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(54) FERRITE SWITCH, MICROWAVE ANTENNA, AND ELECTRONIC DEVICE

FERRITSCHALTER, MIKROWELLENANTENNE UND ELEKTRONISCHE VORRICHTUNG

COMMUTATEUR EN FERRITE, ANTENNE HYPERFRÉQUENCE, ET DISPOSITIF ÉLECTRONIQUE

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Description

TECHNICAL FIELD

[0001] This application relates to the field of high-frequency switch technologies, and in particular, to a ferrite switch, a microwave antenna, and an electronic device.

BACKGROUND

[0002] As data traffic increases, a wireless base station and microwave macro base station need to meet requirements for a larger communication capacity. However, spectrum bandwidth gradually becomes a bottleneck for capacity improvement. A high frequency, for example, a microwave in an E-Band or a D-Band, has more abundant spectrum resources. However, development of matched high-frequency components is not mature. As a result, indicators such as bandwidth, an insertion loss, and reciprocity of some high-frequency components such as a high-frequency switch affect performance of a high-frequency communication system.

[0003] The high-frequency switch includes a ferrite switch. The ferrite switch has a plurality of ports. A correspondence between the plurality of ports is controlled by changing an external magnetization status, to implement a switch selection function. However, in a same external magnetic field state, reciprocity cannot be implemented between two ports of the ferrite switch, which affects flexibility of using the high-frequency switch. In a related technology, a Y-junction combined ferrite switch or a differential phase-shift ferrite switch is used, to resolve a problem that reciprocity cannot be implemented for the ferrite switch. The Y-junction combined ferrite switch means that three Y-junction circulators are disposed, and a switch that may be used for bidirectional transmission is formed by controlling an annular direction of each circulator. The reciprocity of the switch is implemented by adding a phase shifter to the differential phase-shift ferrite switch and controlling a differential phase shift to be close to 0 or 180 degrees.

[0004] However, when the Y-junction combined or differential phase-shift ferrite switch is used, an additional transmission link and the phase shifter complicate a structure of the ferrite switch, and energy and gain losses are high when the ferrite switch is connected to a circuit. US 2009/0268642 A1 relates to a signal routing assembly which accepts a first transmission signal at an input and outputs a substantial portion of the signal at a common port of the signal routing assembly and a second transmission signal is received at the common port and is routed through the signal routing assembly delivered to output of the signal routing assembly. Leakage signals from routing devices leaking the first transmission signal are terminated inside the signal routing assembly. Leakage signal from a divider/combiner are cancelled by reflect signal from at least one reflector device. A transmitter produces the first transmission signal and the signal routing assembly delivers this signal to the common port of the signal routing assembly. In full duplex operation, second transmission signals received at the common port are routed to the output to be applied to a receiver.

US 2017/0149551 A1 relates to a multiplexer which comprises a multiplexer stage that includes: a first three port device coupled to a first port of the multiplexer and a first reflective filter, wherein the first reflective filter has a pass band that passes energy at a first frequency, and reflects energy at at least one of a second frequency outside of the pass band back into the first three port device, and a first filtered-load sub-stage coupled to the first three port device, the sub-stage comprising a second three port device coupled to a second reflective filter and a first absorbing load, where the second reflective filter passes energy at the first frequency to the first absorbing load and reflects energy at the at least one of a second frequency outside of the first pass band back into the second three port device.

SUMMARY

[0005] Embodiments of this application provide a ferrite switch, a microwave antenna, and an electronic device, to resolve problems of a complicated structure and a high insertion loss of a reciprocal ferrite switch. The present invention is defined by the independent claims. In the following, parts of the description and drawings referring to former embodiments which do not necessarily comprise all features to implement embodiments of the claimed invention are understood to not represent embodiments of the invention but to relate to be examples useful for understanding the embodiments of the invention.

[0006] One aspect of embodiments of this application provides a ferrite switch, including a coupler, two ferrite circulators, and a first magic T.

[0007] The ferrite circulators have first ports, second ports, and third ports, the second ports are connected to short-circuit loads, the first ports of the two ferrite circulators are respectively connected to two output ports of the coupler, the two output ports of the coupler are configured to output equi-amplitude in-phase or equi-amplitude phase-inverted power signals, and the third ports of the two ferrite circulators are respectively connected to two input ports of the first magic T; and after the equi-amplitude in-phase or equi-amplitude phase-inverted power signals are input from the two input ports of the first magic T, the power signals are output from two output ports of the first magic T respectively.

[0008] The short-circuit load is configured as follows: When the ferrite circulator is in a first magnetic field bias state, a power signal input from the first port outputs a first phase from the third port; and when the ferrite circulator is in a second magnetic field bias state, after being reflected by the second port, a power signal input from the first port outputs a second phase from the third port, where a phase difference between the first phase and the second phase is 180 degrees. The two ferrite circulators are configured to have a same magnetic field bias state or different magnetic field bias states.

[0009] According to the ferrite switch provided in this embodiment of this application, the coupler, the ferrite circulators connected to the short-circuit loads, and the first magic T are disposed in combination. The two ferrite circulators are controlled to be in the same magnetic field bias state or the different magnetic field bias states, to implement a reciprocal function of the ferrite switch. In addition, the ferrite switch maintains a low insertion loss characteristic of the ferrite circulator and the magic T, and this significantly improves performance of the ferrite switch.

[0010] In a possible implementation, the coupler includes a three dB coupler, the three dB coupler has one input port and two output ports, and after a power signal is input from the input port of the three dB coupler, the power signal is output from the two output ports of the three dB coupler in equi-amplitude in-phase; and a single pole double throw switch includes the one three dB coupler, one first magic T, and two ferrite circulators.

[0011] In this embodiment of this application, the three dB coupler, the ferrite circulators connected to the short-circuit loads, and the first magic T are disposed in combination. The two ferrite circulators are controlled to be in the same magnetic field bias state or the different magnetic field bias states, to implement a function of the single pole double throw switch, and enable the single pole double throw switch to have a reciprocal characteristic. In addition, the single pole double throw switch maintains a low insertion loss characteristic of the ferrite circulator and the magic T. This can significantly improve performance of the ferrite switch, and then improve performance of an antenna.

[0012] In a possible implementation, there are three single pole double throw switches, and a first single pole double throw switch is disposed in series with a second single pole double throw switch and a third single pole double throw switch that are disposed in parallel.

[0013] In this embodiment of this application, a single pole double throw switch and two parallel single pole double throw switches are disposed in series. Each single pole double throw switch is obtained from combination of the three dB coupler, the ferrite circulator connected to the short-circuit load, and the first magic T. By controlling magnetic field bias states of three groups of ferrite circulators, a function of a single pole four throw switch is implemented, and the single pole four throw switch has a reciprocal characteristic. In addition, the single pole four throw switch maintains low insertion loss characteristics of the ferrite circulator and the magic T. This can significantly improve performance of the ferrite switch and then improve performance of an antenna.

[0014] In a possible implementation, the three dB coupler includes a waveguide, microstrip, or stripline form.

[0015] The three dB coupler may be disposed in various forms such as a waveguide, a microstrip, or a stripline, and can flexibly adapt to various port types, and this improves applicability of the ferrite switch.

[0016] In a possible implementation, the coupler includes a second magic T, the second magic T has a first input port, a second input port, a first output port, and a second output port, where either of the first input port and the second input port is configured to input a power signal, a power signal input from the first input port is output in equi-amplitude in-phase through the first output port and the second output port, and a power signal input from the second input port is output in equi-amplitude phase-inverted through the first output port and the second output port.

