 2, path 42, path 44, battery 20, path 46, contact 22' of connector 14a', 14b' or 14c', and the center conductor of cable 34. Unless there is a discontinuity in the center conductor, LED 2 will light. In order to test the shield of cable 34, current flows from contact 24, path 60, LED 4, path 62, battery 18, path 64, contact 24', and the shield of cable 34. Unless there is a discontinuity in the shield, LED 4 will light. When there is a short circuit between the center conductor and shield of cable 34, current flows from contact 22', path 46, battery 20, path 44, path 72, LED 6, path 70, path 64, contact 24', and between the center conductor and the shield of cable 34. Accordingly, LED 6 only lights when there is a short circuit.

Cables having no defects or damage can easily be recognized when both plugs of the cable are attached to the appropriate connector 14 of tester 50 because only LEDs 2 and 4 should be lighted. If either of LEDs 2 or 4 do not light, or if LED 6 does light, the precise defect in cable 34 will be known. This permits the cable to be repaired more easily. Additionally, no switches or buttons need to be activated. Accordingly, the potential for operator error is decreased.

In accordance with a further preferred embodiment of the invention, tester 50 is also operable in a diode check mode and in a continuity mode. Switch 32 is provided on tester 50 to switch between these two modes. Switch 32 can be any standard switch available, for example, a toggle switch. In accordance with a preferred embodiment of the invention, switch 32 has at least two positions 8 and 10. When switch 32 is in position 10, the diode check mode is selected. When in the diode check mode, a current path is formed through contact 12a (of a connector 12 which can be, for example, a banana connector), path 80, path 82, path 62, battery 18, path 64, path 84 and contact 12b. Accordingly, when a diode to be tested is plugged into connector 12, the test diode should light. Additionally, the

polarization of the test diode can be checked. The tested diode can then be used, for example, as one of the LEDs 2, 4, 6 in tester 50. This avoids the installation of LEDs in tester 50 that may be defective or polarized incorrectly.

Connectors other than banana connector 12 could be provided to test other types of lights, indicators or devices.

When switch 32 is in position 8, the continuity mode is selected. When in the continuity mode, a current path is formed through contact 12a, path 80, path 86, battery 20, path 44, path 72, LED 6, path 70, path 64, path 84 and contact 12b. A pair of probes 28 can be plugged into connector 12 to make electrical contact with respective contacts 12a, 12b. Probes 28 can then be used to test various items, paths, conductors, etc. for electrical continuity therethrough. If a circuit is completed between the tips of probes 28, LED 6 will light.

The provision of the diode check and continuity modes increases the versatility of tester 50, enabling a user thereof to carry less test equipment when checking electrical systems.

Tester 50 is capable of testing cables regardless of the position of switch 32. Thus, switch 32 only needs to be a two position switch. However, it is possible to provide a third position, between 8 and 10, for cable testing.

Although the illustrated embodiment tests cables having a center conductor and a shield, the present invention is applicable to any situation where two or more conductive elements (wires, shields, etc.) are provided in a cable.

While this invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, the preferred embodiments of the invention as set forth herein are intended to be illustrative, not limiting. Various changes may be made without departing from the spirit and scope of the invention as defined in the following claims.

# A DEVICE FOR TESTING CABLES

Abstract of the Disclosure

A device for testing current paths is attachable to a conductor. The device automatically checks the current paths of the conductor for continuity of a center conductor, continuity of a shield and a short circuit between the shield and the center conductor. The device includes a pair of connectors and a circuit to provide for testing of the conductive paths of the cable. The pair of connectors electrically connects the conductive paths of a cable to be tested with the circuit paths of the circuit. The circuit paths in the circuit include indicators to simultaneously indicate the results of the testing.

