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(54) U-link connector for RF signals with integrated bias circuit

U-Link-Verbinder für HF-Funksignale mit integrierter Vorspannungsschaltung

Connecteur en U pour signaux RF intégrés avec circuit de polarisation

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Description

Field of the invention

[0001] The invention relates to a connector for RF signals, preferably to a U-link connector for use in a broadcast patch panel.

Description of the related art

[0002] In radio transmission- and communication systems of radio stations the antenna cables are subject to long-term degradation or failure due to electrical, mechanical and environmental stress. To avoid severe damage, which may result in a breakdown of the station, a monitoring of the antenna cables and/or antennas is desired.

[0003] A standard method for monitoring the antenna cables is to disconnect the transmitters during maintenance and to measure the electrical properties of the cables. A disconnection of a transmitter may be done by a U-link connector as disclosed in DE 37 06 989 A1 or US 6,139,369, which may be attached to a patch panel. This method does not allow for a continuous monitoring of the cables and requires a shutdown of the station.

[0004] A method for protection of high-power coaxial cables by continuously monitoring of the transmitted signals is disclosed in US 4,107,631. This method requires two directional couplers and an additional coaxial cable parallel to the high power coaxial cable to be protected. Therefore, it is expensive and a refurbishment of existing stations is hardly possible.

Summary of the invention

[0005] The problem to be solved by the invention is to provide a means and a method for testing and/or monitoring antenna cables in radio transmission and communication systems. There should be a simple and cost effective way of refurbishing existing systems. Furthermore it is preferred, if a continuous monitoring even during operation of the system is possible.

[0006] Solutions of the problem are described in the independent claims. The dependent claims relate to further improvements of the invention.

[0007] A first embodiment relates to a U-link connector for use in a broadcast patch panel, the connector having the function of a test adapter and comprising electrical or electronic components for coupling a test device to the antenna cable to be monitored. Preferably, the U-link connector comprises a filter circuit for coupling DC signals to the antenna cable. The connector may have the function of a bias tee. Such a U- link connector can easily be attached to a broadcast patch panel, which usually is provided between the transmitter(s) and the receiver(s) of a radio station. Here, simply existing old U- link connectors are replaced by the new U- link connector with integrated electrical or electronic components. This allows for a very simple and inexpensive refurbishment of existing stations. It is no more necessary to alter existing cables or waveguides.

[0008] Generally, a U- link connector has a first RF connector and a second RF connector. Both RF connectors preferably are coaxial connectors and further preferably are of the same type. Most preferably, they are male connectors. The RF connectors are connected by a RF line within the U- link connector, preferably a coaxial line. This coaxial line may have an outer conductor, which may be formed by or within the housing of the U- link connector. The outer conductor of the U-link connector connects the outer conductors of the RF connectors. Furthermore, there may be an inner conductor, isolated from the outer conductor and connecting the inner conductors of the RF connectors. Although, in a preferred embodiment, the U- link connector comprises a coaxial line, it may also comprise a strip line or any other line suitable for transmission of RF signals.

[0009] Preferably, the inner conductor comprises and/or forms a series capacitor for coupling RF or high frequency signals between the first RF connector and the second RF connector, while blocking DC or low-frequency signals. The capacitor may be a gap between conductor parts, a stack of plates or any other capacitive element. Preferably, the inner conductor comprises a first inner conductor section and a second inner conductor section, which preferably are flat metal plates. They are arranged, in close proximity parallel with each other to form the coupling capacitor. Most preferably, a dielectric material is provided between the first inner conductor section and the second inner conductor section. This material may be PTFE or Polyimide or any other dielectric material. The inner conductor sections may have bent portions for increasing coupling and mechanical stability.

[0010] Furthermore, it is preferred, to have an inductor connected between the first RF connector and a first test connector. The first test connector may be used for connecting a test and/or measuring and/or monitoring device. The purpose of the inductor is to allow coupling of DC or low frequency signals between the test connector and the first RF connector for blocking RF or high-frequency signals.