[0017] In this embodiment of this application, the second magic T, the ferrite circulators connected to the short-circuit loads, and the first magic T are disposed in combination. The two ferrite circulators are controlled to be in the same magnetic field bias state or the different magnetic field bias states, and a power signal is input from either of the two input ports of the ferrite switch, to implement a function of a double single pole double throw switch, and enable the double single pole double throw switch to have a reciprocal characteristic. In addition, the double single pole double throw switch maintains low insertion loss characteristics of the ferrite circulator and the magic T. This can significantly improve performance of the ferrite switch, and then improve performance of an antenna.

[0018] In a possible implementation, the coupler includes a third magic T, the third magic T includes a third input port, a fourth input port, a third output port, and a fourth output port, where the third input port and the fourth input port are configured to simultaneously input mutually orthogonal power signals, a power signal input from the third input port is output in equi-amplitude in-phase through the third output port and the fourth output port, and a power signal input from the fourth input port is output in equi-amplitude phase-inverted through the third output port and the fourth output port.

[0019] In this embodiment of this application, the third magic T, the ferrite circulators connected to the short-circuit loads, and the first magic T are disposed in combination. The two ferrite circulators are controlled to be in the same magnetic field bias state or the different magnetic field bias states, and mutually orthogonal power signals are controlled to be simultaneously input from the two input ports of the ferrite switch, so that a function of a double pole double throw switch is implemented, and the double pole double throw switch has a reciprocal characteristic. In addition, the double pole double throw switch maintains low insertion loss characteristics of the ferrite circulator and the magic T. This can significantly improve performance of the ferrite switch, and then improve performance of an antenna.

[0020] In a possible implementation, the ferrite circulator includes the waveguide, microstrip, or stripline form.

[0021] The ferrite circulator may be disposed in various forms such as a waveguide, a microstrip, or a stripline, and can flexibly adapt to various port types, and this improves applicability of the ferrite switch.

[0022] In a possible implementation, the first magic T includes the waveguide, microstrip, or stripline form.

[0023] The first magic T may be disposed in various forms such as a waveguide, a microstrip, or a stripline, and can flexibly adapt to various port types, and this improves applicability of the ferrite switch.

[0024] In a possible implementation, the ferrite switch further includes two coils, and the two coils are respectively connected to the two ferrite circulators, and are configured to provide the first magnetic field bias state or the second magnetic field bias state for the ferrite circulators.

[0025] The ferrite circulator may be controlled to be in the first magnetic field bias state or the second magnetic field bias state by controlling switches and current directions of the two coils.

[0026] Another aspect of embodiments of this application provides a microwave antenna, including at least one ferrite switch described above, where the ferrite switch is connected to a feed of the microwave antenna, and the ferrite switch is configured to control the microwave antenna to perform beam sweeping.

[0027] Still another aspect of embodiments of this application provides an electronic device, including the microwave antenna described above.

[0028] Embodiments of this application provide a ferrite switch, an antenna and an electronic device. A coupler, ferrite circulators connected to short-circuit loads, and a first magic T are disposed in combination as the ferrite switch. The two ferrite circulators are controlled to be in a same magnetic field bias state or different magnetic field bias states, to implement a reciprocal function of the ferrite switch. In addition, the ferrite switch maintains low insertion loss characteristics of the ferrite circulator and the magic T. This can significantly improve performance of the ferrite switch, improve performance of an antenna that has the ferrite switch, and improve performance of the electronic device.

BRIEF DESCRIPTION OF DRAWINGS

[0029]

FIG. 1 is a schematic diagram of a structure of a ferrite switch according to an embodiment of this application;

FIG. 2 is a schematic diagram of a structure of a ferrite circulator according to an embodiment of this application;

FIG. 3 is a schematic diagram of a structure of a first magic T according to an embodiment of this application;

FIG. 4 is a schematic diagram of a structure of a single pole double throw switch according to an embodiment of this application;

FIG. 5 is a schematic diagram of a structure of a single pole four throw switch according to an embodiment of this application;

FIG. 6 is a schematic diagram of a structure of a double single pole double throw switch according to an embodiment of this application; and

FIG. 7 is a schematic diagram of a structure of a double pole double throw switch according to an embodiment of this application.

Reference numerals:

[0030] 100-Coupler; 11-Three dB coupler; 12-Second magic T; 13-Third magic T; 200-Ferrite circulator; 21-Short-circuit load; R1-First port; R2-Second port; R3-Third port; 300-First magic T; K1-First single pole double throw switch; K2-Second single pole double throw switch; K3-Third single pole double throw switch.

DESCRIPTION OF EMBODIMENTS

[0031] High-frequency switches include an electromechanical switch, a semiconductor active switch and a ferrite switch. The electromechanical switch controls a connected/disconnected state of a link through a micro electromechanical system to implement a switch function. The semiconductor active switch implements a switch function by changing a direction of a diode bias voltage to control connection and disconnection of a link. The ferrite switch controls a correspondence between ports by changing an external magnetization status, to implement a switch selection function.

[0032] However, the foregoing three high-frequency switches each have different defects. Main disadvantages of the electromechanical switch are high costs, a slow response, and limited service life reliability. Therefore, it is difficult to apply the electromechanical switch to some scenarios in which switches need to be frequently switched. A main disadvantage of the semiconductor active switch, for example, a PIN switch, is a high insertion loss. Therefore, it is difficult to apply the semiconductor active switch to some scenarios in which an insertion loss of a system is sensitive. Performance of the ferrite switch is between the electromechanical switch and the semiconductor active switch, and the ferrite switch is applicable to most scenarios. However, in a same external magnetic field state, reciprocity cannot be implemented between two ports of the ferrite switch, and this non-reciprocity characteristic affects use flexibility of the high-frequency switches.

[0033] In a related technology, a Y-junction combined ferrite switch or a differential phase-shift ferrite switch is used, and this can resolve a problem that reciprocity cannot be implemented for the ferrite switch. The Y-junction combined ferrite switch means that three Y-junction circulators are disposed, and a switch that may be used for bidirectional transmission is formed by controlling an annular direction of each circulator.

The reciprocity of the switch is implemented by adding a phase shifter to the differential phase-shift ferrite switch and controlling a differential phase shift to be close to 0 or 180 degrees. However, when the Y-junction combined or differential phase-shift ferrite switch is used, an additional transmission link and the phase shifter complicate a structure of the ferrite switch, and energy and gain losses are high when the ferrite switch is connected to a circuit at the same time.

[0034] To resolve the foregoing problem, embodiments of this application provide a ferrite switch and an antenna. A coupler, two ferrite circulators, and a magic T are combined, so that reciprocity can be implemented for the ferrite switch, and an advantage of a low insertion loss of the ferrite switch is maintained.

[0035] The following describes the ferrite switch, the microwave antenna, and the electronic device provided in embodiments of this application with reference to the accompanying drawings.

[0036] An embodiment of this application provides an electronic device, including but not limited to a mobile or fixed terminal with an antenna, such as a mobile phone, a tablet computer, a notebook computer, an ultra-mobile personal computer (ultra-mobile personal computer, UMPC), a handheld computer, a walkie-talkie, a netbook, a POS machine, a personal digital assistant (personal digital assistant, PDA), a wearable device, a virtual reality device, a wireless USB flash drive, a Bluetooth speaker/headset, or a vehicle-mounted apparatus.

