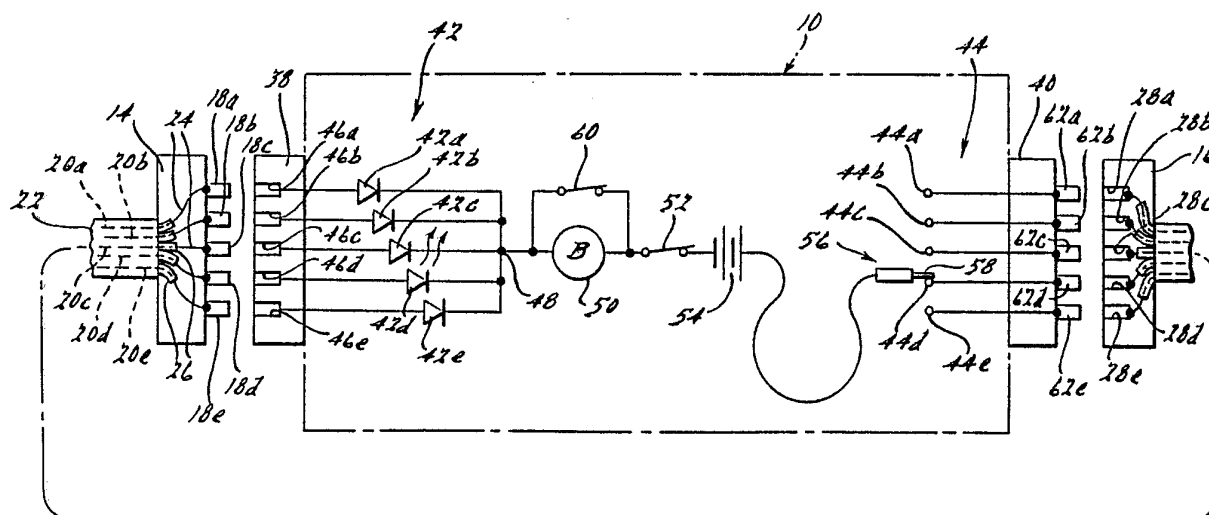




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 4 : G01R 31/02	A1	(11) International Publication Number: WO 87/ 07730 (43) International Publication Date: 17 December 1987 (17.12.87)
(21) International Application Number: PCT/US87/01180 (22) International Filing Date: 21 May 1987 (21.05.87) (31) Priority Application Number: 871,197 (32) Priority Date: 5 June 1986 (05.06.86) (33) Priority Country: US (71) Applicant: HUGHES AIRCRAFT COMPANY [US/US]; 7200 Hughes Terrace, Los Angeles, CA 90045-0066 (US). (72) Inventor: CALDWELL, Michael, P. ; 7541 Sale Avenue, Canoga Park, CA 91307 (US). (74) Agents: SALES, Michael, W. et al.; Hughes Aircraft Company, Post Office Box 45066, Building C1, M/S A-126, Los Angeles, CA 90045-0066 (US).		(81) Designated States: DE (European patent), FR (European patent), GB (European patent), JP, NO. Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: CABLE CONTINUITY CHECKER**(57) Abstract**

A fixture is provided for checking the continuity of a cable having wires running between terminals in two end connectors. The cable is designed so that a single path is provided by each wire and its associated terminals. The connectors are plugged into mating receptacles on the fixture which also includes an array of associated light emitting diodes and an array of pins. The user touches the stylus of a manually movable probe against each pin. Only the associated light emitting device will be energized if there is good continuity for a given path in the cable. Non energizing of the associated device or energizing any other device indicates a lack of continuity and the source thereof.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FR	France	ML	Mali
AU	Australia	GA	Gabon	MR	Mauritania
BB	Barbados	GB	United Kingdom	MW	Malawi
BE	Belgium	HU	Hungary	NL	Netherlands
BG	Bulgaria	IT	Italy	NO	Norway
BJ	Benin	JP	Japan	RO	Romania
BR	Brazil	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	LI	Liechtenstein	SN	Senegal
CH	Switzerland	LK	Sri Lanka	SU	Soviet Union
CM	Cameroon	LU	Luxembourg	TD	Chad
DE	Germany, Federal Republic of	MC	Monaco	TG	Togo
DK	Denmark	MG	Madagascar	US	United States of America
FI	Finland				

CABLE CONTINUITY CHECKER

1 BACKGROUND OF THE INVENTIONTechnical Field

5 This invention relates to equipment used for quality control purposes and, more particularly, to an apparatus for checking electrical cables.

