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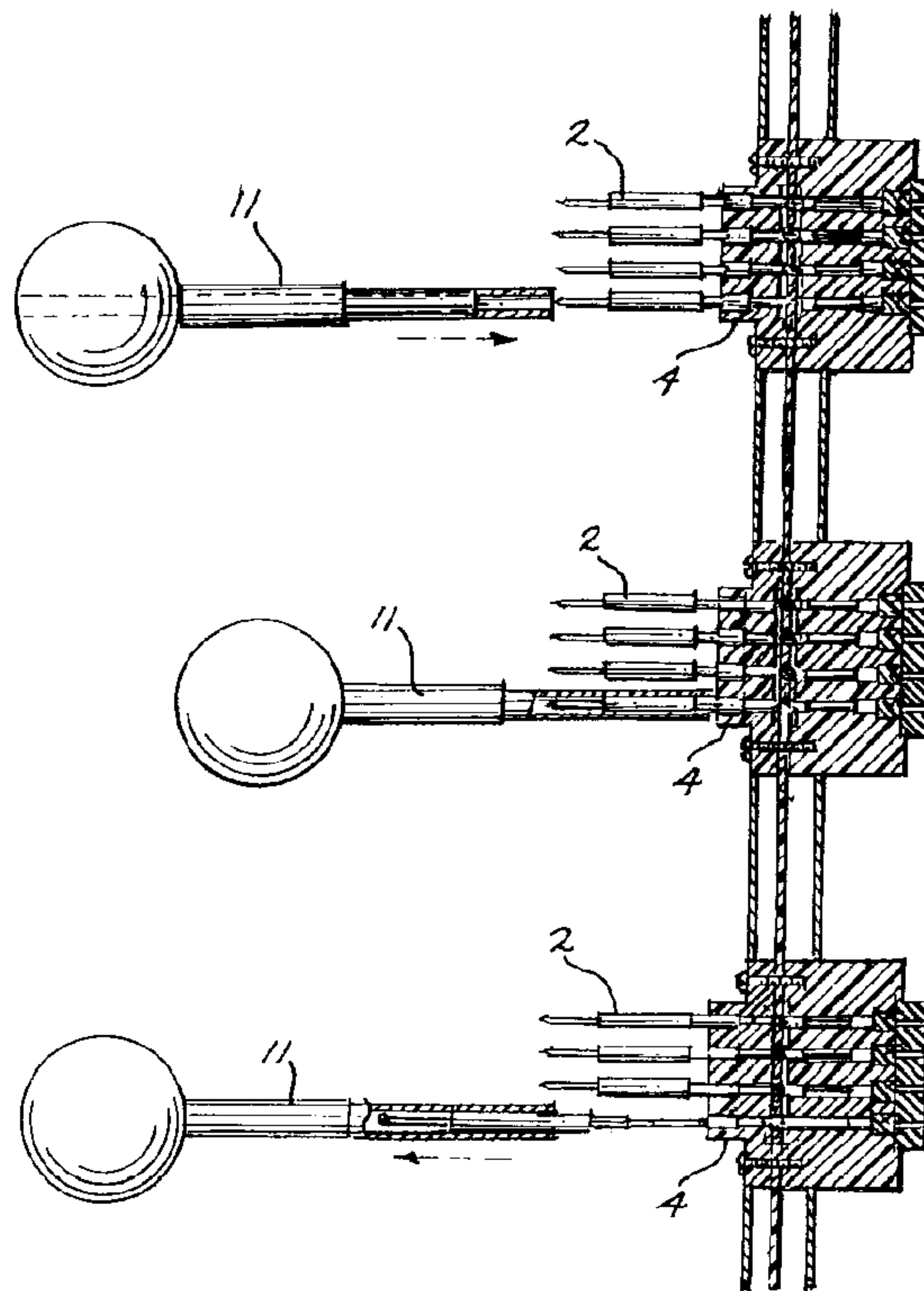
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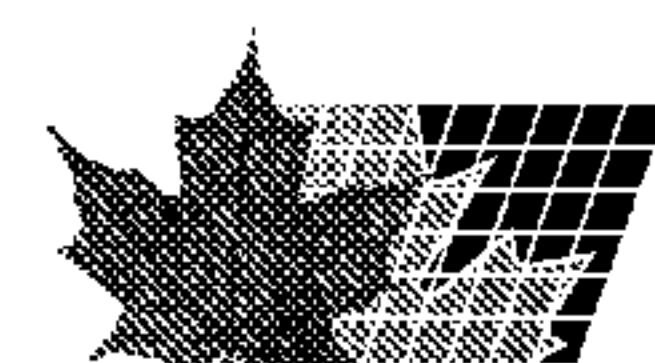
(54) Titre : SYSTEME POUR MODIFIER DES CONNEXIONS DE FILS IMPRIMEES APRES INSTALLATION