[0037] The antenna may be used in a radio device to transmit or receive an electromagnetic wave. A same antenna may be used as a transmit antenna or a receive antenna, and characteristic parameters of the antenna are the same when the antenna is used as the transmit antenna and the receive antenna, that is, the antenna has a reciprocal characteristic. The ferrite switch is connected to a feed of the microwave antenna, and the ferrite switch is configured to control the microwave antenna to perform beam sweeping. To achieve the reciprocal characteristic of the antenna, a high-frequency switch used in the antenna, for example, the ferrite switch, also needs to have the reciprocal characteristic.

[0038] FIG. 1 is a schematic diagram of a structure of a ferrite switch according to an embodiment of this application. Refer to FIG. 1. An embodiment of this application provides a ferrite switch, including a coupler 100, a first magic T 300, and two ferrite circulators 200. The two ferrite circulators 200 are connected in parallel between the coupler 100 and the first magic T 300.

[0039] The coupler 100 refers to a device that can divide one channel of microwave power into several channels proportionally and combine several channels of microwave power into one channel. In this embodiment of this application, the coupler 100 has two output ports S1 and S2, and the two output ports S1 and S2 may output equi-amplitude in-phase power signals or equi-amplitude phase-inverted power signals. Specifically, the coupler 100 may be a three dB coupler, a magic T, or the like that can output two channels of equi-amplitude in-phase or equi-amplitude phase-inverted power signals.

[0040] FIG. 2 is a schematic diagram of a structure of a ferrite circulator according to an embodiment of this application. Refer to FIG. 2. An embodiment of this application provides a ferrite circulator 200. The ferrite circulator 200 is a three-port device and has a first port R1, a second port R2, and a third port R3, and the second port R2 is connected to a short-circuit load 21.

[0041] The short-circuit load 21 is a waveguide sheet. The short-circuit load 21 is configured as follows: When the ferrite circulator 200 is in a first magnetic field bias state, a power signal input from the first port R1 outputs a first phase from the third port R3; and when the ferrite circulator 200 is in a second magnetic field bias state, after being reflected by the second port R2, a power signal input from the first port R1 outputs a second phase from the third port R3, where a phase difference between the first phase and the second phase is 180 degrees.

[0042] First ports R1 of the two ferrite circulators 200 are respectively connected to two output ports S1 and S2 of the coupler 100, and are configured to respectively receive power signals from the two output ports S1 and S2 of the coupler 100.

[0043] When the two output ports S1 and S2 of the coupler 100 output equi-amplitude in-phase power signals, the first ports R1 of the two ferrite circulators 200 input the equi-amplitude in-phase power signals. If the two ferrite circulators 200 are set to be in a same magnetic field bias state, to be specific, both are in the first magnetic field bias state or both are in the second magnetic field bias state, third ports R3 of the two ferrite circulators 200 output the equi-amplitude in-phase power signals. If the two ferrite circulators 200 are set to be in different magnetic field bias states, to be specific, in the first magnetic field bias state and the second magnetic field bias state respectively, the third ports R3 of the two ferrite circulators 200 output the equi-amplitude phase-inverted power signals.

[0044] Similarly, it can be learned that when the two output ports S1 and S2 of the coupler 100 output the equi-amplitude phase-inverted power signals, the first ports R1 of the two ferrite circulators 200 input the equi-amplitude phase-inverted power signals. If the two ferrite circulators 200 are set to be in the same magnetic field bias state, the third ports R3 of the two ferrite circulators 200 output the equi-amplitude phase-inverted power signals. If the two ferrite circulators 200 are set to be in the different magnetic field bias states, the third ports R3 of the two ferrite circulators 200 output the equi-amplitude in-phase power signals.

[0045] On the contrary, when the third ports R3 of the two ferrite circulators 200 input the equi-amplitude in-phase power signals, if the two ferrite circulators 200 are in a same magnetic field bias state, the first ports R1 of the two ferrite circulators 200 output the equi-amplitude in-phase power signals; or if the two ferrite circulators 200 are in different magnetic field bias states, the first ports R1 of the two ferrite circulators 200 output the equi-amplitude phase-inverted power signals. When the third ports R3 of the two ferrite circulators 200 input the equi-amplitude phase-inverted power signals, if the two ferrite circulators 200 are in the different magnetic field bias states, the first ports R1 of the two ferrite circulators 200 output the equi-amplitude in-phase power signals; or if the two ferrite circulators 200 are in the same magnetic field bias state, the first ports R1 of the two ferrite circulators 200 output the equi-amplitude phase-inverted power signals.

[0046] FIG. 3 is a schematic diagram of a structure of a first magic T according to an embodiment of this application. Refer to FIG. 3. A first magic T 300 is a four-port device, is formed by combining an E-T power divider and an H-T power divider that have a symmetric surface, and includes two input ports P1 and P2 and two output ports P3 and P4. P3 forms an H-T power divider with P1 and P2, and P4 forms an E-T power divider with P1 and P2. A function of the first magic T satisfies: When P1 and P2 input equi-amplitude in-phase power signals, a combined power signal thereof is output from P3. When P1 and P2 input equi-amplitude phase-inverted power signals, a combined power signal thereof is output from P4. On the contrary, a power signal input from P3 is output as equi-amplitude in-phase power signals through P1 and P2, and a power signal input from P4 is output as the equi-amplitude phase-inverted power signals through P1 and P2.

[0047] The two input ports P1 and P2 of the first magic T 300 are respectively connected to the third ports R3 of the two ferrite circulators 200.

[0048] A working process of the ferrite switch provided in this embodiment of this application is as follows.

[0049] When two output ports S1 and S2 of a coupler 100 output the equi-amplitude in-phase power signals, if the two ferrite circulators 200 are set to be in a same magnetic field bias state, the third ports R3 of the two ferrite circulators 200 output the equi-amplitude in-phase power signals, and the equi-amplitude in-phase power signals are input from the two input ports P1 and P2 of the first magic T 300, and are output from the output port P3 of the first magic T 300. If the two ferrite circulators 200 are set to be in different magnetic field bias states, the third ports R3 of the two ferrite circulators 200 output the equi-amplitude phase-inverted power signals, and the equal-amplitude phase-inverted power signals are input from the two input ports P1 and P2 of the first magic T 300, and are output from the output port P4 of the first magic T.

[0050] Similarly, when two output ports S1 and S2 of a coupler 100 output the equi-amplitude phase-inverted power signals, if the two ferrite circulators 200 are set to be in a same magnetic field bias state, the third ports R3 of the two ferrite circulators 200 output the equi-amplitude phase-inverted power signals, and the equi-amplitude phase-inverted power signals are input from the two input ports P1 and P2 of the first magic T 300, and are output from the output port P4 of the first magic T 300. If the two ferrite circulators 200 are set to be in different magnetic field bias states, the third ports R3 of the two ferrite circulators 200 output the equi-amplitude in-phase power signals, and the equal-amplitude in-phase power signals are input from the two input ports P1 and P2 of the first magic T 300, and are output from the output port P3 of the first magic T.

[0051] On the contrary, it may be learned that after a power signal is input from P3 of the first magic T, the equi-amplitude in-phase power signals are output from P1 and P2 of the first magic T. In this case, if the two ferrite circulators 200 are in a same magnetic field bias state, the two ports S1 and S2 of the coupler 100 input the equi-amplitude in-phase power signals. If the two ferrite circulators 200 are in different magnetic field bias states, the two ports S1 and S2 of the coupler 100 input the equi-amplitude phase-inverted power signals. After a power signal is input from P4 of the first magic T 300, the equi-amplitude phase-inverted power signals are output from P1 and P2 of the first magic T 300. In this case, if the two ferrite circulators 200 are in a same magnetic field bias state, the two ports S1 and S2 of the coupler 100 input the equi-amplitude phase-inverted power signals. If the two ferrite circulators 200 are in different magnetic field bias states, the two ports S1 and S2 of the coupler 100 input the equi-amplitude in-phase power signals.

