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(54) **A system protecting electric equipment against disconnection from the power supply network**

System zum Schutz eines elektrischen Geräts vor der Trennung von einem Stromversorgungsnetzwerk

Système protégeant un équipement électrique contre la déconnexion du réseau d'alimentation électrique

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EP 2 551 967 B1

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Description

[0001] The invention relates to a system for protecting electric equipment against an arc occurring between contacts of a socket and a plug during disconnection from the power supply network, applicable to household and/or office electronic equipment supplied from a common central AC/DC power supply unit.

[0002] At present, most electric installations are supplied from a 230V AC source. However, all electronic equipment is powered by direct current and therefore it is equipped with systems that convert 230V alternating voltage to *any* direct voltage, *and* most often to one of the following: 3.3V, 5V, 12V, 24V or 48V. There are known electric installations in which, parallel with the standard AC supply, a low-voltage DC power supply is distributed, which is generated from a central AC/DC power supply unit. This eliminates the need to install additional AC/DC power supply units in electronic equipment.

Patent description US2007/0029879 describes a distribution network for buildings that comprises a central universal DC supply unit. The presented patent description has revealed two solutions for supplying electric installations with direct current in buildings. The first solution uses a central DC power supply unit connected to a standard AC network. Direct current is distributed to universal sockets through bundles of wires which contain current-carrying wires and communication wires. The other solution contains additionally a DC converter which is installed in the socket. Additionally sockets can have a LED indicator, a cable-winding mechanism, a fan.

[0003] A problem with low-voltage installations is the large value of current which is to be transmitted through the wires, as the electric power used by equipment is the quotient of voltage and current:

$$P = U * I,$$

where: U - voltage value

I - current value.

[0004] In a low voltage DC line, e.g. 24V or 48V, used to supply household equipment, current flowing through the wires can reach values from a few to almost twenty amperes. At such values of the current, if an operating piece of equipment, that is one connected to the electric installation, is disconnected from that installation, problems arise because during disconnection an electric arc is generated between the supply socket and the plug. Due to the direct current supply this arc is not self-suppressed as is the case with AC power supply. That is the reason why there is a need to protect electric equipment which is connected to a supply network and which is supplied with direct current against its disconnection during its operation.

[0005] There is known from patent description

US7614893B2 a device and method which generate an early warning disconnection signal from an electrical connector supplying external power to a connected device. The connected device includes an early warning disconnect power management circuit, optional to generate power consumption control information in response to generation of the early warning disconnect signal from the electrical connector. In one example the electrical connector includes a lock release mechanism and a signaling mechanism, the signaling mechanism is operationally coupled with the lock release mechanism and configured to generate the early warning disconnect signal from the electrical connector to the connected device prior to the lock release mechanism being in an unlocked state. The presented solution has limited usability in case of connecting ordinary equipment which has not unit called "disconnected power management circuit" as well as a battery. Additionally there is no easy way to add "disconnected power management circuit" into ordinary equipment, because it requires integration inside equipment or use separate device which will provide the functionality of "disconnected power management circuit" .

[0006] From US4398230 patent description there is known an electrical connector which automatically protects against accidental disconnection. The electrical connector is formed from a plug and base which are capable of being integrated by a fixation device to provide from the cooperation of contact terminals within insulating bodies each of which has at least one passage for at least one lead for connection to one of the contact terminals. The fixation device is associated with a locking device which is adapted to receive an unlocking order only when a detection device does not detect the presence of any current in at least one of the leads. The described solution is based on measuring current which is conducting through leads, the locking device is unlocking only when a detection device does not detect the presence of any current in at least one of the leads, it means user cannot disconnect device when he uses device without power on/off switch or in case of emergency situation, in this case electrical arc can occur between contacts.

[0007] Next the patent description US2009051226A1 describes a power unit which includes a plurality of series-connected battery modules and a safety circuit. A service plug is inserted from the side of a terminal board of a battery pack, thereby establishing an electrical connection among battery modules. A connector is provided on a back of a terminal cover by way of a projecting section, and a second safety switch is activated by attachment of a terminal cover and insertion of the connector to the terminal board, thereby establishing an electrical connection among the battery modules. Even when the service plug is attached at the time of completion of maintenance without attachment of terminal cover, the battery modules are still kept in an unconnected state by means of a second switch, and energization, which would otherwise arise with exposed terminals, is prevented. The solution is mainly dedicated for application with battery

modules and cannot be easily used in other environment. Additionally this solution requires to use separate service plug which opens and closes a connection among battery modules.

