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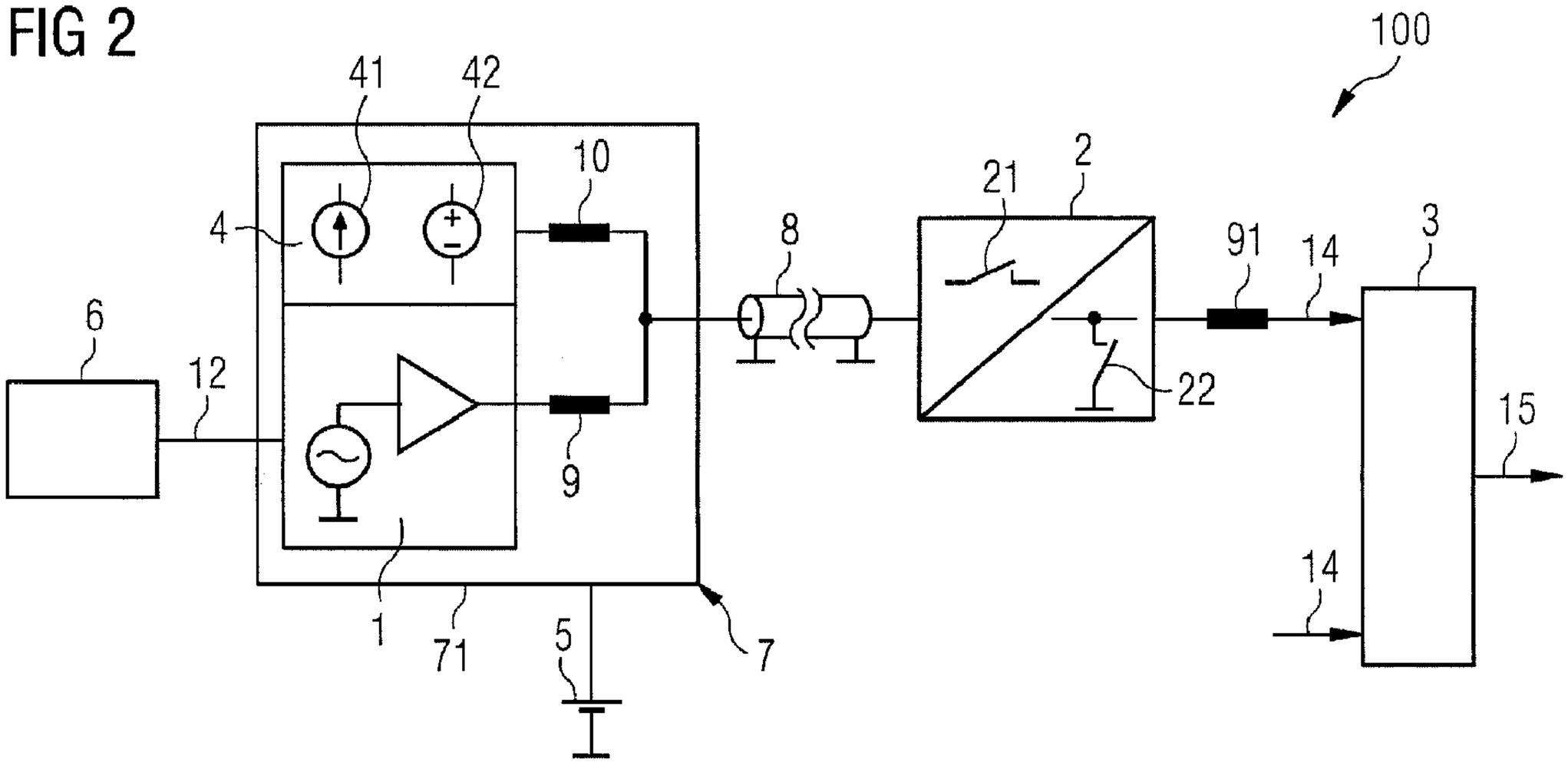
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(54) Title: ARRANGEMENT FOR RF HIGH POWER GENERATION

FIG 2



(57) Abrégé/Abstract:
An Arrangement for RF high power generation is presented. The Arrangement includes a RF power combiner (3), at least one RF power amplifier (1), a switch (2), a control unit (4) and a transmission line (8). The RF power combiner (3) has at least one RF input and at least one RF output. The RF power amplifier (1) is electrically connected to the RF input via the transmission line (8). The switch (2) is included in the transmission line (8). The switch (2) is configured to control, by a switching action, transmission of a RF signal from the RF power amplifier (1) to the RF input via the transmission line (8). The control unit (4) is configured to control the switching action of the switch (2). Furthermore, the control unit (4) is electrically connected to the switch (2) via the same transmission line (8).