[0011] The embodiments shown herein have to provide at least a low VSWR (voltage standing wave ratio) and a low attenuation between the first RF connector and the second RF connector. Furthermore, they should be able to transfer high RF power levels as these are generated by the transmitters.

[0012] The embodiments disclosed herein relate to first and second RF connectors. It is obvious, that the connectors may be exchanged, if necessary. Furthermore, there are no limitations on the specific type of RF connectors.

[0013] The embodiments shown herein may also be applied to antennas, which are only used for receiving signals and therefore handle lower power levels.

[0014] A further embodiment relates to a patch panel

for a radio station comprising at least one U- link connector as disclosed herein. The patch panel may serve to couple signals from a plurality of transmitters via combiners to at least one antenna. By means of the U- link connectors transmitters and /or combiners may be connected/disconnected individually or in groups.

[0015] A method for coupling a DC or low frequency signals to an antenna cable and/or antenna comprises the steps of connecting a U- link connector as described above to a patch panel being connected to the antenna cable and coupling the DC or low-frequency signals via the U- link connector to the antenna.

[0016] It is further preferred, to couple the DC or low frequency signals via a first RF connector of the U- link connector and to block the signals to a second RF connector. This is preferably done by an inductor. Preferably, the method includes coupling RF signals from the second RF connector to the first RF connector, most preferably by means of a series capacitor.

[0017] A method for refurbishing of radio stations or equipment of radio stations includes the step of replacing an existing U- link connector by a U- link connector as disclosed herein to provide access for test equipment to an antenna and its cable.

[0018] The method further comprises the step of connecting a test device to a first test connector of the U-link connector. In a further step, testing of the antenna and its cable may be done by the test device.

Description of Drawings

[0019] In the following, the invention will be described by way of example, without limitation of the general inventive concept, on examples of embodiment with reference to the drawings.

Figure 1 shows an embodiment of a U- link connector in a sectional side view.

Figure 2 shows a sectional view through the first RF connector.

Figure 3 shows a top view.

Figure 4 shows a schematic diagram.

Figure 5 shows a combiner assembly.

[0020] In figure 1, a preferred embodiment according to the invention is shown in a sectional view. A housing 10 holds a first RF connector 40 and a second RF connector 50. The housing further forms an outer conductor holding an inner conductor 60 for guiding a RF signal between the second RF connector 50 and the first RF connector 40, preferably in a TEM (transverse electromagnetic mode) mode. It is preferred, if a transmitter (not shown here) is connected to the second RF connector 50, while an antenna connected by an antenna cable (not shown here) is connected to the first RF connector 40. The first RF connector 40 has an outer conductor 41 and an inner conductor 42. The second RF connector 50 has an outer conductor 51 and the inner conductor 52.

[0021] Preferably, the inner conductor 60 forms a coupling capacitor 20 for coupling RF and high-frequency signal as well as blocking DC and low-frequency signals between the RF connectors. For this purpose there is a first inner conductor section 61 connected to the inner conductor 42 of the first RF connector 40 and a second inner conductor section 62 connected to the inner conductor 52 of the second RF connector 50. Preferably, the first inner conductor section 61 and the second inner conductor section 62 are metal plates, which are arranged, in close proximity parallel with each other to form a coupling capacitor 20. Most preferably, a dielectric material 63 is arranged between the first inner conductor section 61 and the second inner conductor section 62. This material may be PTFE or Polyimide.

[0022] The coupling capacitor 20 may also be a separate component connected between the first inner conductor section 61 and the second inner conductor section 62. It is obvious, that the inner conductor 60 is split to prevent a short circuit of the capacitor.