(54) Title: SYSTEM FOR MODIFYING PRINTED WIRING CONNECTIONS AFTER INSTALLATION



(57) Abrégé/Abstract:

A connector assembly mounted on a printed wiring board allowing modifications to be made to the connectivity using simple wiring techniques. The connector assembly contains special contacts providing three connections. One end of the contact mates with the source or destination of the signals in a modular electronic device. The other end accepts a wired contact for making additional connections not contained in the printed wiring board. The middle section of the contact makes a compliant connection to the printed wiring board. A signal can be disconnected from the printed wiring board by removing the contact and replacing it with a contact that is insulated from the printed wiring board.



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ABSTRACT OF THE DISCLOSURE

A connector assembly mounted on a printed wiring board allowing modifications to be made to the connectivity using simple wiring techniques. The connector assembly contains special contacts providing three connections. One end of the contact mates
5 with the source or destination of the signals in a modular electronic device. The other end accepts a wired contact for making additional connections not contained in the printed wiring board. The middle section of the contact makes a compliant connection to the printed wiring board. A signal can be disconnected from the printed wiring board by removing the contact and replacing it with a contact that is insulated from the printed
10 wiring board.

SYSTEM FOR MODIFYING PRINTED WIRING CONNECTIONS AFTER INSTALLATION

BACKGROUND OF THE INVENTION

Introduction

5 On airplanes, modular electronic devices are mounted on fixed shelves. The electronic connections between the modular electronic devices are made with interconnecting wire bundles. It has been shown that a printed wiring board (PWB) in place of the interconnecting wire bundles would save weight, space, and cost.

10 However, the airplane industry has a history of introducing modifications to electrical wiring in the field. Whereas changes to wire bundles can be made directly in the airplane, making changes (cuts and jumpers) to a PWB cannot. Therefore, PWBs have not replaced wire bundles.

Background

15 Traditionally, the connections between modular electronic devices on commercial airplanes have been made with wire bundles. It has been shown that in cases where a series of modular electronic devices are mounted on fixed shelves, a printed wiring board in place of the interconnecting wire bundles would save weight, save space and cost less to produce.

20 The airplane industry has a history of introducing modifications to electrical wiring in the field. Airlines perceive changes to printed wiring boards using conventional methods as an obstacle to their use. The confines of the electronics bay of

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a commercial airplane do not allow the kind of precision work needed for making PWB modifications. The soldering irons needed for adding jumpers is considered hazardous in the flightline environment where fuel vapors are sometimes present.

Printed wiring boards in combination with wire wrap technology has been
5 proposed as an alternative to pure printed circuits. While this solution offered a good way of adding jumpers, it did not offer practical advantages for making cuts. Wire wrap has also been viewed with disfavor due to its susceptibility to foreign object contamination.

Problem Solved by the Present Invention

10 Once a device with a printed wiring board is designed and built, it is difficult or impossible to change the connectivity of the wiring board in the field in the end product. Making changes to printed wiring boards has traditionally been done by adding "cuts" and "jumpers" to the board. The cut and jumper work is typically only performed in special repair facilities by specially trained technicians using specialized tools. The
15 "cuts" are made by drilling or scraping away the copper trace where the connection is no longer desired. The operation often requires precision in locating the proper trace. The "jumpers" are added by soldering the ends of an insulated wire to the points where a new connection is desired.