Background

10 Electrical cables are used in a wide variety of different applications. Cables are generally characterized by a group of wires coupled at opposite ends to opposing connectors by terminals. The wires typically take the form of an electrically conductive flexible metallic core or rod which is wrapped in an insulating jacket. It is commonplace for a cable to have many
15 wires bound together in a flexible sleeve. Some cables can contain over 100 different wires. In many applications it is important that the integrity of each wire is maintained between a terminal on one connector and its associated terminal on the opposite connector.
20 In other words, there can only be one electrically conductive path between the two terminals in the opposite connectors. It can be appreciated that if continuity is not maintained then it is possible for signals to be erroneously transmitted over the cable to undesirable
25 destinations. In some cases, a wire may fray at the

1 connector and the frayed strands will make contact with
a nearby terminal. In other cases, the terminal does
not in fact make good contact at a connector. Sometimes,
heat generated in the wires will cause the insulation
5 to melt and wires become shorted. Of course, it is
also important that there are no broken wires in the
cable; otherwise, no signal at all will be delivered to
any destination. As a result, it has been general
practice to perform some type of quality control to
10 check the continuity of cables.

Cable continuity, meaning the presence of only
one uninterrupted electrical conductive path for each
wire and its associated terminals in the cable connec-
tors, is obviously a critical requirement.

15 Unfortunately, the testing of cable continuity
has been a time consuming and burdensome task and
therefore costly. One commonly used approach is for
quality control personnel to use a volt-ohm meter or
the like in which each terminal on one connector was
20 checked against every terminal in the opposite connector
to make sure that there is only one good signal path
for that given wire. Then, the user would go to the
next pin and check it against all of the pins in the
opposite connector. This process is continued for each
25 pin in the connector. Obviously such a technique can
be extremely time consuming especially where there are
a number of different wires in the cable.

SUMMARY OF THE INVENTION

30 Pursuant to the present invention, a fixture is
provided that enables the user to quickly and easily
check cables for proper continuity. The fixture in-
cludes two receptacles, one for each connector of the

1 cable. Means are provided for testing the continuity
of the wire terminal paths in the cable and providing
a visual output which is a function of the continuity
of each path. In the preferred embodiment, the fixture
5 includes a first array of light emitting devices and a
second array of pins which correspond to the wires in
the cable. A manually movable probe is used to touch
each pin. If there is continuity for the path then
only one associated light emitting device will be
10 energized. Non energizing of the associated device or
energizing any other device indicates a lack of continuity
and the source thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

15 The various advantages of the present invention
will become apparent to one skilled in the art by
reading the following specification and by reference to
the drawings in which:

FIG. 1 is a perspective view of a fixture made in
20 accordance with the teachings of the present invention;
and

FIG. 2 is an electrical schematic diagram of a
fixture of the type illustrated in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

25 Turning now to the drawings, a fixture 10 is pro-
vided for testing the continuity of a cable 12. Cable
12 includes a male connector 14 and a female connector
16. As best shown in FIG. 2, the male connector 14
30 includes a plurality of terminals such as pins 18(a-e)
which are connected to one end of wires 20(a-e) schemat-
ically illustrated by the dotted lines within flexible
sleeve 22. Each wire 20 consists of an electrically
conductive flexible core or rod 24 surrounded by an
35 insulating jacket 26 throughout much of its length.

11 The opposite ends of the wires 20 are connected to
respective terminals such as sockets 28(a-e) in female
connector 16. It should be noted that the number of
wires and configuration of the connectors can vary
5 considerably and have been greatly simplified in the
drawings to make the explanation of this invention
easier to understand.