[0023] An inductor 30 is arranged in close proximity to the first RF connector 40. Although the inductor may be anywhere else, this results in a compact mechanical design with good RF characteristics. Here, the inductance is wound to a coil being supported by a coil core 37. Its first coil connecting line 31 is connected to a first test connector 33. There may furthermore be a printed circuit board 38 for interconnecting these components and for holding further components. A second coil connecting line 32 at the opposite end of the coil is connected to the first connector inner conductor 42 and to the first inner conductor section 61 of inner conductor 60. There is a coil housing 36 for a housing the inductor 30, the printed circuit board 38 and the test connectors 33, 34.

[0024] Figure 2 shows a sectional view at the portion of the U- link connector close to the first RF connector 40. Here a load connector 34 can be seen which preferably is terminated by a load. There may be a dummy connector 35, for connecting and terminating the first test connector 34 with a load 39 if no test device is attached. For attaching a test device, a specific connector (not shown here) may be used.

[0025] Figure 3 shows a top view. Here, the short-circuit connector 35 can be seen on top of coil housing 36. Section line A-A relates to the sectional view of figure 1, while section line B-B relates to the sectional view of figure 2.

[0026] In figure 4, a schematic circuit diagram is shown. Here a transmitter 71 is connected to second RF connector 50. An antenna together with its cable 70 is connected to first RF connector 40. A test device 72 is connected to first test connector 33. Although not shown in here, it is obvious, that the devices 71 and 70 are connected by coaxial lines. Furthermore, it is preferred to

connect device 72 by a coaxial line too. The ground symbol relates to the housing 10.

[0027] In figure 5, a combiner assembly 80 for combining the signals of a plurality of RF transmitters to feed one or a plurality of antennas is shown. A plurality of combiner units 82 are connected via patch panels 81 by means of U-link connectors 83. The U-link connectors may be used to connect/disconnect individual transmitters and/or combiners to an antenna. The U-link connectors may have switching contacts to disable a transmitter connected to a combiner when the U-link connector is removed.

List of reference numerals

[0028]

10	housing
20	coupling capacitor
30	inductor
31	first coil connecting line
32	second coil connecting line
33	first test connector
34	second test connector
35	short circuit connector
36	coil housing
37	coil core
38	printed circuit board
39	load
40	first RF connector
41	first RF connector outer conductor
42	first RF connector inner conductor
50	second RF connector
51	second RF connector outer conductor
52	second RF connector inner conductor
60	inner conductor
61	first inner conductor section
62	second inner conductor section
63	insulator
70	cable and antenna
71	transmitter
72	test device
80	combiner assembly
81	patch panel
82	combiner unit
83	U-link connector

Claims

1. A U- link connector comprising at least a housing (10), a first RF connector (40), a second RF connector (50), and an inner conductor (60) connecting the first RF connector (40) and the second RF connector (50),
   characterized in, that
   the inner conductor (60) is split and a coupling capacitor (20) is provided for connecting the first RF connector (40) and the second RF connector (50), whereby an inductor (30) is connected between the first RF connector (40) and a first test connector (33), and
   the inner conductor (60) comprises a first inner conductor section (61) and a second inner conductor section (62) forming the coupling capacitor (20), whereby the first inner conductor section (61) and the second inner conductor section (62) are metal plates, which are arranged, in close proximity and parallel to each other.

2. A U- link connector according to claim 1,
   characterized in, that
   a dielectric material (63) is provided between the first inner conductor section (61) and the second inner conductor section (62).

3. A patch panel for a radio station comprising at least one U- link connector according to any one of the previous claims.

4. A method for coupling a DC or low frequency signals to an antenna cable and/or antenna comprises the steps of:

   - connecting a U- link connector according to any one of the previous claims 1 to 3 to a patch panel being connected to the antenna cable and/or antenna,
   - coupling a DC or low frequency signals by the first test connector.

5. A method for refurbishing of a radio station or equipment of a radio station comprises the step of replacing an existing U- link connector by a U- link connector according to any one of the previous claims 1 to 3.