[0008] US 6,683,766 patent description discloses a DC arc detection and prevention circuit where an imminent arc is detected by a sudden drop in current and the power supply is disconnected for a determined period of time. The essence of the system according to the invention, which system comprises an AC supply source electrically connected with a central AC/DC power supply unit, the power supply unit being fitted with at least one output for electric wires for transmitting direct current of different voltage values, the system being furnished with at least one plug-in socket for plugging into it household receivers supplied with direct current, is that it comprises a disconnecting module which is connected into the system between the central AC/DC power supply unit and the contacts of the plug-in socket. The plug-in socket is provided with a monitoring system for detecting an insertion of and an attempt to remove the plug from the plug-in socket and for sending a signal indicative of said insertion of or attempt to remove the plug to the disconnecting module. The disconnecting module is configured for turning on the current that supplies the electric equipment if an insertion of the plug has been detected and turning off the current that supplies the electric equipment if an attempt to remove the plug has been detected. The monitoring system has a form of a coil with a magnetic core. The magnetic core is in the form of a pin of the plug. Preferably, the disconnecting module is situated in the plug-in socket.

[0009] Alternatively, the disconnecting module is situated near the central AC/DC power supply unit and outside the plug-in socket.

[0010] Preferably, the disconnecting module is connected with the monitoring system through communication modules, of which one is located in the plug-in socket and the other near the disconnecting module outside the plug-in module.

[0011] Preferably, the disconnecting module, one of the communication modules and the central AC/DC power supply unit are located in the same casing.

Fig. 1 and fig. 2 show systems for protecting electric equipment against an arc occurring between contacts of a socket and a plug during disconnection from a power supply network;

Fig. 3 shows an example of a schematic of the monitoring system from fig. 1 and fig. 2;

Fig. 4 shows a schematic of the monitoring system from fig. 1 and fig. 2 in embodiments of the invention;

Fig. 5 shows a schematic of a mechanical plug block.

[0012] The system for protecting electric equipment

against an arc occurring between contacts of a socket and a plug during disconnection from a power supply network comprises an AC/DC unit 1 supplied from an alternating current

5 source whose at least one output, only one output being indicated in the drawing, is connected through electric wires 2, a disconnecting module 3, contacts 4 with an electric or electronic receiver 5 requiring a DC power supply and fitted with a plug 6. The disconnecting module 3 is also electrically connected with the contacts 4 through a monitoring system 7 for monitoring an insertion/a removal of the plug 6 from the plug-in socket and for sending a signal indicative of said insertion/removal to the disconnecting module 3 for turning on current that supply equipment if the insertion has been monitored or turning off the current if removal has been detected. The monitoring system 7 is connected to the contacts 4 and to the disconnecting module 3 by signal wires 8. The monitoring system 7 is furnished with measuring elements, which is not shown in the drawing.

[0013] In the first system presented in fig. 1, the disconnecting module 3, the contacts 4 and the monitoring system 7 are located in a common plug-in socket 9a.

[0014] In the second system presented in fig. 2, the disconnecting module 3 is located outside a contact socket 9b in which, besides the contacts 4 and the monitoring system 7, a first communication module 10a is located. The first communication module 10a communicates with a second communication module 10b which in turn is connected electrically with the disconnecting module 3. In this system, the central AC/DC power supply unit 1, the disconnecting module 3 together with the communication module 10b can be located in a common casing 11, which is indicated in the drawing by the dashed line.

[0015] In both systems, between the contacts 4 and the monitoring system 7, a mechanical block 12 can be connected to the system making it impossible to remove the plug 6 from the plug-in socket (9a, 9b), what is indicated by dashed line.

[0016] In all systems the monitoring system 7 can be made in different varieties.

[0017] And so, in the first variety of the monitoring system, presented in fig. 3, the monitoring system 7a is an electric circuit with sets of contacts 13 which is electrically connected with the disconnecting module 3. For the first system, the monitoring system 7a is connected with the disconnecting module 3 directly by the wires 8. The plug 6 can be furnished with a pin 6a which is show in the drawing by a dashed line. For the second system, the monitoring system 7a is connected with the disconnecting module 3 by the wires 8 and the communication modules 10a and 10b.