[0052] The ferrite circulator 200 includes forms such as a waveguide, a microstrip, or a stripline. The first magic T 300 also includes forms such as a waveguide, a microstrip, or a stripline. Flexible adaptation to various port types can be implemented.

[0053] In addition, the ferrite switch provided in this embodiment of this application further includes two coils (not shown in the figure). The two coils are respectively connected to the two ferrite circulators 200, and are configured to provide a first magnetic field bias state or a second magnetic field bias state for the ferrite circulator 200. Switches and current directions of the two coils may be controlled to control the ferrite circulator 200 to be in the first magnetic field bias state or the second magnetic field bias state or have no magnetic field bias state.

[0054] In conclusion, in this embodiment of this application, the coupler 100, the ferrite circulators 200 connected to short-circuit loads 21, and the first magic T 300 are disposed in combination. The two ferrite circulators 200 are controlled to be in the same magnetic field bias state or different magnetic field bias states, to implement a reciprocal function of the ferrite switch. In addition, the ferrite switch maintains low insertion loss characteristics of the ferrite circulator and the magic T. This can significantly improve performance of the ferrite switch, and then improve performance of an antenna.

[0055] The following describes different ferrite switches provided in this application with reference to accompanying drawings and specific embodiments.

Embodiment 1

[0056] FIG. 4 is a schematic diagram of a structure of a single pole double throw switch according to an embodiment of this application. Refer to FIG. 4. An embodiment of this application provides a single pole double throw switch. The single pole double throw switch includes a three dB coupler 11, a first magic T 300, and two ferrite circulators 200. The three dB coupler 11 has one input port S3 and two output ports S4 and S5. First ports R1 of the two ferrite circulators 200 are respectively connected to the two output ports S4 and S5 of the three dB coupler 11. Second ports R2 of the two ferrite circulators 200 are respectively connected to short-circuit loads 21, and third ports R3 of the two ferrite circulators 200 are respectively connected to two input ports P1 and P2 of the first magic T 300.

[0057] A working process of the single pole double throw switch provided in this embodiment of this application is as follows.

[0058] After a power signal is input from the input port S3 of the three dB coupler 11, the power signal is output as equi-amplitude in-phase power signals from the two output ports S4 and S5 of the three dB coupler 11. In this case, if the two ferrite circulators 200 are set to be in a same magnetic field bias state, third ports R3 of the two ferrite circulators 200 output the equi-amplitude in-phase power signals, and finally a power signal is output from an output port P3 of the first magic T 300. If the two ferrite circulators 200 are set to be in different magnetic field bias states, third ports R3 of the two ferrite circulators 200 output equi-amplitude phase-inverted power signals, and finally a power signal is output from an output port P4 of the first magic T 300.

[0059] On the contrary, it may be learned that when a power signal is input from the port P3 of the first magic T 300, the two ferrite circulators 200 are set to be in a same magnetic field bias state, so that a power signal can be finally output from the port S3 of the three dB coupler 11. When a power signal is input from the port P4 of the first magic T 300, the two ferrite circulators 200 are set to be in different magnetic field bias states, so that a power signal can be output from the port S3 of the three dB coupler 11.

[0060] The three dB coupler includes various forms such as a waveguide, a microstrip, or a stripline, and can flexibly adapt to various port types.

[0061] According to the single pole double throw switch provided in this embodiment of this application, the three dB coupler, the ferrite circulators connected to the short-circuit loads, and the first magic T are disposed in combination. The two ferrite circulators are controlled to be in a same magnetic field bias state or different magnetic field bias states, to implement a function of the single pole double throw switch, and enable the single pole double throw switch to have a reciprocal characteristic. In addition, the single pole double throw switch maintains low insertion loss characteristics of the ferrite circulator and the magic T. This can significantly improve performance of the ferrite switch, and then improve performance of an antenna.

Embodiment 2

[0062] FIG. 5 is a schematic diagram of a structure of a single pole four throw switch according to an embodiment of this application. Refer to FIG. 5. An embodiment of this application provides a single pole four throw switch. The single pole four throw switch is formed by connecting three single pole double throw switches provided in Embodiment 1. A first single pole double throw switch K1 is disposed in series with a second single pole double throw switch K2 and a third single pole double throw switch K3 that are disposed in parallel.

[0063] Specifically, an input port S3 of a three dB coupler 11 of the first single pole double throw switch K1 is used as an input port of the single pole four throw switch, and two output ports P3 and P4 of a first magic T 300 of the first single pole double throw switch K1 are respectively connected to an input port S3 of a three dB coupler 11 of the second single pole double throw switch K2 and an input port S3 of a three dB coupler 11 of the third single pole double throw switch K3, output ports P3 and P4 of the first magic T 300 of the second single pole double throw switch K2 and the first magic T 300 of the third single pole double throw switch K3 are used as output ports of the single pole four throw switch. For specific structures of the first single pole double throw switch K1, the second single pole double throw switch K2, and the third single pole double throw switch K3, refer to the descriptions in Embodiment 1. Details are not described herein again.

[0064] A working process of the single pole four throw switch provided in this embodiment of this application is as follows.

[0065] After a power signal is input from the input port S3 of the three dB coupler 11 of the first single pole double throw switch K1, when two ferrite circulators 200 of the first single pole double throw switch K1 are in a same magnetic field bias state, the power signal is output from the output port P3 of the first magic T 300 of the first single pole double throw switch K1. In this case, if the two ferrite circulators 200 of the second single pole double throw switch K2 are in a same magnetic field bias state, a power signal is output from the output port P3 of the first magic T 300 of the second single pole double throw switch K2. If the two ferrite circulators 200 of the second single pole double throw switch K2 are in different magnetic field bias states, a power signal is output from the output port P4 of the first magic T 300 of the second single pole double throw switch K2. After a power signal is input from the input port S3 of the three dB coupler 11 of the first single pole double throw switch K1, when the two ferrite circulators 200 of the first single pole double throw switch K1 are in different magnetic field bias states, a power signal is output from the output port P4 of the first magic T 300 of the first single pole double throw switch K1. In this case, if two ferrite circulators 200 of the third single pole double throw switch K3 are in the same magnetic field bias state, a power signal is output from the output port P3 of the first magic T 300 of the third single pole double throw switch K3. If two ferrite circulators 200 of the third single pole double throw switch K3 are in different magnetic field bias states, a power signal is output from the output port P4 of the first magic T 300 of the third single pole double throw switch K3.

[0066] On the contrary, when a power signal is input from the P3 port of the first magic T 300 of the second single pole double throw switch K2, the two ferrite circulators 200 of the second single pole double throw switch K2 and the two ferrite circulators 200 of the first single pole double throw switch K1 are respectively in a same magnetic field bias state, and a power signal is finally output from the S3 port of the three dB coupler 11 of the first single pole double throw switch K1. When a power signal is input from the P4 port of the first magic T 300 of the second single pole double throw switch K2, the two ferrite circulators 200 of the second single pole double throw switch K2 are set to be in different magnetic field bias states and the two ferrite circulators 200 of the first single pole double throw switch K1 are set to be in a same magnetic field bias state, and a power signal is finally output from the S3 port of the three dB coupler 11 of the first single pole double throw switch K1. When a power signal is input from the P3 port of the first magic T 300 of the third single pole double throw switch K3, the two ferrite circulators 200 of the third single pole double throw switch K3 are set to be in a same magnetic field bias state and the two ferrite circulators 200 of the first single pole double throw switch K1 are set to be in different magnetic field bias states, and a power signal is finally output from the S3 port of the three dB coupler 11 of the first single pole double throw switch K1. When a power signal is input from the P4 port of the first magic T 300 of the third single pole double throw switch K3, the two ferrite circulators 200 of the first single pole double throw switch K1 and the two ferrite circulators 200 of the second single pole double throw switch K2 are respectively in different magnetic field bias states, and a power signal is finally output from the S3 port of the three dB coupler 11 of the first single pole double throw switch K1.