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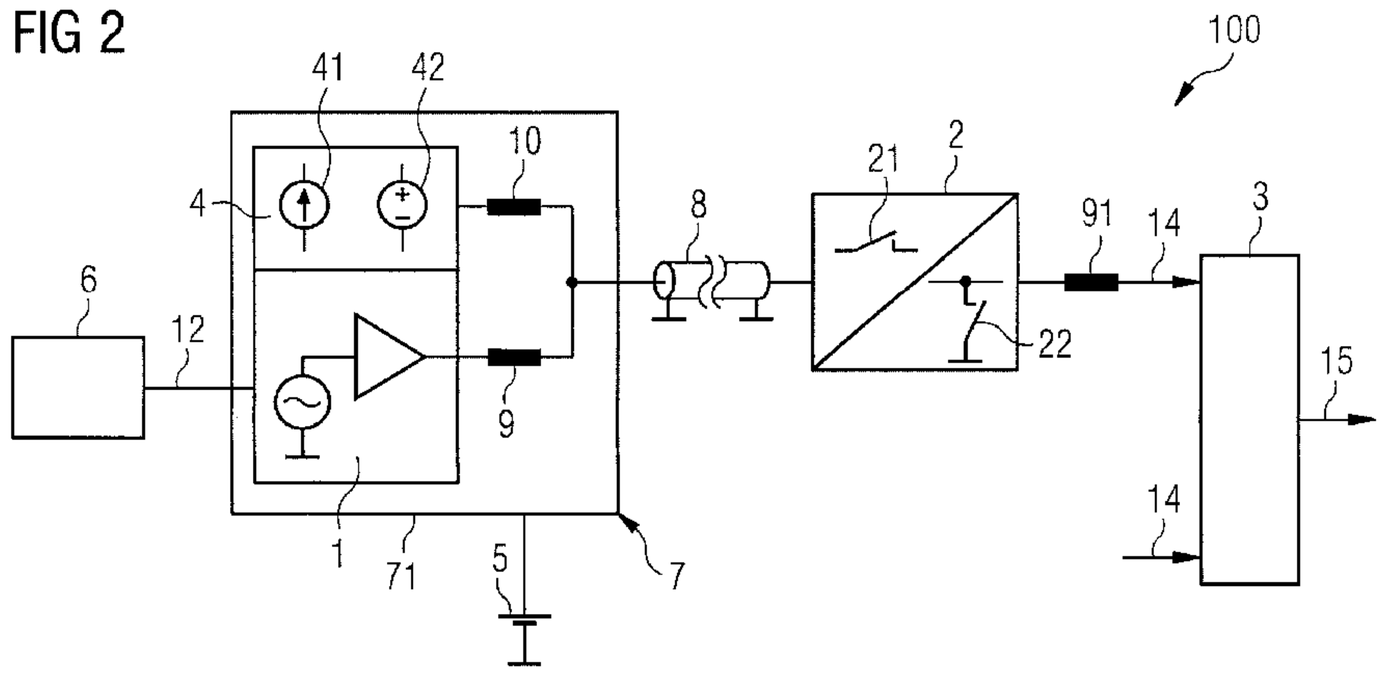
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(54) Title: ARRANGEMENT FOR RF HIGH POWER GENERATION

FIG 2



(57) Abstract: An Arrangement for RF high power generation is presented. The Arrangement includes a RF power combiner (3), at least one RF power amplifier (1), a switch (2), a control unit (4) and a transmission line (8). The RF power combiner (3) has at least one RF input and at least one RF output. The RF power amplifier (1) is electrically connected to the RF input via the transmission line (8). The switch (2) is included in the transmission line (8). The switch (2) is configured to control, by a switching action, transmission of a RF signal from the RF power amplifier (1) to the RF input via the transmission line (8). The control unit (4) is configured to control the switching action of the switch (2). Furthermore, the control unit (4) is electrically connected to the switch (2) via the same transmission line (8).