[0018] In the second variety of the monitoring system, which is an embodiment according to the invention, presented in fig.4, the monitoring system 7b is an electromagnetic circuit formed from a magnetic coil 14 located on a magnetic core 15. The magnetic core 15 is made in the form of a pin 6a of the plug 6. The ends of the magnetic

coil 14 are electrically connected via the wires 8 directly with the disconnecting module 3 for the first embodiment of the invention. For this embodiment of the invention, the ends of the magnetic coil 14 are connected with the disconnecting module 3 via the wires 8 and the communication modules 10a and 10b.

[0019] In both systems, if the monitoring system 7a is applied, the pin 6a of the plug 6 is at the same time an element of the mechanical block 12 which prevents the removal of the plug 6 under load. The other element 16 of the mechanical block 12 is presented as one possible application on the fig.5. The mechanical block 12 comprises a blocking arbor, preferably in the form of the arbor 6a, a pawl 17, a spring 18, a block releasing mechanism 18 which is connected with signal wires 20 which release the other element 16 of the mechanical block 12 with the disconnecting module 3. If the mechanism with the other element 16 of the mechanical block 12 is used, the plug-in socket 9a or 9b is additionally fitted with a pushbutton for releasing the mechanical block, which is not shown in the drawing.

[0020] The functioning of the system according to the invention is explained for the processes of switching on and switching off.

The process of switching on:

Insertion of the plug 6 into the plug-in socket 9a or 9b is detected by the monitoring system 7. The monitoring system 7 sends a signal about the presence of the plug to the disconnecting module 3 through the wires 8 directly to the disconnecting module or through communication modules 10a and 10b and wires 8. The disconnecting module 3 turns on the current that supplies the connected receiver 5.

The process of switching off:

Removal of the plug 6 from the plug-in socket 9a or 9b is detected by the monitoring system 7. The monitoring system 7 sends a signal about an attempt to remove the plug to the disconnecting module 3 either directly through the wires 8 or indirectly through the wires 8 and the communication modules 10a and 10b. The disconnecting module 3 turns off the current that supplies the connected receiver 5.

Key to the drawing

[0021]

1. AC/DC power supply unit
2. electric wires
3. disconnecting module
4. contacts
5. receiver
6. plug
- 6a - pin
7. the monitoring system

7a - the monitoring system in the first embodiment variety

7b - the monitoring system in the second embodiment variety

- 5 8. signal wires
- 9a, 9b - plug-in socket
- 10a, 10b - communication module
11. casing
12. mechanical block
- 10 13. sets of contacts
14. magnetic coil
15. magnetic core
16. other element of the mechanical block
17. pawl
- 15 18. spring
19. block-releasing mechanism
20. block-releasing signal wires

20 Claims

1. A system for protecting electric equipment against an arc occurring between contacts of a socket and a plug during disconnection from a power supply network,
the system comprising an AC supply source electrically connected with a central AC/DC power supply unit (1), the power supply unit (1) being fitted with at least one output for electric wires (2) for transmitting direct current of different voltages, the system being equipped with at least one plug-in socket (9a, 9b) for plugging into it household receivers (5) supplied with direct current; the system comprising a disconnecting module (3) connected into the system between the central AC/DC power supply unit (1) and the contacts (4) of the plug-in socket (9a,9b); the at least one plug-in socket (9a, 9b) comprising a monitoring system (7b) configured for detecting an insertion of and an attempt to remove a plug (6) from the plug-in socket (9a,9b) and for sending a signal indicative of said insertion of or attempt to remove the plug (6) to the disconnecting module (3); the disconnecting module (3) being configured for turning on the current that supplies the electric equipment if an insertion of the plug (6) has been detected and turning off the current that supplies the electric equipment if an attempt to remove has been detected, wherein the monitoring system (7b) has the form of a coil (14) with a magnetic core (15) and the magnetic core (15) is in the form of a pin (6a) of the plug (6).
2. A system according to claim 1 wherein the disconnecting module (3) is situated in the plug-in socket (9a).
3. A system according to claim 1, wherein the disconnecting module (3) is situated near the central AC/DC power supply unit (1) and outside the plug-

in socket (9b).