Patentansprüche

1. Ein Bügelstecker, umfassend zumindest ein Gehäuse (10), einen ersten HF-Steckverbinder (40), einen zweiten HF-Steckverbinder (50) und einen Innenleiter (60), der den ersten HF-Steckverbinder (40) und den zweiten HF-Steckverbinder (50) verbindet,
   dadurch gekennzeichnet, dass
   der Innenleiter (60) geteilt ist und ein Kopplungskondensator (20) zum Verbinden des ersten HF-Steckverbinders (40) und des zweiten HF-Steckverbinders (50) vorgesehen ist, wodurch eine Induktivität (30) zwischen dem ersten HF-Steckverbinder (40) und einem ersten Prüfsteckverbinder (33) verbunden ist, und
   der Innenleiter einen ersten Innenleiterabschnitt (61) und einen zweiten Innenleiterabschnitt (62) umfasst, welche den Kopplungskondensator (20) bilden, wobei der erste Innenleiterabschnitt (61) und der zweite

Innenleiterabschnitt (62) Metallplatten sind, die in unmittelbarer Nähe und parallel zueinander angeordnet sind.

2. Bügelstecker nach Anspruch 1, **dadurch gekennzeichnet, dass** ein dielektrisches Material (63) zwischen dem ersten Innenleiterabschnitt (61) und dem zweiten Innenleiterabschnitt (62) vorgesehen ist.

3. Ein Koppelfeld (Patch Panel) für eine Funkstation, umfasst zumindest einen Bügelstecker nach einem der vorhergehenden Ansprüche.

4. Verfahren zum Koppeln von Gleichspannungs- oder Niederfrequenzsignalen mit einem Antennenkabel und/oder einer Antenne, umfasst die folgenden Schritte:

   - Verbinden eines Bügelsteckers nach einem der vorhergehenden Ansprüche 1 bis 3 mit einem Koppelfeld, das mit dem Antennenkabel und/oder der Antenne verbunden ist,
   - Koppeln von Gleichspannungs- oder Niederfrequenzsignalen durch den ersten Prüfsteckverbinder.

5. Ein Verfahren zum Aufrüsten einer Funkstation oder Ausrüstung einer Funkstation umfasst den Schritt des Ersetzens eines vorhandenen Bügelsteckers durch einen Bügelstecker nach einem der vorhergehenden Ansprüche 1 bis 3.

Revendications

1. Connecteur pour liaison en U comprenant au moins un boîtier (10), un premier connecteur RF (40), un deuxième connecteur RF (50) et un conducteur intérieur (60) qui connecte le premier connecteur RF (40) et le deuxième connecteur RF (50), **caractérisé en ce que** le conducteur intérieur (60) est divisé et une capacité de couplage (20) est prévue pour connecter le premier connecteur RF (40) et le deuxième connecteur RF (50), une inductance (30) étant montée entre le premier connecteur RF (40) et un premier connecteur de test (33), et le conducteur intérieur (60) comprend une première section de conducteur intérieur (61) et une deuxième section de conducteur intérieur (62) formant la capacité de couplage (20), la première section de conducteur intérieur (61) et la deuxième section de conducteur intérieur (62) étant des plaques métalliques disposées très près les unes des autres et parallèlement les unes aux autres.

2. Connecteur pour liaison en U selon la revendication 1, **caractérisé en ce qu'**un matériau diélectrique (63) est prévu entre la première section de conducteur intérieur (61) et la deuxième section de conducteur intérieur (62).

3. Tableau de connexions pour une station de radiodiffusion comprenant au moins un connecteur pour liaison en U selon l'une quelconque des revendications précédentes.

4. Procédé pour coupler des signaux de courant continu ou à basse fréquence à un câble d'antenne et/ou à une antenne, comprenant les étapes de :

   - connexion d'un connecteur pour liaison en U selon l'une quelconque des revendications 1 à 3 à un tableau de connexions à connecter au câble d'antenne et/ou à l'antenne,
   - couplage de signaux de courant continu ou à basse fréquence par le premier connecteur de test.