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Description

Arrangement for RF high power generation

The present invention relates to an arrangement for RF high power generation, and more particularly to an arrangement for RF high power generation including a RF power combiner, at least one RF amplifier and a switch along with its control unit.

RF power combiners are devices used in radio technology when there is a requirement of combining RF (radio frequency) power or RF signals. RF power combiners receive a plurality of RF inputs and transform the impedance of the received RF inputs to impedance of a single transmission line as output. One way to generate high RF power is to use a number of RF power amplifiers with a common, particularly single RF power combiner. RF power from the RF power amplifiers is fed to the RF power combiner. The RF power amplifiers are connected via their transmission lines to the common RF power combiner. The RF signals from the RF power amplifier are aggregated in the RF power combiner to yield a high RF power. Commonly, coaxial cables and/or strip-lines are used as transmission lines connecting each of the RF power amplifiers with the RF power combiner. The output power of RF power combiner is required to be adjusted and optimized to obtain a desired output RF signal.

One way of adjustment and/or optimization of the output RF power is by controlling the RF signals from the RF power amplifiers feeding the RF power combiner. For example, if there is a requirement of lowering power of the RF output of the RF power combiner one or more of the RF power amplifiers may be stopped from providing the input to the RF power combiner. Alternatively, for example, if there is a requirement of increasing power of the RF output of the RF power combiner one or more of the RF power amplifiers may be required to be switched on for providing the input to the RF power combiner. To achieve this control on the RF power

amplifiers, i.e. to control the RF power amplifiers such that RF signal from only the desired RF amplifiers is fed into the RF power combiner, each transmission line connecting a given RF amplifier to the RF power combiner is equipped with a switch, usually positioned at each of the RF power inputs of the RF power combiner. Each switch by its switching action allows or disallows a given RF power amplifier from providing its RF signal to the RF power combiner. Usually each switch is controlled by a separate control unit. The control unit induces the switching action i.e. turns the switch ON or OFF . The control unit is connected to the switch by separate electrical connectors. Information to the control unit to induce the switch may come from a central control system.

In particular the high power RF amplifier/generator system may include a plurality of RF power amplifiers each with its separate switch, and each switch having its control unit connected with the switch with separate electrical connectors. Therefore a lot of wires or electrical connectors are required for connecting the control unit to the switch. This makes the entire layout or arrangement complex and cost intensive.

The object of the present technique is to present simple and cost effective arrangement for RF high power generation which at least partially obviates the requirement of lot of electrical connectors.

The above objects are achieved by an Arrangement for RF high power generation according to claim 1 of the present technique.

According to an aspect of the present technique an Arrangement for RF high power generation is presented. The Arrangement includes a RF power combiner, at least one RF power amplifier, a switch, a control unit and a transmission line. The RF power combiner has at least one RF input and at least one RF output. The RF power amplifier is electrically

connected to the RF input via the transmission line. The switch is included in the transmission line. The switch is adapted to perform a switching action. The switch is configured to control, by the switching action, transmission of a RF signal from the RF power amplifier to the RF input via the transmission line. The control unit is electrically connected to the switch. The control unit is configured to control the switching action of the switch. Furthermore, the control unit is electrically connected to the switch via the same transmission line. Thus requirement of having additional connections or transmission lines between the control unit and the switch is obviated. The same transmission line conducts the RF signal from the RF power amplifier to the switch and also simultaneously conducts a control signal i.e. a DC signal from the control unit to the switch. The control signal induces the switching action in the switch. This results into simple arrangement of the RF high power generation. Furthermore, since lesser elements are required i.e. only one and the same transmission line between the RF power amplifier and the switch and between the control unit and the switch, the complexity of the circuit is reduced and it further results into cost effectiveness and possibility of easy maintenance.

In an embodiment of the Arrangement the transmission line is a coaxial cable. The coaxial cable is a simple and efficient way for establishing the transmission line which conducts the RF signal from the RF power amplifier to the RF power combiner and which also simultaneously conducts a control signal i.e. a DC signal from the control unit to the switch.

In another embodiment of the Arrangement, the RF power amplifier and the control unit form a RF module. The RF module is a single unit. The RF module may be in form of a box or casing having the RF power amplifier and the control unit. Such RF module makes the Arrangement simple and easy to integrate in a RF tract.