Cable 12 is designed so that there is only one
electrical conductive path between associated terminals
100 in the connectors. For example, there should be only
one signal path between terminal pin 18d in connector
14 to terminal socket 18d in connector 16. If, however,
there is an electrical short between one or more of the
wires 20 then this can result in an undesirable "extra"
15 electrically conductive path through the cable for any
given wire. For example, this can result in a situation
where a signal applied to terminal 18d can "branch"
through the shorted wires and be delivered to two or
more of the terminals 28 whose wires have been shorted
20 together. The fixture 10 and method of using it accord-
ing to the present invention is designed to check for
these undesirable cable conditions, as well as for
broken wires.

The fixture 10 generally consists of a box-like
25 housing 30 having a major upper surface 32 and opposing
sides 34, 36. The fixture may be designed to be hand-
held. On one side a female receptacle 38 is located
for receiving male connector 14. (See FIG. 2) The
opposite housing side 36 has a male receptacle 40
30 mounted thereto for receiving female connector 16 as
seen in FIG. 1 as well as in FIG. 2.

Fixture 10 is provided with an array of light
emitting devices 42 such as light emitting diodes (LEDs)
that are preferably arranged in a given geometrical
35

1 pattern. There is one LED for each wire 20 and path in
the cable 12. Additionally, the array of LEDs may be
arranged in a geometrical pattern that corresponds with
the geometrical pattern of the terminals on connector
5 14. Suitable indicia such as the alphanumeric labels
shown in FIG. 1 are provided on the fixture to provide
the user with a correlation between each LED and its
associated connector terminal. Thus, the LED array in
FIG. 1 is shown in a rectangular pattern to correspond
10 with the rectangular pattern of male terminals 18 in
connector 14. A second array of electrically conductive
contacts in the form of pins 44 is provided adjacent to
the LED array; here, one pin 44 is located above an
associated LED 42 on housing surface 32.

15 Attention should now be drawn to the electrical
schematic diagram of FIG. 2. Receptacle 38 is provided
with a plurality of female sockets 46(a-e) for receiving
the male pins of connector 14. Each socket terminal is
electrically connected to the anode of one of the LEDs
20 42. Thus, there is a one-to-one relationship between
the LEDs, terminals in the connectors, the wires and
thus each path in the cable. The cathodes of all of
the LEDs are connected together at a common node 48.
Node 48 is connected in series with a buzzer 50, power
25 switch 52, battery 54 and a probe 56 having a stylus
58. Because LEDs are used, the power source may be
kept small, whereby the overall fixture size and shape
can be adapted for portability and for hand-holding. A
separate on/off switch 60 for the buzzer 50 is also
30 provided in this embodiment. Each of the pins 44 is
electrically connected in a one-to-one relationship
with the terminal pins 62(a-e) of receptacle 40.

1 The method of using fixture 10 will now be
described. The connectors 14 and 16 of the cable 12
are mated together with their respective receptacles 38
and 40. The power switch 52 is turned on and the user
5 may optionally elect to arm the buzzer by appropriately
moving switch 60. Then all the user needs to do is to
touch the probe stylus 58 to each pin 44. If there is
good continuity for a given path which provides a single
path between connector terminals then only the associated
10 LED 42 (the one below the pin 42 being touched) will be
energized. Otherwise, another LED will be lit or two
or more LEDs will be lit thereby indicating to the user
that there is a lack of continuity in that particular
path in the cable (e.g. that a short with the other
15 indicated wire or terminal has occurred). If no LED is
lit this means that there is a broken signal path
between connector terminals for that wire.