5. Procédé pour rénover une station de radiodiffusion ou le matériel d'une station de radiodiffusion, comprenant l'étape de remplacement d'un connecteur pour liaison en U existant par un connecteur pour liaison en U selon l'une quelconque des revendications 1 à 3.

Fig. 1

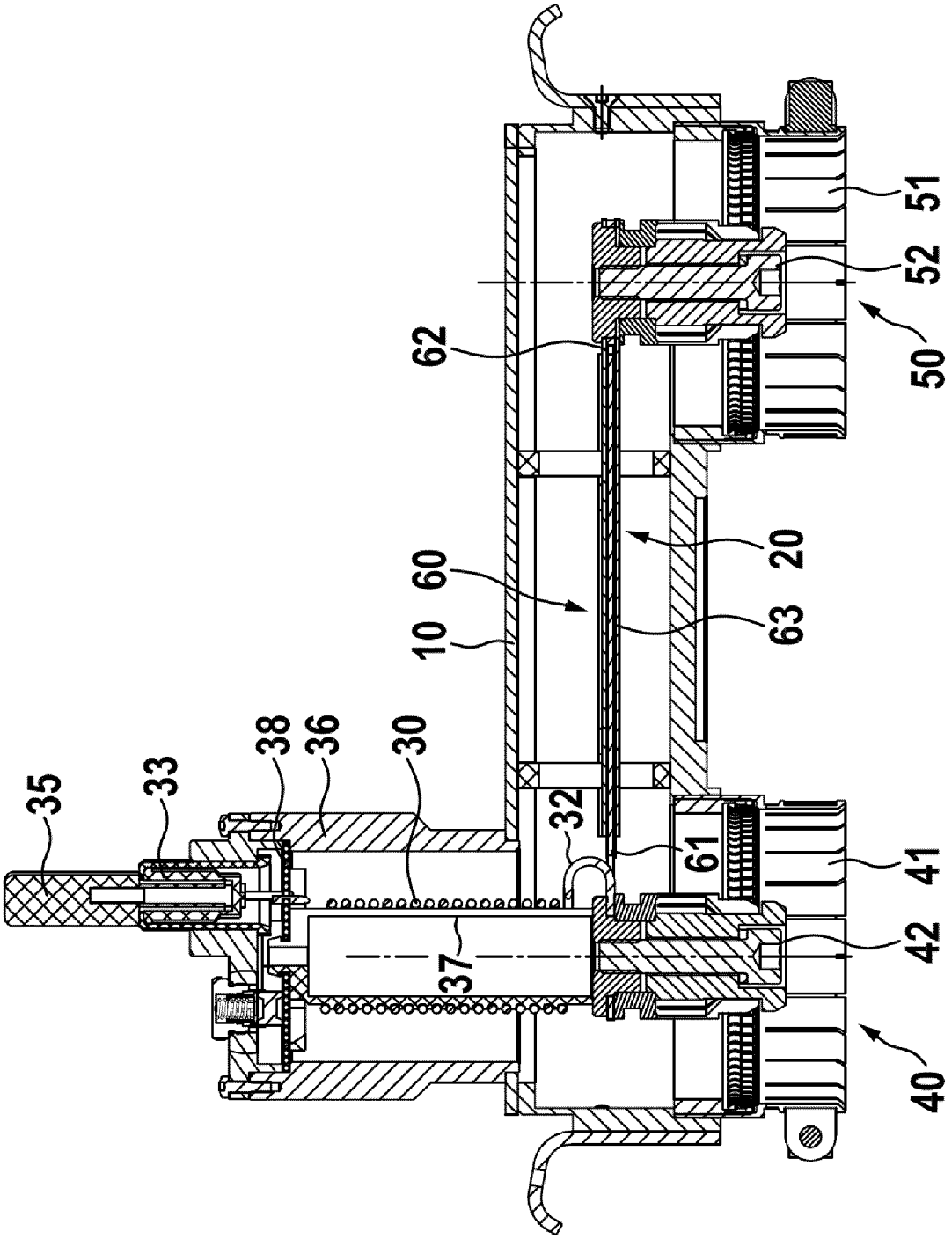