[0067] It should be noted that, according to a structure and a working principle of the single pole four throw switch provided in this embodiment of this application, it is not difficult to figure out that a plurality of single pole double throw switches may be further disposed in series and parallel, to implement a function of a single pole multi throw switch.

[0068] According to the single pole four throw switch provided in this embodiment of this application, one single pole double throw switch and two parallel single pole double throw switches are disposed in series. Each single pole double throw switch is obtained from combination of the three dB coupler, the ferrite circulators connected to the short-circuit loads, and the first magic T. By controlling magnetic field bias states of three groups of ferrite circulators, a function of a single pole four throw switch is implemented, and the single pole four throw switch is enabled to have a reciprocal characteristic. In addition, the single pole four throw switch maintains low insertion loss characteristics of the ferrite circulator and the magic T. This can significantly improve performance of the ferrite switch, and then improve performance of an antenna.

Embodiment 3

[0069] FIG. 6 is a schematic diagram of a structure of a double single pole double throw switch according to an embodiment of this application. Refer to FIG. 6. An embodiment of this application provides a double single pole double throw switch. The double single pole double throw switch includes a second magic T 12, a first magic T 300, and two ferrite circulators 200. The second magic T 12 has a first input port S6, a second input port S7, a first output port S8, and a second output port S9, either of the first input port S6 and the second input port S7 is configured to input a power signal, a power signal input from the first input port S6 is output in equi-amplitude in-phase through the first output port S8 and the second output port S9, and a power signal input from the second input port S7 is output in equi-amplitude phase-inverted through the first output port S8 and the second output port S9.

[0070] First ports R1 of the two ferrite circulators 200 are respectively connected to the first output port S8 and the second output port S9 of the second magic T 12, second ports R2 of the two ferrite circulators 200 are respectively connected to short-circuit loads 21, and third ports R3 of the two ferrite circulators 200 are respectively connected to two input ports P1 and P2 of the first magic T 300.

[0071] A working process of the double single pole double throw switch provided in this embodiment of this application is as follows.

[0072] After a power signal is input from the first input port S6 of the second magic T 12, the power signal is output as equi-amplitude in-phase signals from the first output port S8 and the second output port S9 of the second magic T 12. In this case, if the two ferrite circulators 200 are set to be in a same magnetic field bias state, third ports R3 of the two ferrite circulators 200 output equi-amplitude in-phase power signals, and finally a power signal is output from an output port P3 of the first magic T 300. If the two ferrite circulators 200 are set to be in different magnetic field bias states, third ports R3 of the two ferrite circulators 200 output equi-amplitude phase-inverted power signals, and finally a power signal is output from an output port P4 of the first magic T 300.

[0073] After a power signal is input from the second input port S7 of the second magic T 12, the power signal is output from the first output ports S8 and the second output ports S9 of the second magic T 12 in equi-amplitude phase-inverted. In this case, if the two ferrite circulators 200 are set to be in a same magnetic field bias state, third ports R3 of the two ferrite circulators 200 output equi-amplitude phase-inverted power signals, and finally a power signal is output from an output port P4 of the first magic T 300. If the two ferrite circulators 200 are set to be in different magnetic field bias states, third ports R3 of the two ferrite circulators 200 output equi-amplitude in-phase power signals, and finally a power signal is output from the output port P3 of the first magic T 300.

[0074] On the contrary, when a power signal is input from the port P3 of the first magic T 300, the two ferrite circulators 200 are set to be in a same magnetic field bias state, so that the power signal can be finally output from the first input port S6 of the second magic T 12, and the two ferrite circulators 200 are set to be in opposite magnetic field bias states, so that the power signals can be finally output from the second input port S7 of the second magic T 12. When a power signal is input from the port P4 of the first magic T 300, the two ferrite circulators 200 are set to be in a same magnetic field bias state, so that the power signal may be finally output from the second input port S7 of the second magic T 12, and the two ferrite circulators 200 are set to be in opposite magnetic field bias states, so that a power signal may be finally output from the first input port S6 of the second magic T 12.

[0075] The second magic T 12 includes various forms such as a waveguide, a microstrip, or a stripline, and can flexibly adapt to various port types.

[0076] According to the double single pole double throw switch provided in this embodiment of this application, the second magic T, the ferrite circulators connected to the short-circuit loads, and the first magic T are disposed in combination. The two ferrite circulators are controlled to be in a same magnetic field bias state or different magnetic field bias states, and a power signal is input from either of the two input ports of the ferrite switch, to implement a function of the double single pole double throw switch, and enable the double single pole double throw switch to have a reciprocal characteristic. In addition, the double single pole double throw switch maintains low insertion loss characteristics of the ferrite circulator and the magic T. This can significantly improve performance of the ferrite switch, and then improve performance of an antenna.

Embodiment 4

[0077] FIG. 7 is a schematic diagram of a structure of a double pole double throw switch according to an embodiment of this application. Refer to FIG. 7. An embodiment of this application provides a double pole double throw switch. The double pole double throw switch includes a third magic T 13, a first magic T 300, and two ferrite circulators 200. The third magic T 13 has a third input port S10, a fourth input port S11, a third output port S12, and a fourth output port S13, the third input port S10 and the fourth input port S11 are configured to input mutually orthogonal power signals simultaneously, a power signal input from the third input port S10 is output in equi-amplitude in-phase through the third output port S12 and the fourth output port S13, and a power signal input from the fourth input port S11 is output in equi-amplitude phase-inverted through the third output port S12 and the fourth output port S13.

[0078] First ports R1 of the two ferrite circulators 200 are respectively connected to the third output port S12 and the fourth output port S13 of the third magic T 13, second ports R2 of the two ferrite circulators 200 are respectively connected to short-circuit loads 21, and third ports R3 of the two ferrite circulators 200 are respectively connected to two input ports P1 and P2 of the first magic T 300.

[0079] A working process of the double pole double throw switch provided in this embodiment of this application is as follows.

[0080] After the mutually orthogonal power signals are input from the third input port S10 and the fourth input port S11 of the third magic T 13, the power signals do not interfere with each other. The power signal input from the third input port S10 is output as a first channel of equi-amplitude in-phase power signals from the third output port S12 and the fourth output port S13 of the third magic T 13, and the power signal input from the fourth input port S11 of the third magic T 13 is output as a second channel of equi-amplitude phase-inverted power signals from the third output port S12 and the fourth output port S13 of the third magic T 13.

[0081] In this case, if the two ferrite circulators 200 are set to be in a same magnetic field bias state, the first channel of power signals in equi-amplitude in-phase continuously output equi-amplitude in-phase power signals through the third ports R3 of the two ferrite circulators 200, and finally the first channel of power signals are output from an output port P3 of the first magic T 300. While the second channel of power signals in equi-amplitude phase-inverted continuously output the equi-amplitude phase-inverted power signals through the third ports R3 of the two ferrite circulators 200, and finally the second channel of power signals are output from an output port P4 of the first magic T 300.