In another embodiment of the present technique, the Arrangement includes a RF choke connected between the control unit and the RF power amplifier. The RF choke electrically isolates the control unit from the RF signal coming from the RF power amplifier, when the RF power amplifier is in use or has been used to generate the RF signal. This ensures that the control unit is not affected by the RF signal.

In another embodiment of the present technique, the Arrangement includes a first DC-blocking capacitor connected between the RF power amplifier and the control unit. The first DC-blocking capacitor electrically isolates the RF power amplifier from a DC signal coming from the control unit, when the control unit is in use or has been used to generate the DC signal. This ensures that the RF power amplifier is not affected by the DC signal.

In another embodiment of the present technique, the Arrangement includes a second DC-blocking capacitor connected between the switch and the RF power combiner. The second DC-blocking capacitor electrically isolates the RF power combiner from the DC signal coming from the control unit, when the control unit is in use or has been used to generate the DC signal. This ensures that the RF power combiner is not affected by the DC signal.

In another embodiment of the Arrangement, the control unit includes a stabilized DC source and/or a DC voltage source. This provides a simple embodiment of the control unit.

In another embodiment of the Arrangement, the switch includes a PIN diode. The PIN diode is capable of switching between ON mode and OFF mode, in which the RF signal is allowed or disallowed, respectively, to flow across the switch. The PIN diode is an efficient switch for RF applications.

In another embodiment of the Arrangement, the switch includes a transistor. The transistor is capable of switching between ON mode and OFF mode, in which the RF signal is allowed

or disallowed, respectively, to flow across the switch. The transistor is an efficient switch for RF applications.

In another embodiment of the Arrangement, the switch is connected in series with respect to the transmission line and the RF power combiner. This provides a simple way of integrating the switch in the Arrangement.

In another embodiment of the Arrangement, the switch is connected in parallel with respect to the transmission line and the RF power combiner. This provides another simple way of integrating the switch in the Arrangement.

The present technique is further described hereinafter with reference to illustrated embodiments shown in the accompanying drawings, in which:

FIG 1 illustrates a layout known from the state of the art, and

FIG 2 illustrates an Arrangement, in accordance with aspects of the present technique.

Hereinafter, above-mentioned and other features of the present technique are described in details. Various embodiments are described with reference to the drawing, wherein like reference numerals are used to refer to like elements throughout. In the following description, for purpose of explanation, numerous specific details are set forth in order to provide a thorough understanding of one or more embodiments. It may be noted that the illustrated embodiments are intended to explain, and not to limit the invention. It may be evident that such embodiments may be practiced without these specific details.

In FIG 1 a layout 10 as known from the state of the art for RF power amplifiers 1 and a RF power combiner 3 is depicted. In the layout 10, the RF power combiner 3 includes RF inputs 14 and a RF output 15. Each of the RF input 14 of the RF

power combiner 3 is connected by a transmission line 11 to the RF power amplifier 1. An RF signal or RF power from the RF power amplifiers 1 is fed to the RF input 14 of the RF power combiner 3 via the transmission line 11. To control the feed from the RF power amplifiers 1, i.e. to control the RF power amplifiers 1 such that RF signal from only the desired RF amplifiers 1 is fed into the RF power combiner 3, each transmission line 11 connecting a given RF amplifier 1 to the RF power combiner 3 is equipped with a switch 2. The switch 2 is usually positioned at the respective RF power input 14 to which the transmission line 11 connects. Each switch 2 by its switching action allows or disallows a given RF power amplifier 1 from providing its RF signal to the RF power combiner 3. Each switch 2 is controlled by a separate control unit 4. The control unit 4 induces the switching action i.e. turns the switch ON or OFF . The control unit 4 is connected to the switch 2 by separate electrical connectors 13. Information to the control unit 4 to induce the switch 2 to be in the ON or the OFF state is provided from a central control system 6 via the connectors 12.

It may be noted that although only two power amplifiers 1 and their respective connections and switches 2 and control units 4 are depicted in FIG 1, the high power RF amplifier/generator systems may include a plurality of the RF power amplifiers 1 each with its separate switch 2, and each switch 2 with its separate control unit 4 connected with the switch 2 via separate electrical connectors 13.