 With the probe stylus in the position illustrated
in FIG. 2 it can be appreciated that the fixture 10
20 completes an electric circuit between the opposite ends
of wire 20d. Beginning with terminal 18d of connector
core or rod 24 through the middle sheath portion 22 to
female terminal 28d in connector 16; then through
terminal pin 62d in receptacle 40 through pin 42d which
25 projects from the top surface 32 of the fixture 10.
The circuit then passes through the probe stylus 58 to
battery 54 then through switches 52 and 60 (which is
shown in FIG. 2 as shorting out buzzer 50 thereby
inactivating it) and then to node 48. From node 48 the
30 circuit is completed through LED 42d and terminal 46d
back to terminal 18d to which it is mated. Thus, it
can be seen that only one LED is lit when there is only
one electrically conductive circuit path between the one
terminal at one end of the wire and the other. Assume,

1 for example, that there is a short between wires 20d
and 20e, i.e., the electrically conductive rods of
these two wires are touching. Under these circumstances
there is established two current paths - through LEDs
5 42d and 42e - thereby lighting both of them. The user
can observe this phenomena when viewing the array of
LEDs and since each LED is associated with a given
wire it is possible for the user to detect which wires
are shorted together. Likewise, if there is a broken
10 wire then no LED will be energized because the wire
will fail to complete the necessary circuit for any
LED to be lit.

It can further be seen that in operation the
stylus can be rapidly moved from pin to pin and so long
15 as continuity is present for each path, only the one
associated LED for each pin will be lit. To the eye of
the tester, the pattern of LEDs will appear as a uni-
form line of LEDs being sequentially lit. A lack of
continuity will appear as a blatant irregularity
20 in the light pattern, providing a quick and inexpensive
cable continuity check. Further, by observing which of
the LEDs are lit, a user can readily deduce the probable
source and cause of the improper continuity condition.
The geometrical pattern for indicating proper/improper
25 continuity can be varied depending on the choice of the
designer. By inclusion of the LED's or other low power
visual display means, the power requirements for the
fixture may be kept low. As a result, the fixture may
be designed to be hand-held and portable so that the
30 test routine can be performed without elaborate or
expensive equipment.

1 From the foregoing description it can be appre-
ciated that the task of checking the continuity of
wires in cables has been made considerably easier by
way of this invention. All the user needs to do is to
5 plug in both ends of the cable to the fixture and
sequentially touch each of the pins 44 with the probe
stylus 58 while observing the LEDs 42 adjacent to the
pins on the fixture. Those skilled in the art can
appreciate that other advantages can be obtained from
10 the use of this invention and that modifications can be
made without departing from the true spirit of the
invention after studying the specification, drawings
and following claims.

15

20

25

30

35

CLAIMSWhat is Claimed is:

- 1 1. A method of testing for the continuity of a
cable having wires running between terminals in connec-
tors at opposite ends thereof, the cable being designed
so that a single path is provided by each wire and its
5 associated terminals in the connectors, said method
comprising:
 plugging the connectors into first and second
receptacles, respectively, in a test fixture;
 sequentially touching electrical contacts on
10 the fixture, said contacts associated with each path in
the cable; and
 providing a visual output that is a function
of the continuity of each path in the cable.
- 1 2. The method of Claim 1 wherein said fixture
includes a plurality of light emitting devices associated
with each contact and wherein only one associated light
emitting device will be lit if there is continuity for
the path being checked.
- 1 3. The method of Claim 2 wherein said fixture
includes an array of pins projecting from an upper sur-
face of a housing, said pin array being located adjacent
to an array of said light emitting devices and wherein
said method includes the steps of:
5 sequentially touching each pin in the array
with a manually movable probe; and
 observing the number and location of light
emitting devices that are energized.

1 4. A fixture for testing the continuity of a
cable having wires running between terminals in connec-
tors at opposite ends thereof, the cable being designed
so that a single path is provided by each wire and its
5 associated terminals in the connectors, said fixture
comprising:

 a housing having a main surface;
 a first receptacle on the housing for receiving
one of the connectors;
10 a second receptacle on the housing for
receiving the other connector;
 each receptacle having a plurality of electrical
terminals therein which mate with corresponding terminals
in the received connectors; and
15 means carried by the housing for testing the
continuity of each path in the cable, said means being
electrically coupled to the receptacles and providing a
visual output which is a function of the continuity of
each path.