4. A system according to claim 3, wherein the disconnecting module (3) is connected with the monitoring system (7) through communication modules (10a, 10b) of which one (10a) is located in the plug-in socket (9b), and the other (10b) near the disconnecting module (3) outside the plug-in socket (9b).
5. A system according to claim 4, wherein the disconnecting module (3), the communication module (10b) and the central AC/DC power supply unit (1) are located in a common casing (11).

Patentansprüche

1. Ein System zum Schutz eines elektrischen Geräts vor der Bogenentladung, die zwischen den Verbindungen der Steckbuchse und des Steckers bei der Trennung vom Stromversorgungsnetzwerk entsteht, welches eine elektrisch an ein zentrales AC/DC-Netzteil (1) angebundene Wechselstromquelle beinhaltet, das Netzteil (1) ist mit wenigstens einer Ausgangskabelleitung (2) für die Überleitung von Gleichstrom von unterschiedlichen Spannungen ausgestattet, das System ist mit wenigstens einer Steckbuchse (9a, 9b) zur Anbindung der mit unterschiedlichem Gleichstrom betriebenen Haushaltsgeräten (5) ausgestattet; das System umfasst ein Schaltermodul (3), angebunden an das System zwischen dem zentralen AC/DC-Netzteil (1) und den Verbindungen (4) der Steckbuchse (9a, 9b); die mindestens eine Steckbuchse (9a, 9b) umfasst ein Kontrollsystem (7b), eingestellt zur Detektion des Steckeranschlussvorgangs sowie des Versuchs, den Stecker (6) aus der Steckbuchse (9a, 9b) herauszuziehen und zur Überleitung eines diese Vorgänge des Anschlusses oder der versuchten Trennung anzeigenden Signals an das Schaltermodul (3), welches eingestellt ist, um bei der Detektion des Steckeranschlusses (6) den Strom einzuschalten und bei der Detektion des Trennungsversuchs den Strom auszuschalten, in welchem das Kontrollsystem (7b) die Form einer Spule (14) mit magnetischem Kern (15) hat und der magnetische Kern (15) die Form eines Kontaktstifts (6a) des Steckers (6) hat.
2. Ein System nach Anspruch 1, in welchem sich das Schaltermodul (3) in der Steckbuchse (9a) befindet.
3. Ein System nach Anspruch 1, in welchem sich das Schaltermodul (3) neben dem zentralen AC/DC-Netzteil (1) und außerhalb der Steckbuchse (9b) befindet.
4. Ein System nach Anspruch 3, in welchem das Schal-

termodul (3) an das Kontrollsystem (7) über die Kommunikationsmodule (10a, 10b) angebunden ist, wobei sich eins davon (10a) in der Steckbuchse (9b), und das andere (10b) neben dem Schaltermodul (3) außerhalb der Steckbuchse (9b) befindet.

5. Ein System nach Anspruch 4, in welchem sich das Schaltermodul (3), das Kommunikationsmodul (10b) und das zentrale AC/DC-Netzteil (1) in einem gemeinsamen Gehäuse (11) befinden.

Revendications

1. Système protégeant l'équipement électrique contre la déconnexion du réseau d'alimentation électrique survenant entre les contacts de la prise électrique et la fiche de contact pendant la déconnexion du réseau d'alimentation, comprenant une source de tension alternative AC connectée électriquement à un feeder central AC/DC (1), ledit feeder (1) étant muni au moins d'une sortie des fils électriques (2) pour la transmission du courant continu de différents voltages ; le système étant équipé au moins d'une prise électrique (9a, 9b) servant à brancher des appareils électroménagers (5) alimentés du courant continu ; le système comprenant un module de disjoncteur (3) connecté au système entre le feeder central AC/DC (1) et les contacts (4) de la prise électrique (9a, 9b), d'au moins une prise électrique (9a, 9b) comportant un système de monitoring (7b) configuré pour détecter l'insertion et la tentative de sortir la fiche (6) de la prise électrique (9a, 9b) et pour envoyer le signal indiquant l'insertion ou la tentative de sortir la fiche (6) du module de disjoncteur (3) qui est configuré à la mise sous tension du réseau alimentant l'équipement électrique lorsque le branchement de la fiche (6) est détecté ou à couper le courant alimentant l'équipement électrique lorsque la tentative de sortir la fiche est détectée, dans lequel le système de monitoring (7b) a la forme de bobine (14) avec un noyau magnétique (15), et le noyau magnétique (15) a la forme de goupille (6a) de la fiche (6).
2. Le système selon la revendication 1 dans lequel le module de disjoncteur (3) est situé dans la prise électrique (9a).
3. Le système selon la revendication 1 dans lequel le module de disjoncteur (3) est situé à côté du feeder central AC/DC (1) et en dehors de la prise électrique (9b).
4. Le système selon la revendication 1 dans lequel le module de disjoncteur (3) est connecté au système de monitoring (7) par intermédiaire des modules de communication (10a, 10b) dont l'un (10a) est situé dans la prise électrique (9b) et l'autre (10b) à côté