The present invention allows changes in connectivity to be introduced to a
20 device using only the tools, skills and materials that would be familiar to a mechanic

with a background working with wire bundles. Further, the modifications can be done where the printed wiring board is installed instead of a repair facility.

BRIEF SUMMARY OF THE INVENTION

5 The present invention enables the use of PWBs to replace interconnecting wire bundles. Therefore, changes in connectivity may be introduced using only tools, skills, and materials familiar to the mechanic instead of the requirement of a repair facility.

10 A novel connector assembly is hereinafter described. The present connector assembly contains special contact providing three connections. The front end of the contact mates with the connector for a modular electronic device. The rear end can accept a wired contact for making additional connections not contained in the PWB. The middle section of the contact makes a compliant connection to the board. Additionally, a signal can be disconnected from the PWB by removing the contact and replacing it with a contact that is insulated from the PWB. Thus, the present
15 invention allows the opening of an existing connection, adding a connection, or replacing a connection.

A hereinafter described embodiment of the present invention comprises a connector with a double ended pin contact with compliant section, a double ended pin contact with an insulated section, and the flexibility of adding connecting wires to any
20 contact in the connector using a rear insert.

In accordance with one aspect of the invention, there is provided, in a system for modifying printed wiring connections after installation, a connector assembly mounted on a printed wiring board. The connector assembly has elongated contacts with two pin sections on the respective ends thereof. A first end mates with a source

or destination of signals on a device that mates with the connector and a second end accepts wired contacts for making additional connections not contained in the printed wiring board.

5 In accordance with another aspect of the invention, there is provided, in a system for modifying printed wiring connections after installation, a double ended connector pin contact having a compliant section for making electrical contact between a device which mates with the connector and a plated hole in a printed wiring board.

10 In accordance with another aspect of the invention, there is provided, in a system for modifying printed wiring connections after installation, a double ended connector pin contact having an insulated section for electrically isolating a signal on the contact from a plated hole in a printed wiring board. The contact extends through the plated hole to form a further contact for providing a connection made for wires added in a connection modification.

15 In accordance with another aspect of the invention, there is provided a system for modifying the electrical connections of a connector mounted on a printed wiring board wherein the connector assembly uses removable, double ended contacts featuring a solderless, compliant connection to the printed wiring board and features ends that will mate with conventional connector contacts and held in place by the
20 connector inserts that form mating areas for connectors or wire contacts.

In accordance with another aspect of the invention, there is provided a system for modifying the electrical connections of a connector mounted on a printed wiring board wherein the connector assembly uses removable, double ended contacts that are electrically insulated from the printed wiring board and features ends that will

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mate with conventional connector contacts and held in place by the connector inserts that form mating areas for connectors or wire contacts.

5 The double ended contacts can be individually removed from one side of the connector assembly and this may be done after partially disassembling a retention insert.

A portion of the retention insert may double as a mass insertion tool for pressing individual or multiple compliant contacts into the plated through holes of the printed wiring board.

10 A portion of the retention insert may prevent undesired movement of a retained contact when engagement of a miss-aligned mating contact is attempted.

A rear insert may accept and retain wire contacts that mate with one end of the double ended contacts.

Prior Art Patent Literature

15 **Harting et al., U.S. Patent No. 5,509,823 – “Electrical Mating Connector”**
This patent relates to a shielding technique for a connector.

Fiori et al., U.S. Patent No. 5,312,265 – “Electrical Connector Suitable for Use With Variable Numbers of Electrical Conductors”
This patent relates to a way of keeping a connector sealed from moisture or other contaminants even with empty contact locations.

20 **Yoshino, U.S. Patent No. 5,334,341 “Connector Having Electromagnetic Shielding Film”**
This patent relates to a manner of providing shielding around each individual contact of a connector to prevent crosstalk between pins.

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Benasutti, U.S. Patent No. 4,530,551 "Circuit Change Pin for Printed Wiring Board"

This patent proposes a change to a printed circuit backplane using an elongated connector contact that is insulated from the printed wiring board plated through hole.

5 The contact is in two pieces. It appears that the two-piece contact would require access to both sides of the printed circuit board. The present invention provides a one-piece contact that can be installed with access to only one side of the board.