Fig. 2

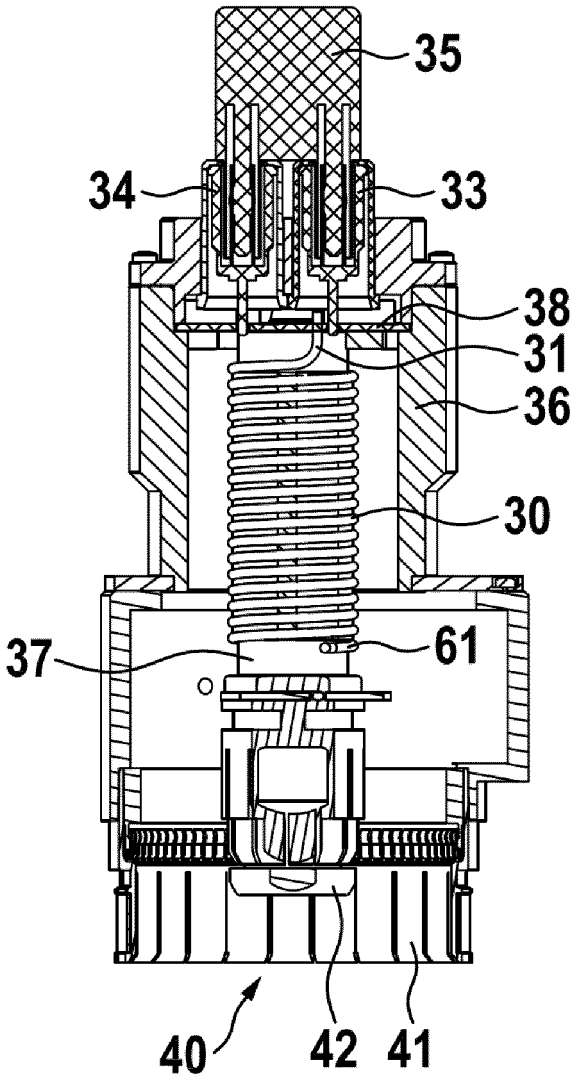


Fig. 3

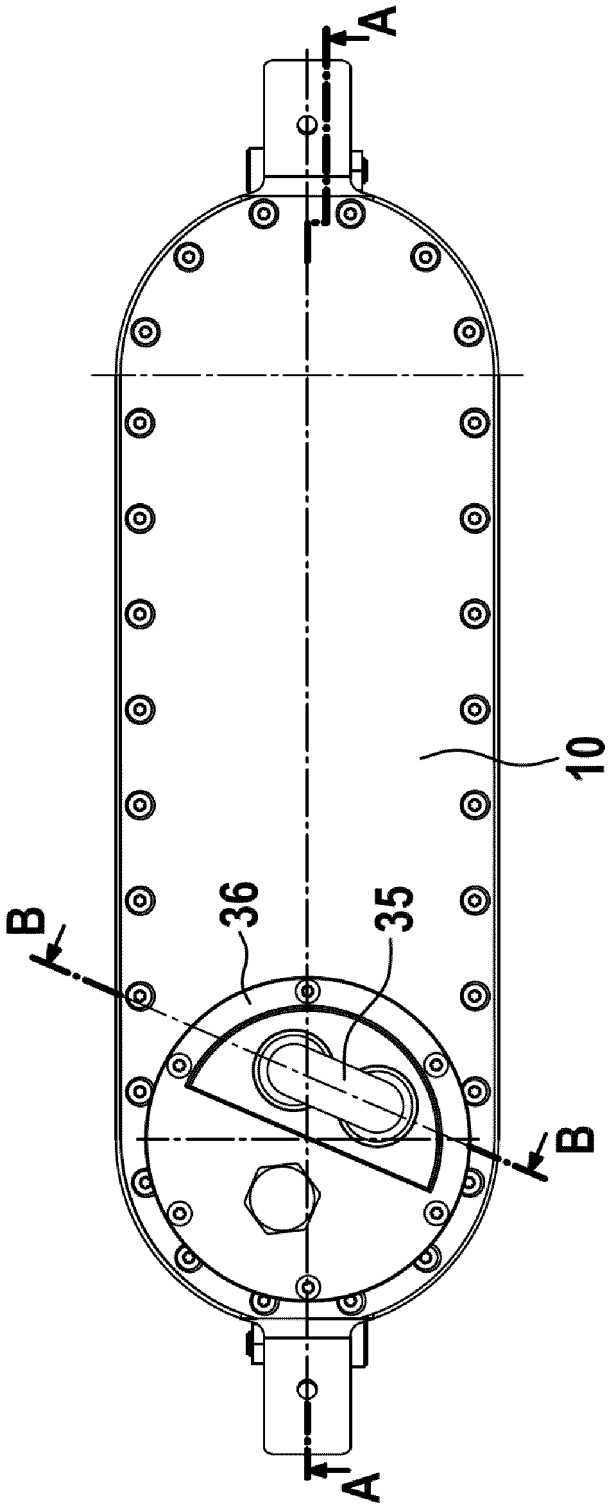


Fig. 4

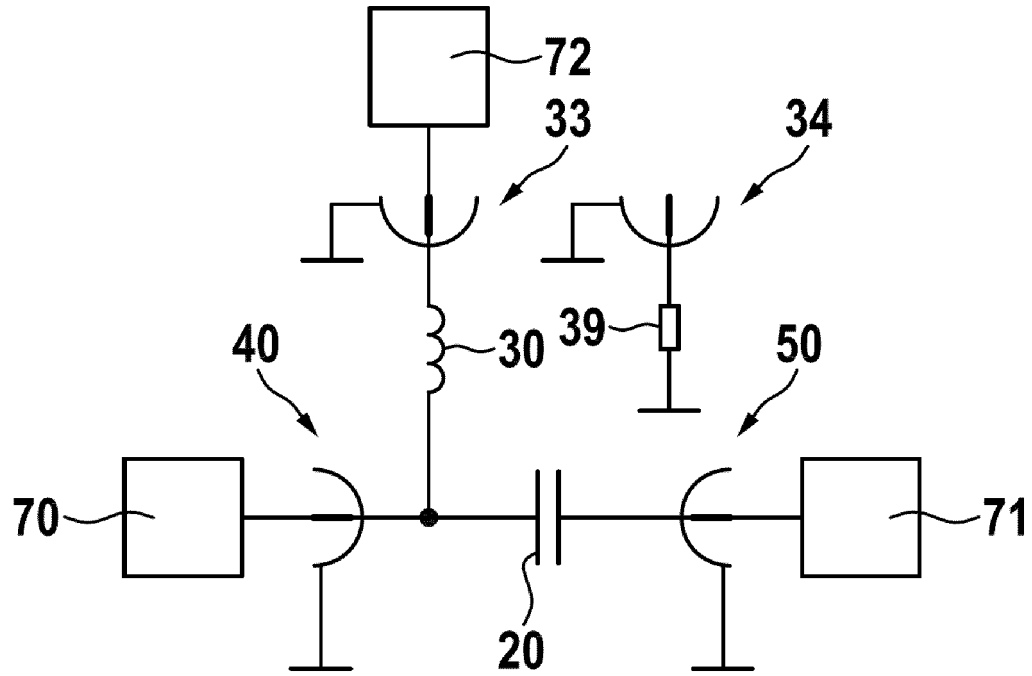