The control unit 4 controls position of the switch 2 by applying current or voltage to the switch 2 and by this way switching it to conductive and non-conductive states accordingly. The control unit 4 may include a stabilized DC source 41 and/or a DC voltage source 42 along with an optional microprocessor (not shown) to control the DC current or the DC voltage provided from the control unit 4 to the switch 2. A DC power supply 5 is used to provide power for the control unit 4. Thus it is evident from the layout 10 that to connect one RF power amplifier 1 to one RF input 14

of the RF power combiner 3, at least one transmission line 11 is needed to connect the RF power amplifier 1 to the RF input 14 and at least one electrical connector 13 is needed to connect the control unit 4 to the switch 2 that controls the transmission line 11.

FIG 2 illustrates an Arrangement 100, in accordance with aspects of the present technique. The Arrangement 100 includes a RF power combiner 3, at least one RF power amplifier 1, a switch 2, a control unit 4 and a transmission line 8.

The RF power combiner 3 is a RF power combining circuit that accepts multiple input RF signals and deliver a single RF output signal. The RF power combiner 3 includes multiple RF inputs 14 and at least one RF output 15. The RF power combiner 3 receives RF power through the plurality of RF inputs 14 and transforms the impedance of the received RF power to impedance of a resultant single output. The resultant single output exits the RF power combiner 3 via a single RF output 15. The RF power combiner 3 may be of various types, for example zero-degree RF power combiners, and may have any technical specification.

The RF power amplifier 1 is electrically connected to the RF input 14 via the transmission line 8. The transmission line 8 may be, but not limited to, a coaxial cable.

The switch 2 or the RF switch 2, may be, but not limited to, a transistor, a PIN diode, and so on and so forth. The switch 2 is adapted to perform a switching action. The switch is configured to control, by the switching action, transmission of a RF signal from the RF power amplifier 1 to the RF input 14 passed via the transmission line 8. The control unit 4 is electrically connected to the switch 2. The control unit 4 is configured to control the switching action of the switch 2. The control unit 4 may include a stabilized DC source 41 and/or a DC voltage source 42 along with an optional microprocessor (not shown) to control the DC current or the

DC voltage provided from the control unit 4 to the switch 2. A DC power supply 5 is used to provide power for the control unit 4. The control unit 4 is electrically connected to the switch 2 via the same transmission line 8. Thus requirement of having electrical connectors 13 as depicted in FIG 1 between the control unit 4 and the switch 2 is obviated. In the Arrangement 100 of the present technique, the same transmission line 8 conducts the RF signal from the RF power amplifier 1 to the RF input 14 and also simultaneously conducts a control signal i.e. a DC signal from the control unit 4 to the switch 2. The control signal induces the switching action in the switch 2.

In one embodiment of the Arrangement 100, the switch 2 is connected in series with respect to the transmission line 8, the RF power combiner 3 and the RF power amplifier 1. In FIG 2, reference numeral 21 schematically depicts the switch 2 in series connection. The switch 2 may be positioned at the RF input 14. Alternatively, in another embodiment of the Arrangement 100, the switch is connected in parallel with respect to the transmission line 8 and the RF power combiner 3. In FIG 2, reference numeral 22 schematically depicts the switch 2 in parallel connection.

When the switch 2 is included in the Arrangement 100 connected in series with the transmission line 8, in ON mode, the switch 2 for example the PIN diode 2 allows flow of the RF signal via the transmission line 8 from the RF power amplifier 1 to the RF power combiner 3, and in OFF mode the PIN diode 2 disallows flow of the RF signal via the transmission line 8 from the RF power amplifier 1 to the RF power combiner 3. The control unit 4 controls position of the switch 2 by applying current or voltage to the switch 2, and by this way transforming the switch 2 to conductive or non-conductive states accordingly.

As mentioned above, the switch 2 may also be operated in parallel connection schematic. When connected in parallel, for example the switch 2 may be connected to provide a short

circuit to the RF signal coming from the RF power amplifier 1, and thus when the switch is ON or CLOSED RF signal from the RF power amplifier 1 is routed through the switch 2 and not towards the RF power combiner 3, whereas when the switch is OFF or OPEN RF signal from the RF power amplifier 1 is not routed through the switch and thus routed towards the RF power combiner 3. It may be noted, that as may be appreciated by one skilled in the art of electrical sciences, the switch 2 may be connected in the Arrangement 100 in different circuit topologies within the scope of the present technique i.e. the control signal to the switch 2 from the control unit 4 is provided by the same transmission line 8 via which the RF signal from the RF power amplifier 1 is provided to the RF input 14.