Zaderej, U.S. Patent No. 5,127,949 "Plated Electrical Connectors"

This patent involves forming electrical connectors as an integral part of the manufacture of a printed wiring board.

5 **Paulas, U.S. Patent No. 5,257,949 "Connector with Interchangeable Contacts"**

This patent covers a sophisticated type of filter connector with provisions for different types of filter contacts and transient suppression contacts.

10 **Marolda, U.S. Patent No. 4,909,751 "Underwater Mateable Electrical Connector"**

This patent covers an electrical connector that can be mated while it is submerged in water.

15 **Marolda, U.S. Patent No. 4,874,326 "Elastomeric Electrical Isolation Membrane"**

This patent relates to an underwater connector.

20 **Benasutti, U.S. Patent No. 4,418,326 "Electrical Connector for Printed Wiring Board"**

This patent covers a soldered connector that can be disassembled to allow cleaning and replacement of damaged contacts.

BRIEF DESCRIPTION OF THE DRAWINGS

25 Fig. 1 is a cut-away view of a preferred embodiment of the present system for modifying printed wiring connectors;

Fig. 2 is illustrative of the present system with the connector shell and connector insert removed and illustrates the sequence of removing the double-ended connector pin contact hereinafter described; and

Fig. 3 is illustrative of a replaced connection.

5 DETAILED DESCRIPTION OF THE INVENTION

The printed wiring board 1 contains copper traces that carry electrical signals between the plated through holes. The plated through holes are where electrical connections are made between the traces and connector contacts.

10 The double-ended connector pin contact with compliant section 2 makes an electrical connection between the device that mates with the connector and the plated through hole in the printed wiring board. The contact is not soldered in place. Prior to insertion, the diameter of the compliant section is larger than the diameter of the plated through hole. When the contact is installed, the compliant section is under compression in the plated through hole creating a physical, gas tight, electrical connection to the
15 plated through hole. The contact extends through the plated through hole to form a second mating interface on the far side of the printed wiring board. The end of the contact on the far side of the printed wiring board is used as a connection node for wires added as part of a connection modification.

20 The double-ended connector pin contact with insulated section 3 electrically isolates the contact from the plated through hole in the printed wiring board 1. The contact has, in place of a compliant section, an insulated sleeve that prevents electrical

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conduction with the plated through hole. The contact extends through the plated through hole to form a second mating interface on the far side of the printed wiring board. The end of the contact on the far side of the printed wiring board is used as a connection node for wires added as part of a connection modification.

5 The bottom insert 4 and the connector insert 7 and the contacts 2 and 3 are installed as an assembly into the printed wiring board. The bottom insert 4 and the connector insert 7 captures the contacts as an insert set. The bottom insert 4 prevents the contacts from being forced through the printed wiring board by a miss-aligned mating contact.

10 The connector insert 7 holds the double-ended connector pin contact in place and it is also used as a mass insertion tool. Force applied by a press to the front of the insert is transferred to the contacts through the insert and forces the compliant sections into the plated through holes.

 The rear insert 5 captivates the mating socket contact of a jumper wire that
15 connects to the extended portion of the double-ended connector pin contact.

 The rubber grommet 6 (part of the rear insert) provides wire support and some protection of the contact area inside the rear insert from foreign objects and moisture.

 The connector shell 8 (mounting fasteners are not shown) captivates the connector insert and provides the rugged mechanical interface required to interface to a
20 modular electronic device.

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The front housing 9 and the rear housing 10 are metal covers that protect the assembly from foreign objects and provide additional stiffness to the assembly.

Opening a Connection

Remove fasteners (not shown) from the connector shell 8 and remove the shell.

- 5 Slide the connector insert 7 off of the double-ended connector pin contacts 2. Figure 2 shows the system with the connector shell and connector insert removed. It illustrates the sequence of removing a double-ended connector pin contact 2 described next.

Slide the hollow shaft of the contact removal tool 11 over the end of the double-ended connector pin contact.

- 10 The contact removal tool 11 grabs the ledge of the largest diameter of the contact such that when a force is applied to the tool away from the printed wiring board the contact is extracted from the printed wiring board. Remove the contact from the contact removal tool by pushing the contact further into the shaft until it falls out the other end of the shaft near the handle.