[0082] In this case, if the two ferrite circulators 200 are set to be in different magnetic field bias states, the first channel of equi-amplitude in-phase power signals are output as equi-amplitude phase-inverted power signals through the third ports R3 of the two ferrite circulators 200, and finally are output from an output port P4 of the first magic T 300; and the second channel of equi-amplitude phase-inverted power signals are output as the equi-amplitude in-phase power signals through the third ports R3 of the two ferrite circulators 200, and finally are output from an output port P3 of the first magic T 300.

[0083] On the contrary, it may be learned that when power signals that are mutually orthogonal are respectively input from the ports P3 and P4 of the first magic T 300, the power signals do not interfere with each other. If the two ferrite circulators 200 are set to be in a same magnetic field bias state, so that the power signal input from the port P3 of the first magic T 300 can be finally output from the third input port S10 of the third magic T 13, and the power signal input from the port P4 of the first magic T 300 can be finally output from the fourth input port S11 of the third magic T 13. If the two ferrite circulators 200 are set to be in opposite magnetic field bias states, the power signal input from the port P3 of the first magic T 300 can be finally output from the fourth input port S11 of the third magic T 13, and the power signal input from the port P4 of the first magic T 300 can be finally output from the third input port S10 of the third magic T 13.

[0084] The third magic T 13 includes various forms such as a waveguide, a microstrip, or a stripline, and can flexibly adapt to various port types.

[0085] According to the double pole double throw switch provided in this embodiment of this application, the third magic T, the ferrite circulators connected to the short-circuit loads, and the first magic T are disposed in combination. The two ferrite circulators are controlled to be in a same magnetic field bias state or different magnetic field bias states, and mutually orthogonal power signals are controlled to be simultaneously input from the two input ports of the ferrite switch, so that a function of the double pole double throw switch is implemented, and the double pole double throw switch is enabled to have a reciprocal characteristic. In addition, the double pole double throw switch maintains low insertion loss characteristics of the ferrite circulator and the magic T. This can significantly improve performance of the ferrite switch, and then improve performance of an antenna.

[0086] Finally, it should be noted that the foregoing embodiments are merely intended for describing the technical solutions of embodiments of this application other than limiting embodiments of this application. Although embodiments of this application are described in detail with reference to the foregoing embodiments, persons of ordinary skill in the art should understand that they may still make modifications to the technical solutions described in the foregoing embodiments or make equivalent replacements to some or all technical features thereof, without departing from the scope of the technical solutions of embodiments of this application.

Claims

1. A ferrite switch, comprising a coupler (100), a first magic T (300) and two ferrite circulators (200), wherein

   the ferrite circulators (200) have first ports (R1), second ports (R2), and third ports (R3), the second ports (R2) are connected to short-circuit loads (21), the first ports (R1) of the two ferrite circulators (200) are respectively connected to two output ports (S1, S2) of the coupler (100), the two output ports (S1, S2) of the coupler (100) are configured to output equi-amplitude in-phase or equi-amplitude phase-inverted power signals, and the third ports (R3) of the two ferrite circulators (200) are respectively connected to two input ports (P1, P2) of the first magic T (300);

   the short-circuit load (21) is configured as follows: when the ferrite circulator (200) is in a first magnetic field bias state, a power signal input from the first port (R1) outputs a first phase from the third port (R3); and when the ferrite circulator (200) is in a second magnetic field bias state, after being reflected by the second port (R2), a power signal input from the first port (R1) outputs a second phase from the third port (R3), wherein a phase difference between the first phase and the second phase is 180 degrees;

   the two ferrite circulators (200) are configured to have a same magnetic field bias state or different magnetic field bias states.

2. The ferrite switch according to claim 1, wherein the coupler (100) comprises a three dB coupler (11), the three dB coupler has one input port (S3) and two output ports (S4, S5), and after a power signal is input from the input port (S3) of the three dB coupler (11), the power signal is output from the two output ports (S4, S5) of the three dB coupler (11) in equi-amplitude in-phase; and a single pole double throw switch comprises the one three dB coupler (11), the one first magic T (300), and the two ferrite circulators (200).

3. The ferrite switch according to claim 2, wherein there are three single pole double throw switches (K1, K2, K3), and a first single pole double throw switch (K1) is disposed in series with a second single pole double throw switch (K2) and a third single pole double throw switch (K3) that are disposed in parallel.

4. The ferrite switch according to claim 2 or 3, wherein the three dB coupler (11) comprises a waveguide, microstrip, or stripline form.

5. The ferrite switch according to claim 1, wherein the coupler (100) comprises a second magic T (T12), the second magic T (12) has a first input port (S6), a second input port (S7), a first output port (S8), and a second output port (S9), wherein either of the first input port (S6) and the second input port (S7) is configured to input a power signal, a power signal input from the first input port (S6) is output in equi-amplitude in-phase through the first output port (S8) and the second output port (S9), and a power signal input from the second input port (S7) is output in equi-amplitude phase-inverted through the first output port (S8) and the second output port (S9), the first ports (R1) of the two ferrite circulators (200) are respectively connected to two output ports (S8, S9) of the second magic T (T12).

6. The ferrite switch according to claim 1, wherein the coupler (100) comprises a third magic T (T13), the third magic T comprises a third input port (S10), a fourth input port (S11), a third output port (S12), and a fourth output port (S13), wherein the third input port (S10) and the fourth input port (S11) are configured to simultaneously input mutually orthogonal power signals, a power signal input from the third input port (S10) is output in equi-amplitude in-phase through the third output port (S12) and the fourth output port (S13), and a power signal input from the fourth input port (S11) is output in equi-amplitude phase-inverted through the third output port (S12) and the fourth output port (S13), the first ports (R1) of the two ferrite circulators (200) are respectively connected to two output ports (S12, S13) of the third magic T (T13).

7. The ferrite switch according to any one of claims 1 to 6, wherein the ferrite circulator (200) comprises the waveguide, microstrip, or stripline form.

8. The ferrite switch according to any one of claims 1 to 7, wherein the first magic T (300) comprises the waveguide, microstrip, or stripline form.

9. The ferrite switch according to any one of claims 1 to 8, wherein the ferrite switch further comprises two coils, and the two coils are respectively connected to the two ferrite circulators (200), and are configured to provide the first magnetic field bias state or the second magnetic field bias state for the ferrite circulators.

10. A microwave antenna, comprising at least one ferrite switch according to any one of claims 1 to 9, wherein the ferrite switch is connected to a feed of the microwave antenna, and the ferrite switch is configured to control the microwave antenna to perform beam sweeping.

11. An electronic device, comprising the microwave antenna according to claim 10.

Patentansprüche

1. Ferritschalter, der einen Koppler (100), ein erstes magisches T (300) und zwei Ferritzirkulatoren (200) umfasst, wobei

   die Ferritzirkulatoren (200) erste Tore (R1), zweite Tore (R2) und dritte Tore (R3) aufweisen, die zweiten Tore (R2) mit Kurzschlusslasten (21) verbunden sind, die ersten Tore (R1) der zwei Ferritzirkulatoren (200) jeweils mit zwei Ausgangstoren (S1, S2) des Kopplers (100) verbunden sind, die zwei Ausgangstore (S1, S2) des Kopplers (100) zum Ausgeben von Äqui-Amplituden-gleichphasigen oder Äqui-Amplitudenphaseninvertierten Leistungssignalen ausgelegt sind und die dritten Tore (R3) der zwei Ferritzirkulatoren (200) jeweils mit zwei Eingangstoren (P1, P2) des ersten magischen T (300) verbunden sind;

   die Kurzschlusslast (21) wie folgt ausgelegt ist: wenn der Ferritzirkulator (200) in einem ersten Magnetfeldvorspannungszustand ist, gibt ein von dem ersten Tor (R1) eingegebenes Leistungssignal eine erste Phase von dem dritten Tor (R3) aus; und wenn der Ferritzirkulator (200) in einem zweiten Magnetfeldvorspannungszustand ist, gibt ein von dem ersten Tor (R1) eingegebenes Leistungssignal, nachdem es durch das zweite Tor (R2) reflektiert wurde, eine zweite Phase von dem dritten Tor (R3) aus, wobei eine Phasendifferenz zwischen der ersten Phase und der zweiten Phase 180 Grad ist;

   die zwei Ferritzirkulatoren (200) dazu ausgelegt sind, einen gleichen Magnetfeldvorspannungszustand oder verschiedene Magnetfeldvorspannungszustände aufzuweisen.