du module de disjoncteur (3) en dehors de la prise électrique (9b).

5. Le système selon la revendication 1 dans lequel le module de disjoncteur (3), le module de communication (10b) et le feeder central AC/DC (1) sont logés dans un boîtier commun (11).

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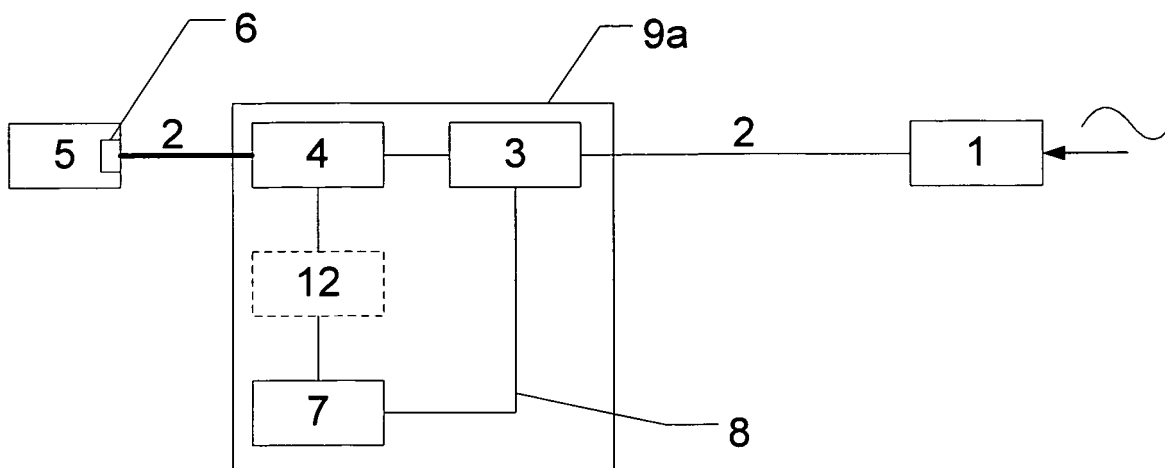