- 15 Slide the connector insert 7 over the double-ended connector contacts 2 that remain installed. Fasten the connector shell over the connector insert.

Adding a Connection:

- Prepare a wire of sufficient length terminated to a MIL-C-39029 or similar socket contact. Using a MIL-I-81969 or similar wire insertion tool, insert one end of
- 20 the prepared wire through the rubber grommet 6 of the rear insert 5 at the location of the contact carrying the desired signal. Using the same insertion tool, insert the other

end of the prepared wire through the rubber grommet of the rear insert at the location of the contact that is to receive the signal.

Replacing a Connection:

There are often cases where a signal must be disconnected from the plated
5 through hole on the printed wiring board but a connection must also be added. In this case the following steps are used:

Remove fasteners (not shown) from the connector shell 8 and remove the shell.
Slide the connector insert 7 off of the double-ended connector pin contacts 2. Slide the hollow shaft of the contact removal tool 11 over the end of the double-ended connector
10 pin contact 2. Pull the tool back away from the printed wiring board thereby removing the contact as described in *Opening a Connection* and as shown in Fig. 2. In place of the removed contact, install a double-ended connector pin contact with insulated section 3. The contact will slide into place. Slide the connector insert over the double-ended connector pin contacts. Fasten the connector shell over the connector insert. Add a
15 connection with a wire as described in *Adding a Connection*.

Figure 3 illustrates one example of a replaced connection. A short length of insulated wire 12 installed on the rear insert 5 makes a connection between a contact 13 isolated from the board and another contact 14.

Modifying connections using the aforementioned system accomplishes what cuts
20 and jumpers accomplish in conventional printed wiring board systems except it:

- Does not require precision removal of conductive material;

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- Does not require soldering devices and drills; and
- Uses the type of tools and techniques currently in use in field service of airplanes.

Unique features of the present invention include:

- 5
- Connector contacts that can be removed with minor disassembly of the connector;
 - A double-ended connector pin contact having a compliant section;
 - A double-ended connector pin contact having an insulated section;
- and
- 10
- Connecting wires can be added to any signal carried in the connector using the rear insert.

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CLAIMS

1. In combination in a system for modifying printed wiring connections after installation:

5 a connector assembly mounted on a printed wiring board, said connector assembly having elongated contacts with two pin sections on the respective ends thereof, a first end mating with a source or destination of signals on a device that mates with the connector and a second end accepting wired contacts for making additional connections not contained in said printed wiring board.

10 2. In combination in a system for modifying printed wiring connections after installation:

a double ended connector pin contact having a compliant section for making electrical contact between a device which mates with the connector and a plated hole in a printed wiring board.

15

3. In combination in a system for modifying printed wiring connections after installation:

a double ended connector pin contact having an insulated section for electrically isolating a signal on the contact from a plated hole in a printed wiring board, said
20 contact extending through said plated hole to form a further contact for providing a connection made for wires added in a connection modification.

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4. A system for modifying the electrical connections of a connector mounted on a printed wiring board wherein the connector assembly uses removable, double ended contacts featuring a solderless, compliant connection to the printed wiring board and features ends that will mate with conventional connector contacts and held in place by the connector inserts that form mating areas for connectors or wire contacts.

5. A system for modifying the electrical connections of a connector mounted on a printed wiring board wherein the connector assembly uses removable, double ended contacts that are electrically insulated from the printed wiring board and features ends that will mate with conventional connector contacts and held in place by the connector inserts that form mating areas for connectors or wire contacts.

6. A system for modifying the electrical connections of a connector mounted on a printed wiring board as defined in claims 4 and 5 wherein said double ended contacts can be individually removed from one side of said connector assembly.

7. A system for modifying the electrical connections of a connector mounted on a printed wiring board as defined in claim 6 wherein said double ended contacts can be individually removed from one side of said connector assembly after partially disassembling a retention insert.

8. A system for modifying the electrical connections of a connector mounted on a printed wiring board as defined in claim 7 wherein a portion of said retention insert doubles as a mass insertion tool for pressing individual or multiple said compliant contacts into the plated through holes of said printed wiring board.