The Arrangement 100 includes a RF choke 10 of FIG 2 connected between the control unit 4 and the RF power amplifier 1. The RF choke 10 electrically isolates the control unit 4 from the RF signal coming from the RF power amplifier 1, when the RF power amplifier 1 is in use or has been used to generate the RF signal. Furthermore, the Arrangement 100 includes a first DC-blocking capacitor 9 connected between the RF power amplifier 1 and the control unit 4. The first DC-blocking capacitor 9 electrically isolates the RF power amplifier 1 from a DC signal coming from the control unit 4, when the control unit 4 is in use or has been used to generate the DC signal. The DC signal coming from the control unit 4 includes the signal to control or induce the switch 2 i.e. to transform the switch 2 between its conductive and non conductive state or to maintain the switch 2 in its conductive or nonconductive state.

In one embodiment of the Arrangement 100, the RF power amplifier 1 and the control unit 4 form a RF module 7. The RF module 7 is a single unit. The RF module 7 may be in form of a box 71 or casing having the RF power amplifier 1 and the control unit 4 positioned inside the box 71. Additionally, the RF choke 10 and the first DC-blocking capacitor may also be positioned inside the RF module 7. A DC power supply 5 is

provided to the RF module 7. A central control system 6 provides information to the control unit 4.

The Arrangement 100 further includes a second DC-blocking capacitor 91 connected between the switch 2 and the RF power combiner 3. The second DC-blocking capacitor 91 electrically isolates the RF power combiner 3 from the DC signal coming from the control unit 4 and through the switch 2, when the control unit 4 is in use or has been used to generate the DC signal.

While the present technique has been described in detail with reference to certain embodiments, it should be appreciated that the present technique is not limited to those precise embodiments. Rather, in view of the present disclosure which describes exemplary modes for practicing the invention, many modifications and variations would present themselves, to those skilled in the art without departing from the scope and spirit of this invention. The scope of the invention is, therefore, indicated by the following claims rather than by the foregoing description. All changes, modifications, and variations coming within the meaning and range of equivalency of the claims are to be considered within their scope.

List of Reference Characters

1	RF power amplifier
2	Switch
3	RF power combiner
4	Control unit
5	DC power supply
6	Central control system
7	RF module
8	Transmission line
9	First DC-blocking capacitor
10	RF choke
11	Connector between the RF power amplifier and the switch
12	Connector between the Central control system and the Control unit
13	Connector between the control unit and the switch
14	RF input of the RF power combiner
15	RF output of the RF power combiner
21	series connected switch
22	parallel connected switch
41	stabilized DC source
42	DC voltage source
71	box of RF module
91	second DC-blocking capacitor
100	Arrangement for RF high power generation

Claims

1. An Arrangement (100) for RF high power generation, the Arrangement (100) comprising:
   - a RF power combiner (3) with at least one RF input (14) and at least one RF output (15),
   - at least one RF power amplifier (1) electrically connected to the RF input (14) via a transmission line (8),
   - at least one switch (2) comprised in the transmission line (8), the switch (2) configured to control, by a switching action, transmission of a RF signal from the RF power amplifier (1) to the RF input (14) via the transmission line (8),
   - a control unit (4) electrically connected to the switch (2), the control unit (4) configured to control the switching action of the switch (2),

characterized in that the control unit (4) is electrically connected to the switch (2) via the same transmission line (8).

2. The Arrangement (100) according to claim 1, wherein the transmission line (8) is a single coaxial cable.

3. The Arrangement (100) according to claim 1 or 2, wherein the RF power amplifier (1) and the control unit (4) form a RF module (7) and wherein the RF module (7) is a single unit.

4. The Arrangement (100) according to any one of claims 1 to 3, further comprising a RF choke (10) connected between the control unit (4) and the RF power amplifier (1) to electrically isolate the control unit (4) from the RF signal from the RF power amplifier (1).

5. The Arrangement (100) according to any one of claims 1 to 4, further comprising a first DC-blocking capacitor (9) connected between the RF power amplifier (1) and the

control unit (4) to electrically isolate the RF power amplifier (1) from a DC signal from the control unit (4).

6. The Arrangement (100) according to any one of claims 1 to 5, further comprising a second DC-blocking capacitor (91) connected between the switch (2) and the RF power combiner (3) to electrically isolate the RF power combiner (3) from the DC signal from the control unit (4).