1 5. The fixture of Claim 4 wherein said means
comprises circuit means coupled between the first and
second receptacles, said circuit means including a
plurality of light emitting devices, each device having
5 one end coupled to one of the terminals in said first
receptacle;

 said circuit means being adapted to energize
only the light emitting device for the path being tested
if there is continuity for the path being tested.

1 6. The fixture of Claim 5 which further includes
a plurality of contact members on the housing, each
contact member being connected to one of the terminals
in the second receptacle; and

5 said fixture further including manually
movable probe means having a stylus electrically
connected at one end to a node common to the opposite
ends of all of said light emitting devices;

 whereby the user can touch each contact member
10 with the stylus and observe the light emitting devices,
good continuity of each path being insured if only the
associated light emitting device is energized when the
probe stylus touches the associated contact member.

1 7. The fixture of Claim 6 wherein said light
emitting devices and contact members are arranged in a
geometrical pattern generally corresponding to the
pattern of terminals in the connectors; and wherein the
5 fixture further includes indicia on the housing to
provide visual correlation between the light emitting
devices and contact members and their respective termi-
nals to which they are associated whereby the user can
determine the probable source of any lack of continuity
10 when other than the one associated light emitting device
is energized.

1 8. A fixture for testing the continuity of a
cable having wires running between terminals in connec-
tors at opposite ends thereof, the cable being designed
so that a single path is provided by such wire and its
5 associated terminals in the connectors, said fixture
comprising:

 a box-like housing having an upper major
surface;

10 a first receptacle located on one side of the housing for receiving one of the cable connectors;

a second receptacle located on an opposite side of the housing for receiving the other cable connector;

155 each receptacle having a plurality of electrical terminals which mate with corresponding terminals in their respective connectors;

an array of light emitting devices arranged on said major surface in a geometrical pattern of the terminals in one connector;

20 indicia associated with each device to correlate each device with a given terminal in said one connector;

25 an array of pins projecting from said major surface of the housing adjacent to said light emitting devices;

a manually movable probe having a stylus adapted to permit a user to manually touch the stylus against each pin in the array;

30 said light emitting devices each having one of their ends each connected to one terminal in the first receptacle, the other ends of said light emitting devices all being coupled to a common node;

said common node being electrically connected through a battery to the probe stylus;

35 said pins each being coupled to a terminal in said second receptacle; and

40 whereby continuity for each path in the cable can be checked by the user touching each pin in the array, and observing light emitting devices which are energized, the energizing of the one associated light emitting device signifying good continuity for the path being tested.

1 9. The fixture of Claim 8 wherein the light
emitting devices comprise light emitting diodes.

1 10. The fixture of Claim 9 which further includes
an audible alarm.

1 11. The fixture of Claims 6 and 8 wherein the
light emitting devices are so arranged that during
rapid testing with the stylus, a lack of continuity
will blatantly appear.

1 12. The fixture of Claims 4 and 8 wherein said
fixture is adapted for low power operation whereby
the fixture may be hand-held and portable.