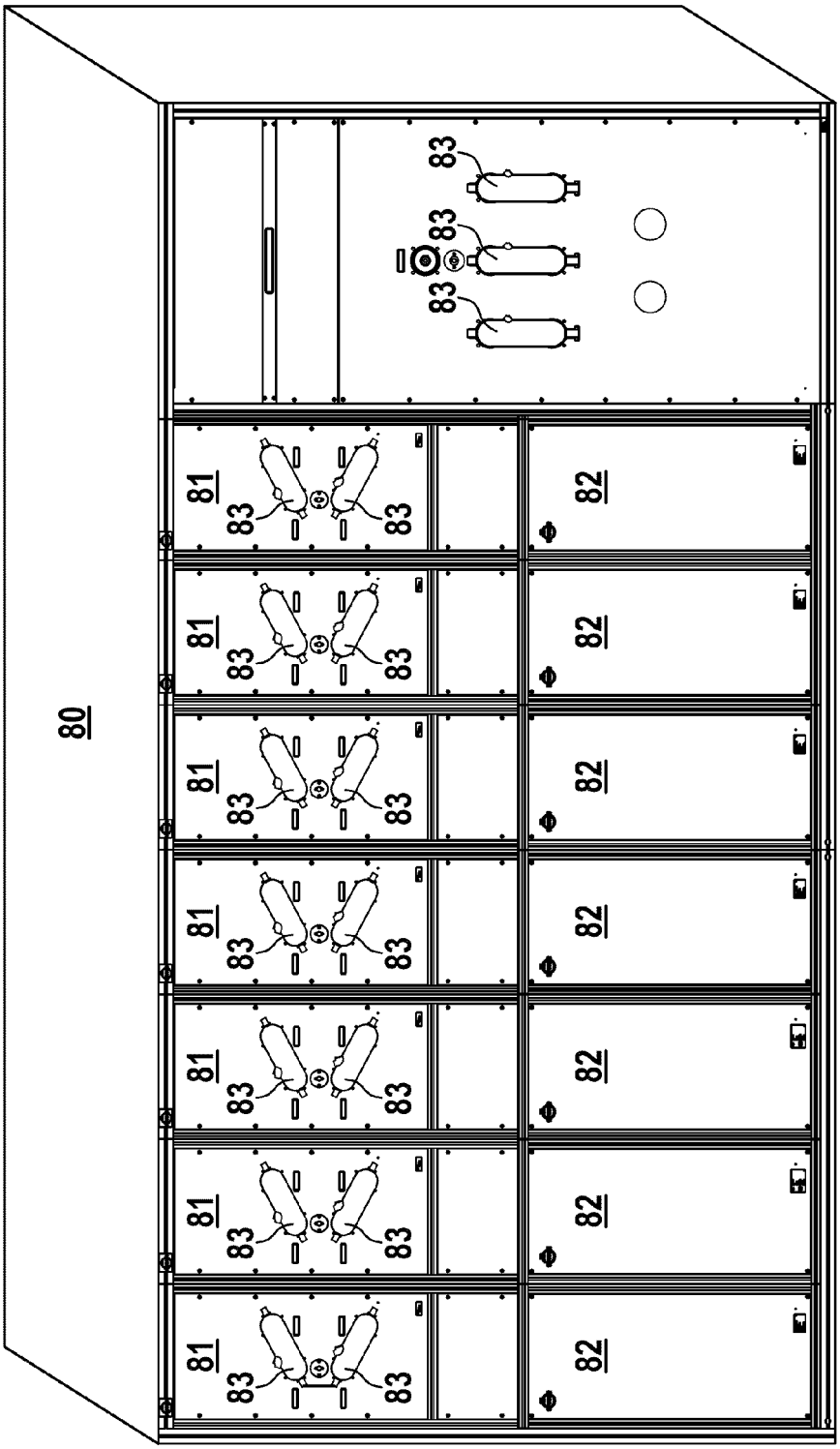


Fig. 5



REFERENCES CITED IN THE DESCRIPTION

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