7. The Arrangement (100) according to any one of claims 1 to 6, wherein the control unit (4) comprises a stabilized DC source (41) and/or a DC voltage source (42).

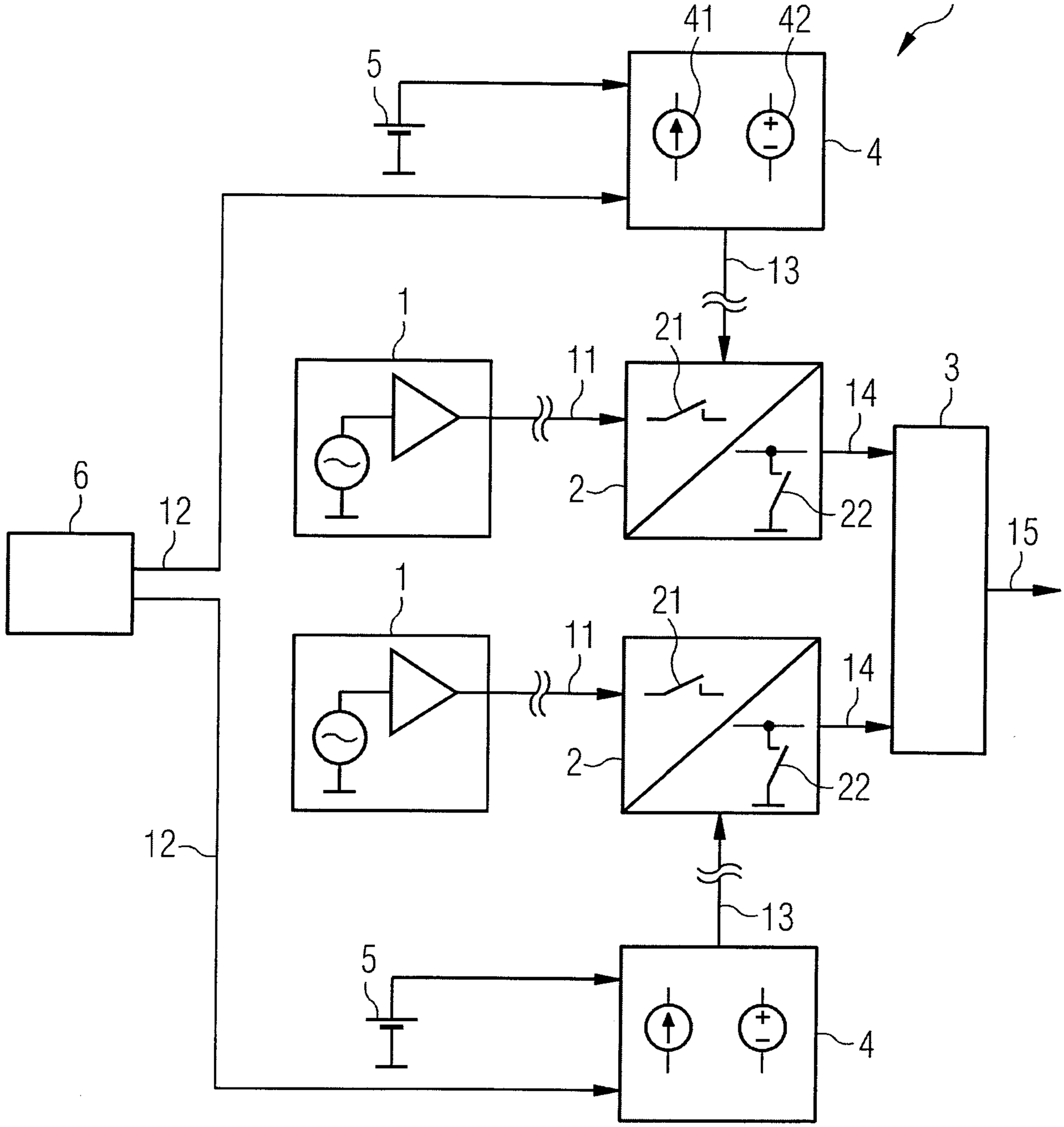
8. The Arrangement (100) according to any one of claims 1 to 7, wherein the switch (2) comprises a PIN diode.