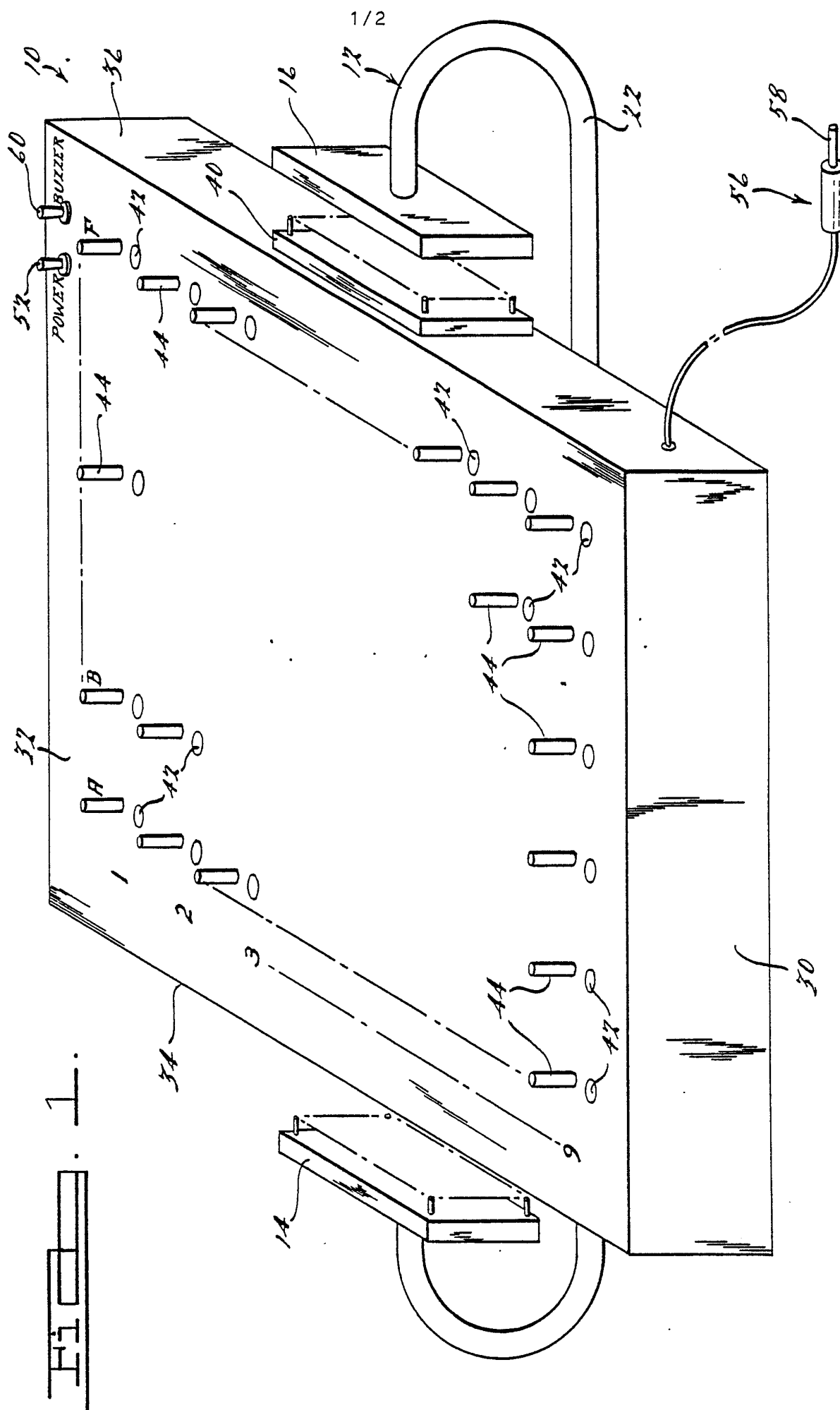