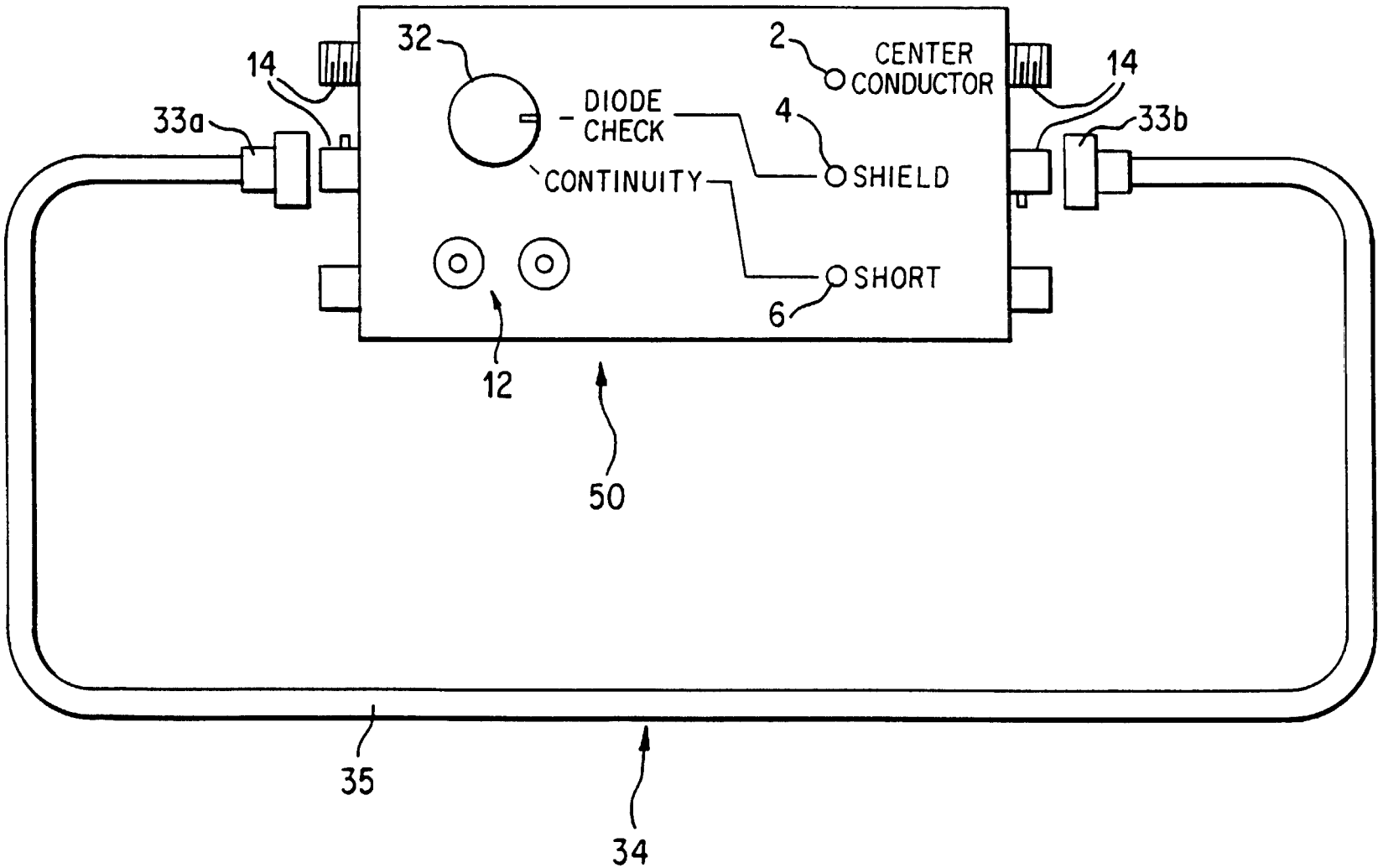
32
2
CENTER
CONDUCTOR
14
14
33a
33b
DIODE
CHECK
4
SHIELD
CONTINUITY
SHORT
6
12
50
35
34