Fig 1

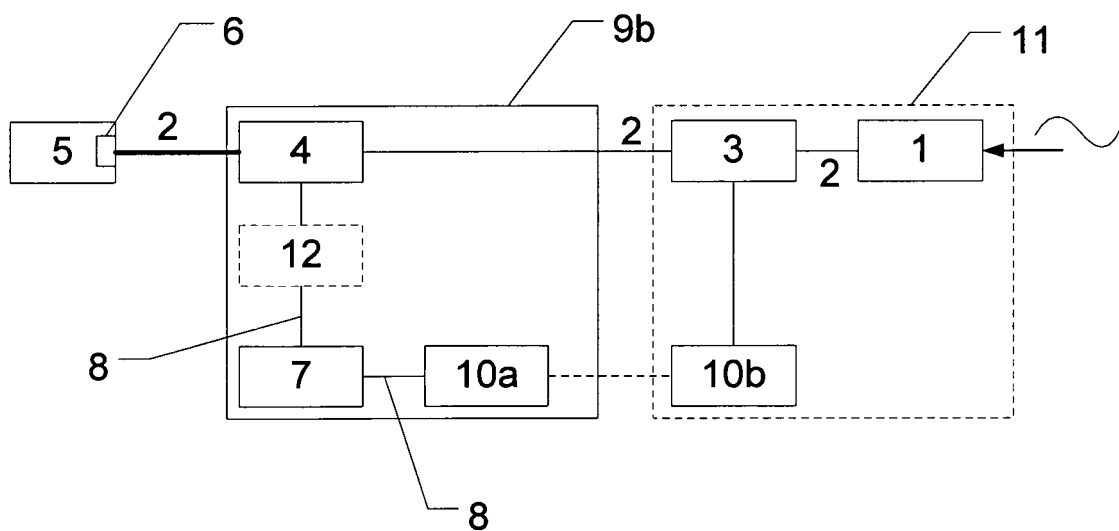


Fig 2

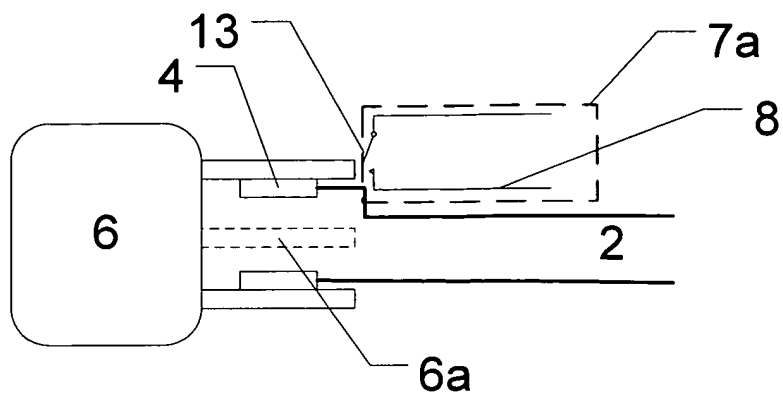


Fig 3

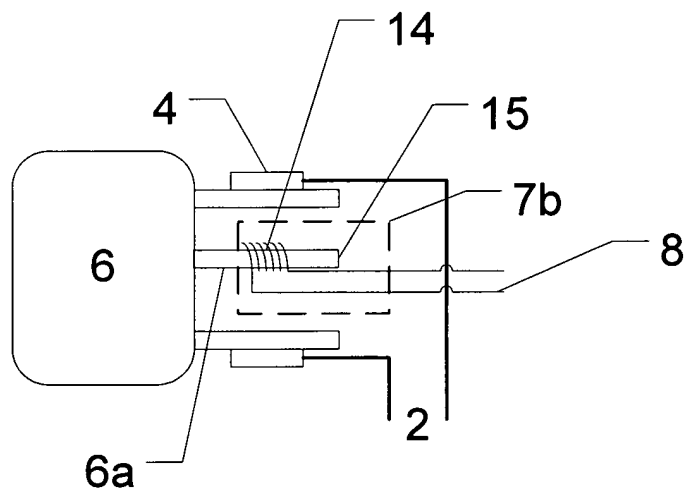


Fig 4

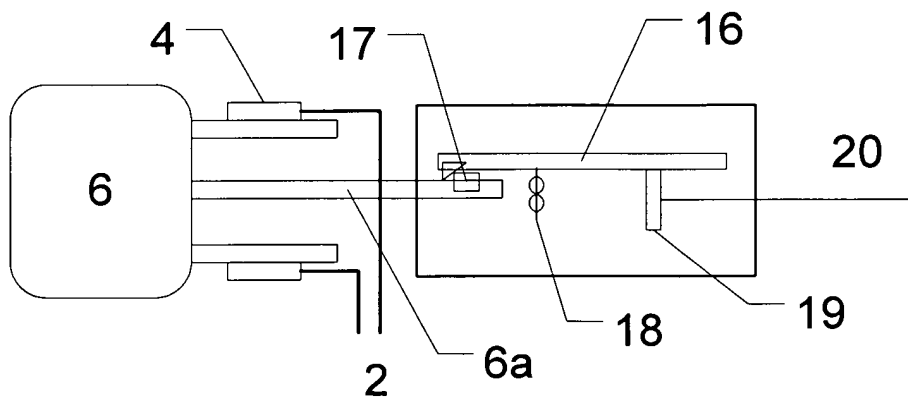


Fig 5

REFERENCES CITED IN THE DESCRIPTION

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