9. The Arrangement (100) according to any one of claims 1 to 7, wherein the switch (2) comprises a transistor.

10. The Arrangement (100) according to any one of claims 1 to 9, wherein the switch (2) is connected in series with respect to the transmission line (8) and the RF power combiner (3).

11. The Arrangement (100) according to any one of claims 1 to 9, wherein the switch (2) is connected in parallel with respect to the transmission line (8) and the RF power combiner (3).

FIG 1 (STATE OF THE ART)



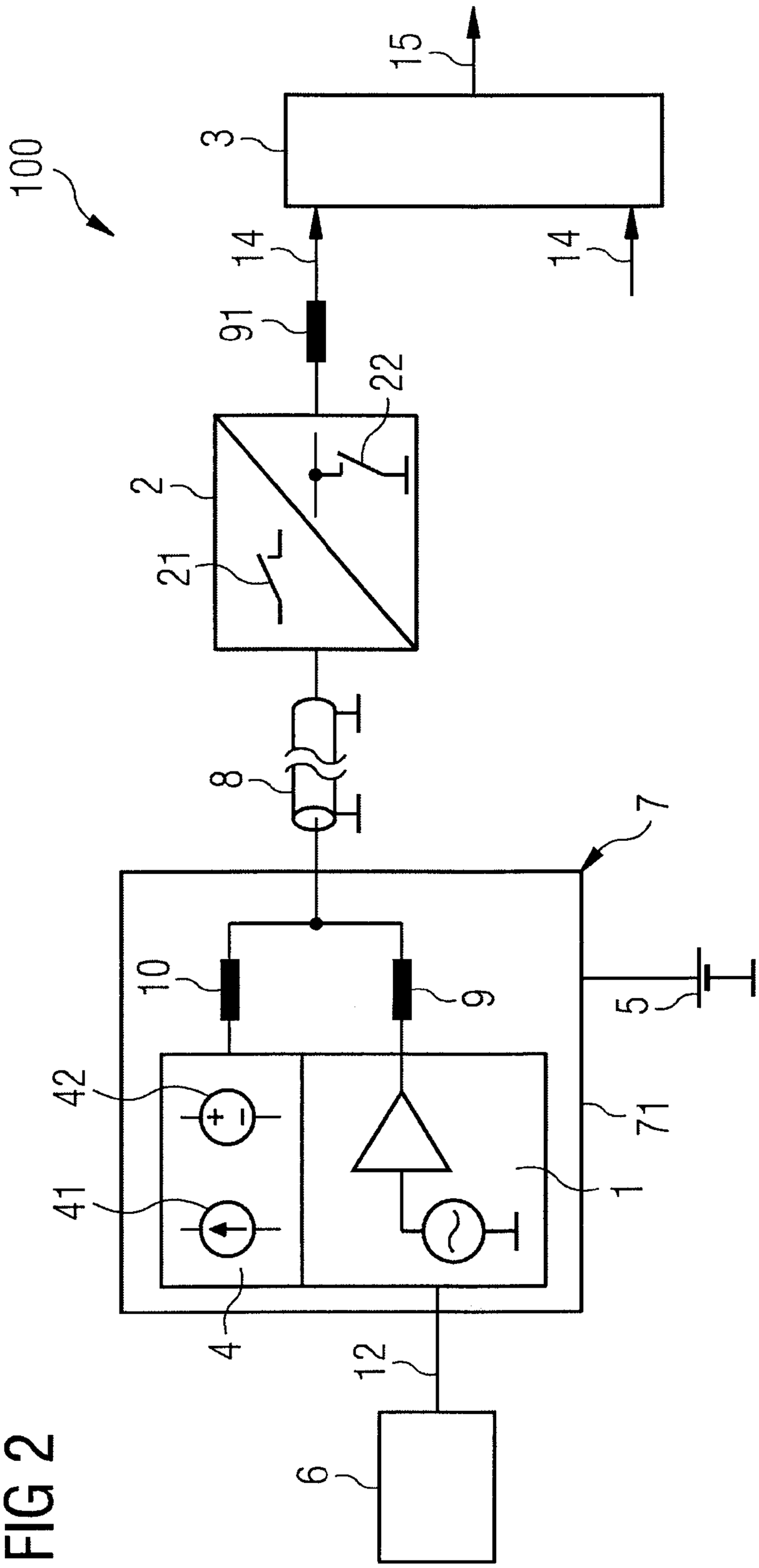


FIG 2

FIG 2