FIG. 1

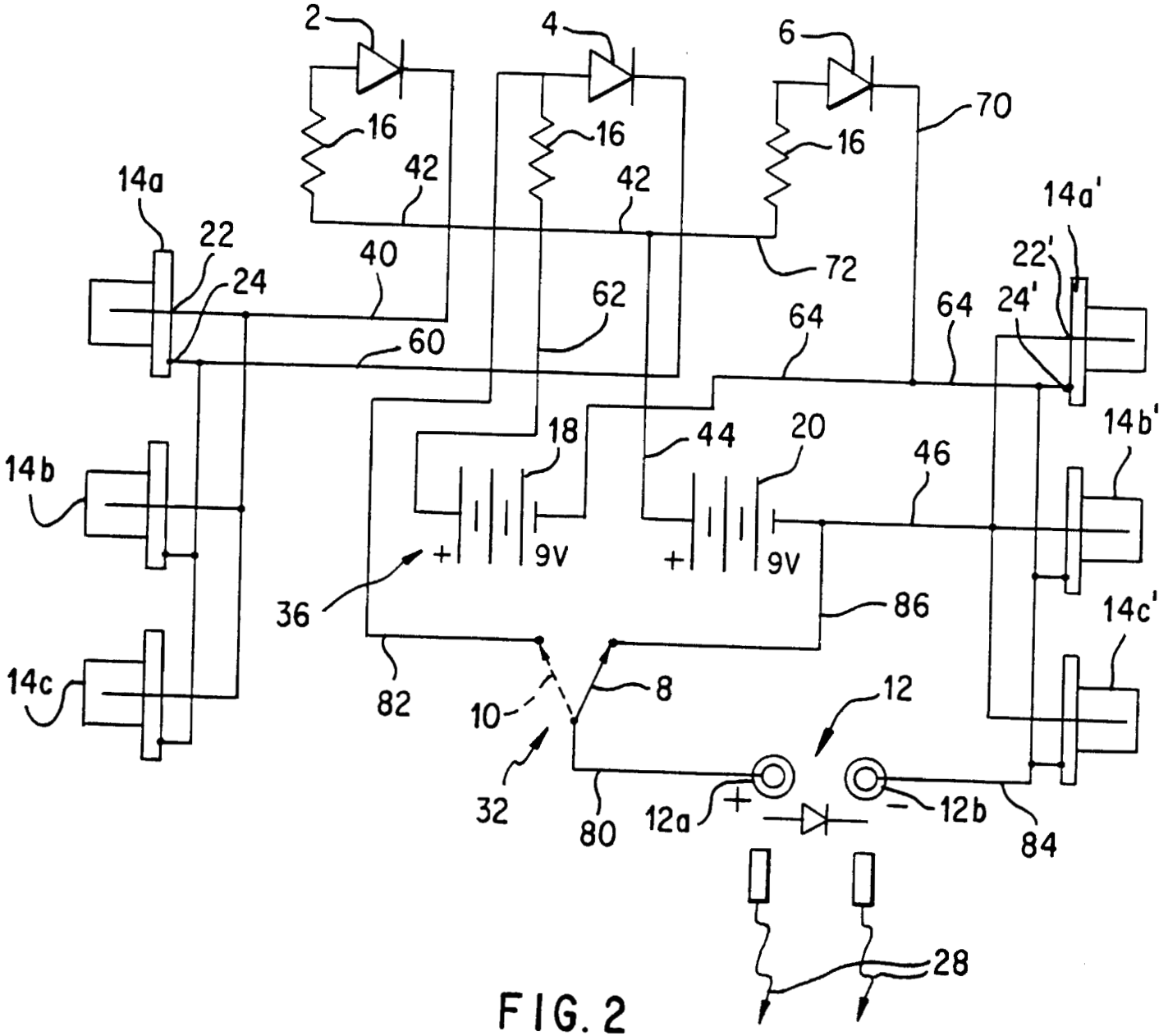
2
4
6
16
16
16
70
42
42
14a
22
24
40
72
14a'
22'
24'
62
64
64
60
18
44
20
46
14b
14b'
+
9V
+
9V
36
86
14c
14c'
82
10
8
12
32
80
12a
+
12b
84
28

FIG. 2