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9. A system for modifying the electrical connections of a connector mounted on a printed wiring board as defined in claim 7 wherein a portion of said retention insert prevents undesired movement of a retained contact when engagement of a miss-aligned mating contact is attempted.

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10. A system for modifying the electrical connections of a connector mounted on a printed wiring board as defined in claims 4 and 5 wherein a rear insert accepts and retains wire contacts that mate with one end of said double ended contacts.

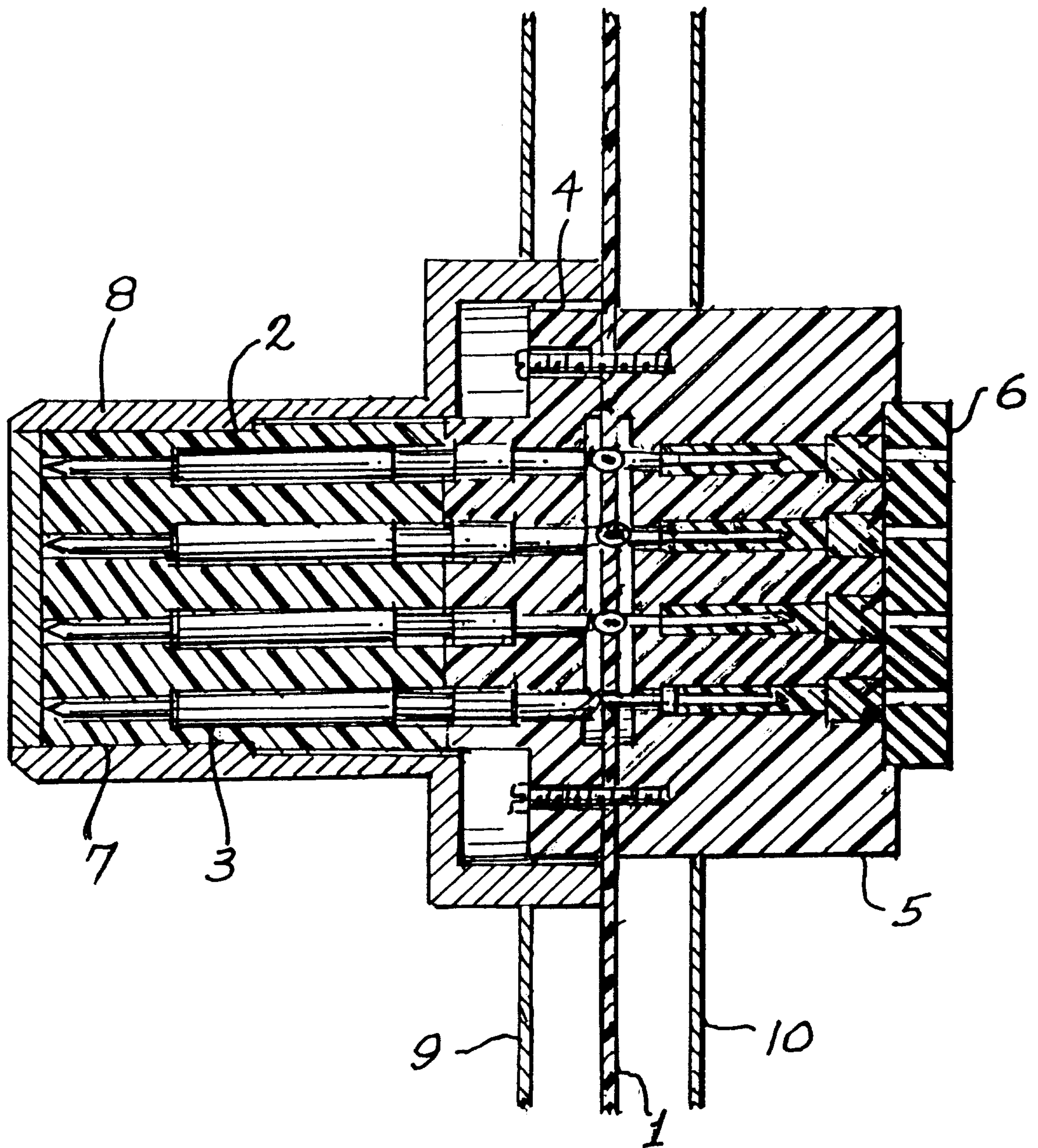


Fig. 1.