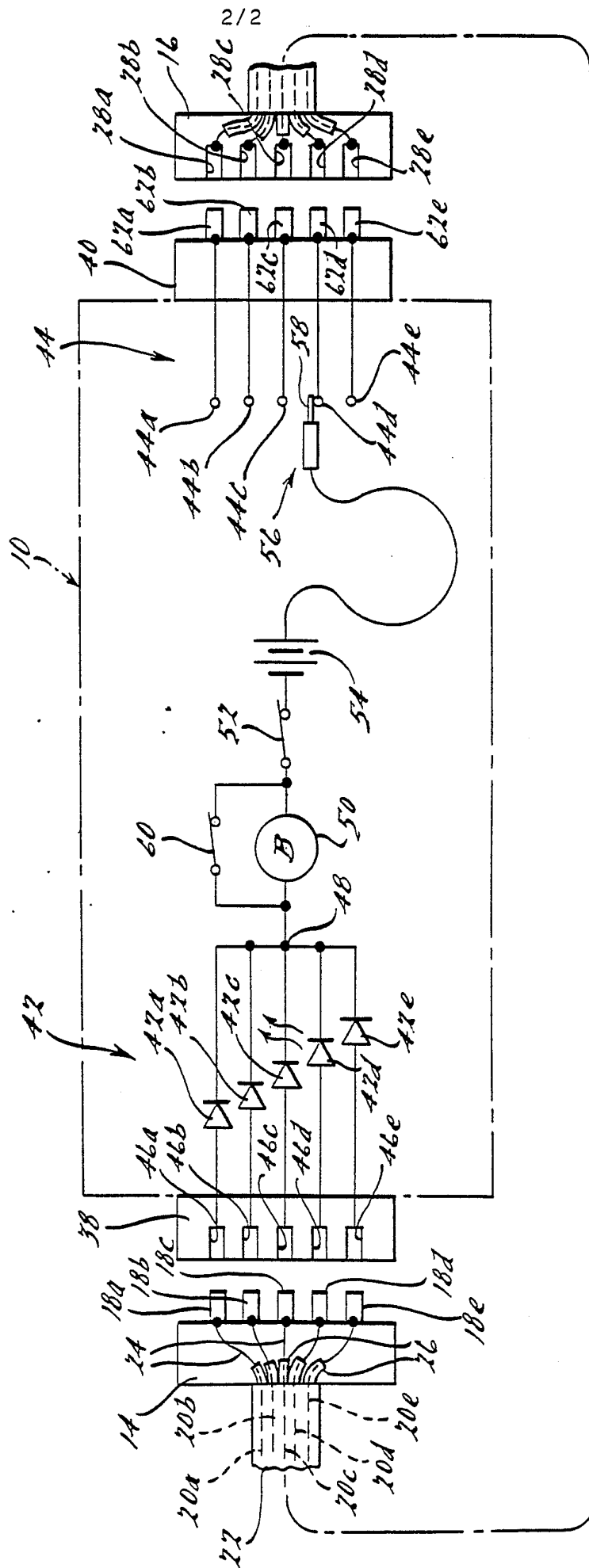