2. Ferritschalter nach Anspruch 1, wobei der Koppler (100) einen Drei-dB-Koppler (11) umfasst, der Drei-dB-Koppler ein Eingangstor (S3) und zwei Ausgangstore (S4, S5) aufweist und, nachdem ein Leistungssignal von dem Eingangstor (S3) des Drei-dB-Kopplers (11) eingegeben wird, das Leistungssignal von den zwei Ausgangstoren (S4, S5) des Drei-dB-Kopplers (11) Äqui-Amplituden-gleichphasig ausgegeben wird; und ein einpoliger Wechselschalter den einen Drei-dB-Koppler (11), das eine erste magische T (300) und die zwei Ferritzirkulatoren (200) umfasst.

3. Ferritschalter nach Anspruch 2, wobei drei einpolige Wechselschalter (K1, K2, K3) vorhanden sind und ein erster einpoliger Wechselschalter (K1) in Reihe mit einem zweiten einpoligen Wechselschalter (K2) und einem dritten einpoligen Wechselschalter (K3), die parallel angeordnet sind, angeordnet ist.

4. Ferritschalter nach Anspruch 2 oder 3, wobei der Drei-dB-Koppler (11) eine Wellenleiter-, Mikrostreifen- oder Streifenleitungsform umfasst.

5. Ferritschalter nach Anspruch 1, wobei der Koppler (100) ein zweites magisches T (T12) umfasst, das zweite magische T (12) ein erstes Eingangstor (S6), ein zweites Eingangstor (S7), ein erstes Ausgangstor (S8) und ein zweites Ausgangstor (S9) aufweist, wobei beide des ersten Eingangstors (S6) und des zweiten Eingangstors (S7) zum Eingeben eines Leistungssignals ausgelegt sind, ein Leistungssignal, das von dem ersten Eingangstor (S6) eingegeben wird, Äqui-Amplituden-gleichphasig durch

das erste Ausgangstor (S8) und das zweite Ausgangstor (S9) ausgegeben wird und ein Leistungssignal, das von dem zweiten Eingangstor (S7) eingegeben wird, Äqui-Amplituden-phaseninvertiert durch das erste Ausgangstor (S8) und das zweite Ausgangstor (S9) ausgegeben wird, die ersten Tore (R1) der zwei Ferritzirkulatoren (200) jeweils mit zwei Ausgangstoren (S8, S9) des zweiten magischen T (T12) verbunden sind.

6. Ferritschalter nach Anspruch 1, wobei der Koppler (100) ein drittes magisches T (T13) umfasst, das dritte magische T ein drittes Eingangstor (S10), ein viertes Eingangstor (S11), ein drittes Ausgangstor (S12) und ein viertes Ausgangstor (S13) umfasst, wobei das dritte Eingangstor (S10) und das vierte Eingangstor (S11) zum gleichzeitigen Eingeben gegenseitig orthogonaler Leistungssignale ausgelegt sind, ein Leistungssignal, das von dem dritten Eingangstor (S10) eingegeben wird, Äqui-Amplituden-gleichphasig durch das dritte Ausgangstor (S12) und das vierte Ausgangstor (S13) ausgegeben wird und ein Leistungssignal, das von dem vierten Eingangstor (S11) eingegeben wird, Äqui-Amplituden-phaseninvertiert durch das dritte Ausgangstor (S12) und das vierte Ausgangstor (S13) ausgegeben wird, die ersten Tore (R1) der zwei Ferritzirkulatoren (200) jeweils mit zwei Ausgangstoren (S12, S13) des dritten magischen T (T13) verbunden sind.

7. Ferritschalter nach einem der Ansprüche 1 bis 6, wobei der Ferritzirkulator (200) die Wellenleiter-, Mikrostreifen- oder Streifenleitungsform umfasst.

8. Ferritschalter nach einem der Ansprüche 1 bis 7, wobei das erste magische T (300) die Wellenleiter-, Mikrostreifen- oder Streifenleitungsform umfasst.

9. Ferritschalter nach einem der Ansprüche 1 bis 8, wobei der Ferritschalter ferner zwei Spulen umfasst und die zwei Spulen jeweils mit den zwei Ferritzirkulatoren (200) verbunden und zum Bereitstellen des ersten Magnetfeldvorspannungszustands oder des zweiten Magnetfeldvorspannungszustands für die Ferritzirkulatoren ausgelegt sind.

10. Mikrowellenantenne, die zumindest einen Ferritschalter nach einem der Ansprüche 1 bis 9 umfasst, wobei der Ferritschalter mit einer Zuleitung der Mikrowellenantenne verbunden ist und der Ferritschalter zum Steuern der Mikrowellenantenne zum Durchführen eines "Beamsweeping" ausgelegt ist.

11. Elektronisches Gerät, das die Mikrowellenantenne nach Anspruch 10 umfasst.

Revendications

1. Commutateur en ferrite, comprenant un coupleur (100), un premier T magique (300) et deux circulateurs en ferrite (200), dans lequel

les circulateurs en ferrite (200) ont des premiers ports (R1), des deuxièmes ports (R2), et des troisièmes ports (R3), les deuxièmes ports (R2) sont connectés à des charges à court-circuit (21), les premiers ports (R1) des deux circulateurs en ferrite (200) sont respectivement connectés à deux ports de sortie (S1, S2) du coupleur (100), les deux ports de sortie (S1, S2) du coupleur (100) sont configurés pour sortir des signaux de puissance en phase équi-amplitude ou en phase inversée équi-amplitude, et les troisièmes ports (R3) des deux circulateurs en ferrite (200) sont respectivement connectés à deux ports d'entrée (P1, P2) du premier T magique (300) ;

la charge à court-circuit (21) est configurée comme suit : lorsque le circulateur en ferrite (200) est dans un premier état de polarisation en champ magnétique, un signal de puissance entré depuis le premier port (R1) sort une première phase depuis le troisième port (R3) ; et, lorsque le circulateur en ferrite (200) est dans un second état de polarisation en champ magnétique, après être réfléchi par le deuxième port (R2), un signal de puissance entré depuis le premier port (R1) sort une seconde phase depuis le troisième port (R3), dans lequel une différence de phase entre la première phase et la seconde phase est de 180 degrés ;

les deux circulateurs en ferrite (200) sont configurés pour avoir un même état de polarisation en champ magnétique ou des états de polarisation en champ magnétique différents.