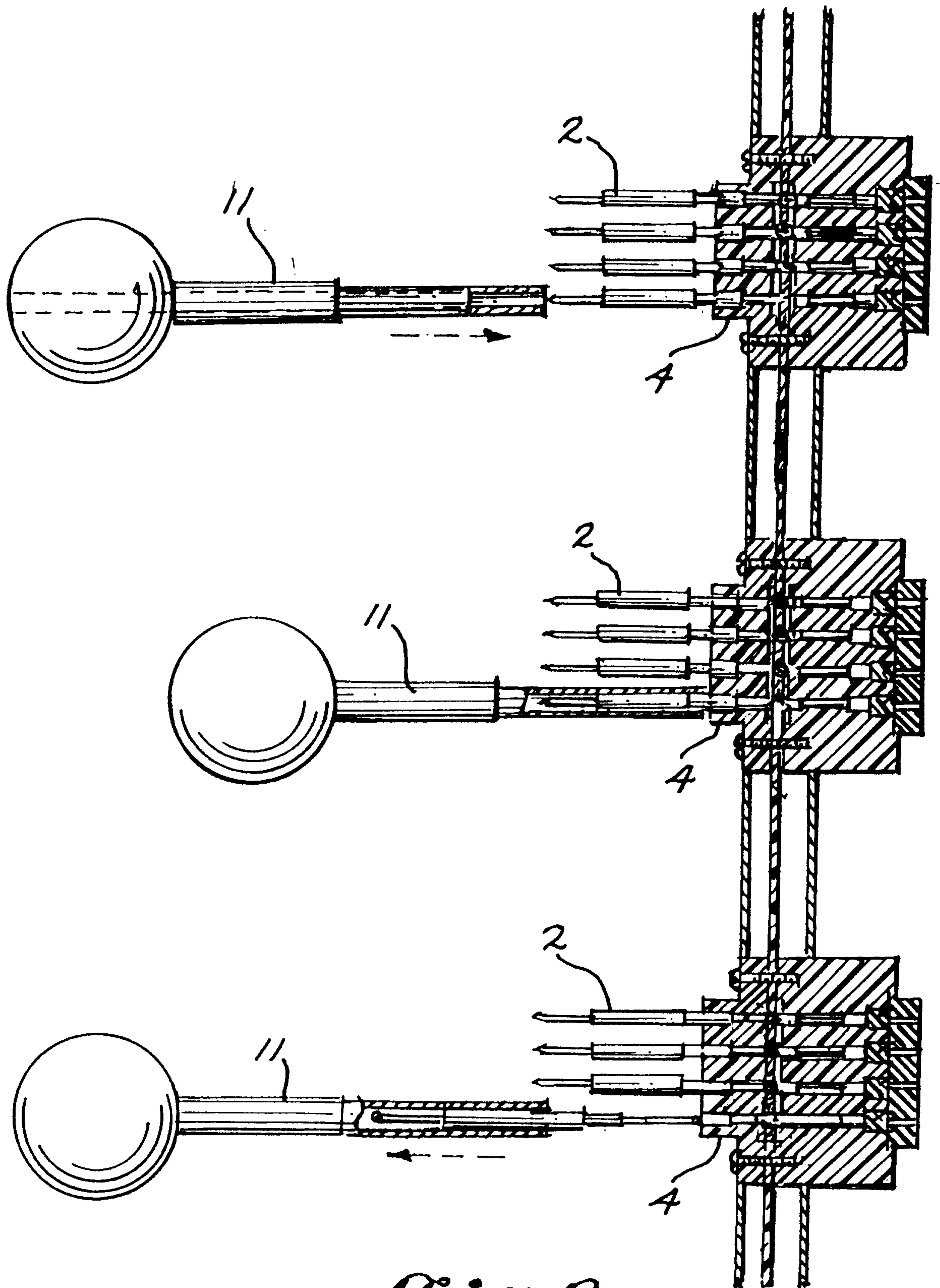


Fig. 2.