FIG. 2.



INTERNATIONAL SEARCH REPORT

International Application No PCT/US 87/01180

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC ⁴ : G 01 R 31/02																													
II. FIELDS SEARCHED Minimum Documentation Searched ⁷ <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%; border-bottom: 1px solid black;">Classification System</td> <td style="border-bottom: 1px solid black;">Classification Symbols</td> </tr> <tr> <td style="padding: 5px;">IPC⁴</td> <td style="padding: 5px;">G 01 R 31/00</td> </tr> </table> Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸			Classification System	Classification Symbols	IPC ⁴	G 01 R 31/00																							
Classification System	Classification Symbols																												
IPC ⁴	G 01 R 31/00																												
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹ <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Category ⁹</th> <th style="width: 70%;">Citation of Document, ¹¹ with Indication, where appropriate, of the relevant passages ¹²</th> <th style="width: 20%;">Relevant to Claim No. ¹³</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td style="vertical-align: top;">DE, A, 2448972 (KLIMMER) 29 April 1976 see page 1, lines 1-20; page 3, line 13 - page 4, line 9; figures 1-3</td> <td style="text-align: center; vertical-align: top;">1,4</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td style="text-align: center; vertical-align: top;">--</td> <td style="text-align: center; vertical-align: top;">2,5,7,12</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td style="vertical-align: top;">GB, A, 2022853 (P.D. TOULOUSE) 19 December 1979 see page 2, line 126 - page 3, line 9; figure 9</td> <td style="text-align: center; vertical-align: top;">1,4</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td style="vertical-align: top;">see page 1, lines 82-88</td> <td style="text-align: center; vertical-align: top;">2,6,7,9-11</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td style="vertical-align: top;">US, A, 2488556 (PARMENTER) 22 November 1949 see column 3, line 52 - column 4, line 45; figure 1</td> <td style="text-align: center; vertical-align: top;">3,7,8</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td style="vertical-align: top;">US, A, 4227146 (HODGE) 7 October 1980 see column 3, line 31 - column 4, line 10; figures 1,5,6</td> <td style="text-align: center; vertical-align: top;">4</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td style="text-align: center; vertical-align: top;">--</td> <td style="text-align: center; vertical-align: top;">5,7</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td style="vertical-align: top;">DE, A, 3216764 (LICENTIA) 10 November 1983 see page 6, line 22 - page 7, line 20;</td> <td style="text-align: center; vertical-align: top;">6</td> </tr> </tbody> </table>			Category ⁹	Citation of Document, ¹¹ with Indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	X	DE, A, 2448972 (KLIMMER) 29 April 1976 see page 1, lines 1-20; page 3, line 13 - page 4, line 9; figures 1-3	1,4	A	--	2,5,7,12	X	GB, A, 2022853 (P.D. TOULOUSE) 19 December 1979 see page 2, line 126 - page 3, line 9; figure 9	1,4	A	see page 1, lines 82-88	2,6,7,9-11	A	US, A, 2488556 (PARMENTER) 22 November 1949 see column 3, line 52 - column 4, line 45; figure 1	3,7,8	X	US, A, 4227146 (HODGE) 7 October 1980 see column 3, line 31 - column 4, line 10; figures 1,5,6	4	A	--	5,7	A	DE, A, 3216764 (LICENTIA) 10 November 1983 see page 6, line 22 - page 7, line 20;	6
Category ⁹	Citation of Document, ¹¹ with Indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³																											
X	DE, A, 2448972 (KLIMMER) 29 April 1976 see page 1, lines 1-20; page 3, line 13 - page 4, line 9; figures 1-3	1,4																											
A	--	2,5,7,12																											
X	GB, A, 2022853 (P.D. TOULOUSE) 19 December 1979 see page 2, line 126 - page 3, line 9; figure 9	1,4																											
A	see page 1, lines 82-88	2,6,7,9-11																											
A	US, A, 2488556 (PARMENTER) 22 November 1949 see column 3, line 52 - column 4, line 45; figure 1	3,7,8																											
X	US, A, 4227146 (HODGE) 7 October 1980 see column 3, line 31 - column 4, line 10; figures 1,5,6	4																											
A	--	5,7																											
A	DE, A, 3216764 (LICENTIA) 10 November 1983 see page 6, line 22 - page 7, line 20;	6																											
¹⁰ Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family																													
IV. CERTIFICATION <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black;">Date of the Actual Completion of the International Search</td> <td style="width: 50%; border-bottom: 1px solid black;">Date of Mailing of this International Search Report</td> </tr> <tr> <td style="padding: 5px;">19th August 1987</td> <td style="padding: 5px;">18 NOV 1987</td> </tr> <tr> <td style="border-bottom: 1px solid black;">International Searching Authority</td> <td style="border-bottom: 1px solid black;">Signature of Authorized Officer</td> </tr> <tr> <td style="padding: 5px;">EUROPEAN PATENT OFFICE</td> <td style="padding: 5px;">M. VAN MOL </td> </tr> </table>			Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	19th August 1987	18 NOV 1987	International Searching Authority	Signature of Authorized Officer	EUROPEAN PATENT OFFICE	M. VAN MOL																			
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report																												
19th August 1987	18 NOV 1987																												
International Searching Authority	Signature of Authorized Officer																												
EUROPEAN PATENT OFFICE	M. VAN MOL																												

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
	figures 1,2	
	--	
A	DE, A, 3423035 (PHILIPS) 9 January 1986 see page 3, line 16 - page 4, line 16; figure 1	8
	--	
A	US, A, 4429274 (HAMBLEN) 31 January 1984 see column 4, lines 52-56; column 5, lines 10-31; column 5, lines 60-64; figures 1,2,7	12

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO.

PCT/US 87/01180 (SA 17332)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 28/08/87

The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A- 2448972	29/04/76	None	
GB-A- 2022853	19/12/79	None	
US-A- 2488556		None	
US-A- 4227146	07/10/80	None	
DE-A- 3216764	10/11/83	None	
DE-A- 3423035	09/01/86	None	
US-A- 4429274	31/01/84.	None	

For more details about this annex :
see Official Journal of the European Patent Office, No. 12/82