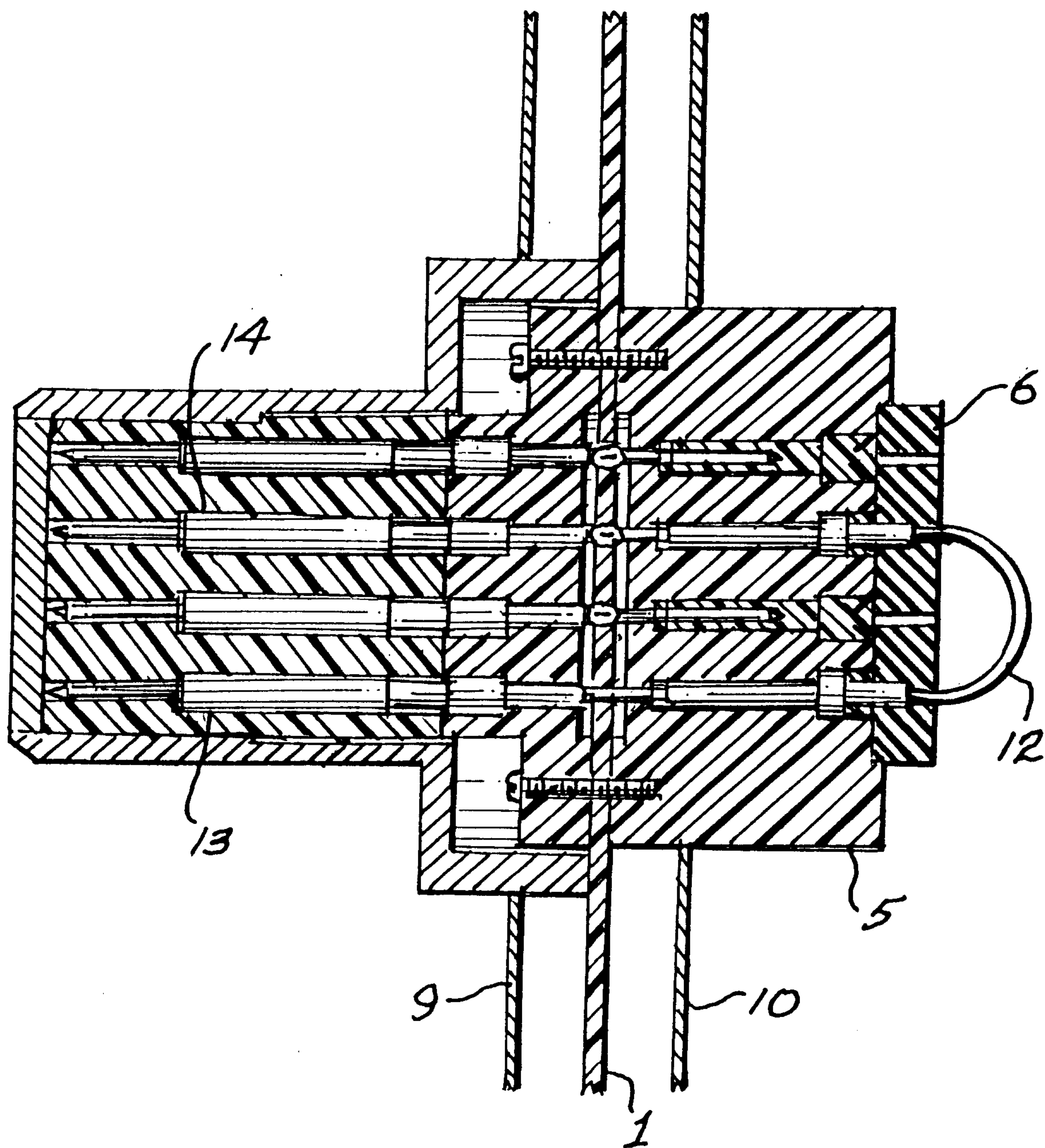


Fig. 3.