2. Commutateur en ferrite selon la revendication 1, dans lequel le coupleur (100) comprend un coupleur à trois dB (11), le coupleur à trois dB a un port d'entrée (S3) et deux ports de sortie (S4, S5), et, après qu'un signal de puissance est entré depuis le port d'entrée (S3) du coupleur à trois dB (11), le signal de puissance est sorti depuis les deux ports de sortie (S4, S5) du coupleur à trois dB (11) en phase équi-amplitude ; et un commutateur unipolaire à deux directions comprend l'un coupleur à trois dB (11), l'un premier T magique (300), et les deux circulateurs en ferrite (200).

3. Commutateur en ferrite selon la revendication 2, dans lequel il y a trois commutateurs unipolaires à deux directions (K1, K2, K3), et un premier commutateur unipolaire à deux directions (K1) est disposé en série avec un deuxième commutateur unipolaire à deux directions (K2) et un troisième commutateur unipolaire à deux directions (K3) qui sont disposés en parallèle.

4. Commutateur en ferrite selon la revendication 2 ou 3, dans lequel le coupleur à trois dB (11) comprend une forme guide d'ondes, microruban, ou ligne-ruban.

5. Commutateur en ferrite selon la revendication 1, dans lequel le coupleur (100) comprend un deuxième T magique (T12), le deuxième T magique (12) a un premier port d'entrée (S6), un deuxième port d'entrée (S7), un premier port de sortie (S8), et un deuxième port de sortie (S9), dans lequel l'un ou l'autre du premier port d'entrée (S6) et du deuxième port d'entrée (S7) est configuré pour entrer un signal de puissance, un signal de puissance entré depuis le premier port d'entrée (S6) est sorti en phase équi-amplitude par l'intermédiaire du premier port de sortie (S8) et du deuxième port de sortie (S9), et un signal de puissance entré depuis le deuxième port d'entrée (S7) est sorti en phase inversée équi-amplitude par l'intermédiaire du premier port de sortie (S8) et du deuxième port de sortie (S9), les premiers ports (R1) des deux circulateurs en ferrite (200) sont respectivement connectés à deux ports de sortie (S8, S9) du deuxième T magique (T12).

6. Commutateur en ferrite selon la revendication 1, dans lequel le coupleur (100) comprend un troisième T magique (T13), le troisième T magique comprend un troisième port d'entrée (S10), un quatrième port d'entrée (S11), un troisième port de sortie (S12), et un quatrième port de sortie (S13), dans lequel le troisième port d'entrée (S10) et le quatrième port d'entrée (S11) sont configurés pour entrer simultanément des signaux de puissance mutuellement orthogonaux, un signal de puissance entré depuis le troisième port d'entrée (S10) est sorti en phase équi-amplitude par l'intermédiaire du troisième port de sortie (S12) et du quatrième port de sortie (S13), et un signal de puissance entré depuis le quatrième port d'entrée (S11) est sorti en phase inversée équi-amplitude par l'intermédiaire du troisième port de sortie (S12) et du quatrième port de sortie (S13), les premiers ports (R1) des deux circulateurs en ferrite (200) sont respectivement connectés à deux ports de sortie (S12, S13) du troisième T magique (T13).

7. Commutateur en ferrite selon l'une quelconque des revendications 1 à 6, dans lequel le circulateur en ferrite (200) comprend la forme guide d'ondes, microruban, ou ligne-ruban.

8. Commutateur en ferrite selon l'une quelconque des revendications 1 à 7, dans lequel le premier T magique (300) comprend la forme guide d'ondes, microruban, ou ligne-ruban.

9. Commutateur en ferrite selon l'une quelconque des revendications 1 à 8, dans lequel le commutateur en ferrite comprend en outre deux bobines, et les deux bobines sont respectivement connectées aux deux circulateurs en ferrite (200), et sont configurées pour fournir le premier état de polarisation en champ magnétique ou le second état de polarisation en champ magnétique pour les circulateurs en ferrite.

10. Antenne à micro-ondes, comprenant au moins un commutateur en ferrite selon l'une quelconque des revendications 1 à 9, dans lequel le commutateur en ferrite est connecté à une alimentation de l'antenne à micro-ondes, et le commutateur en ferrite est configuré pour commander l'antenne à micro-ondes pour réaliser un balayage de faisceau.

11. Dispositif électronique, comprenant l' antenne à micro-ondes selon la revendication 10.

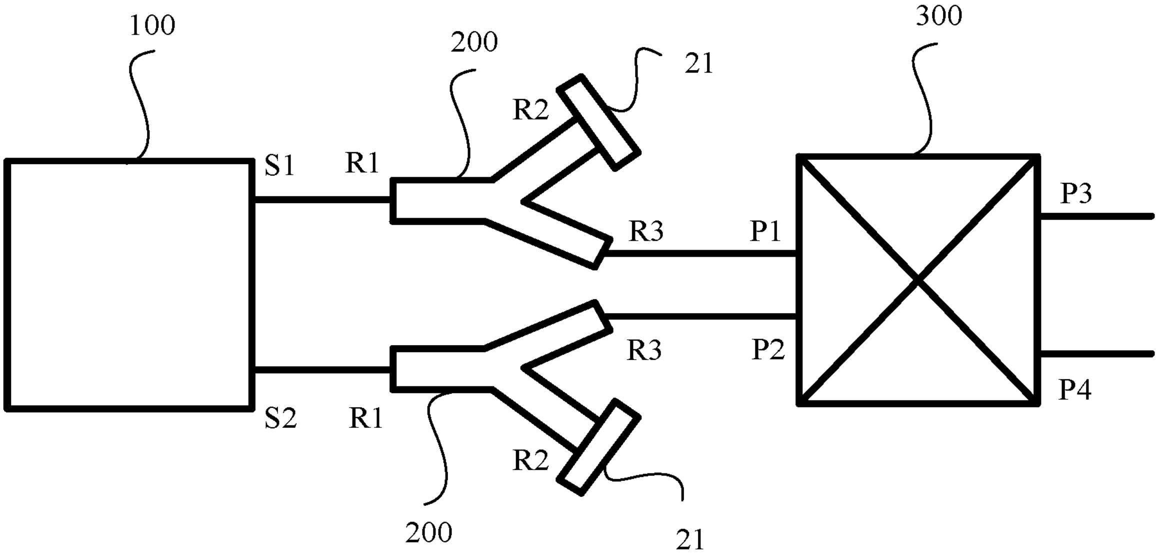

FIG. 1

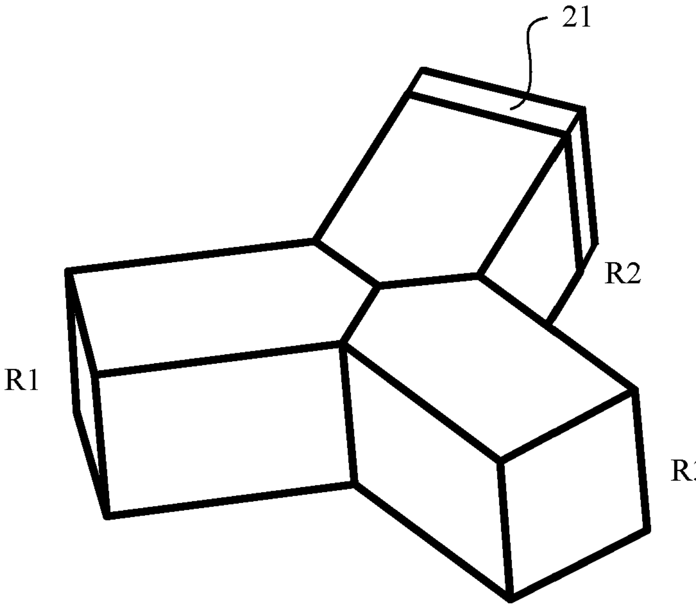

FIG. 2

20

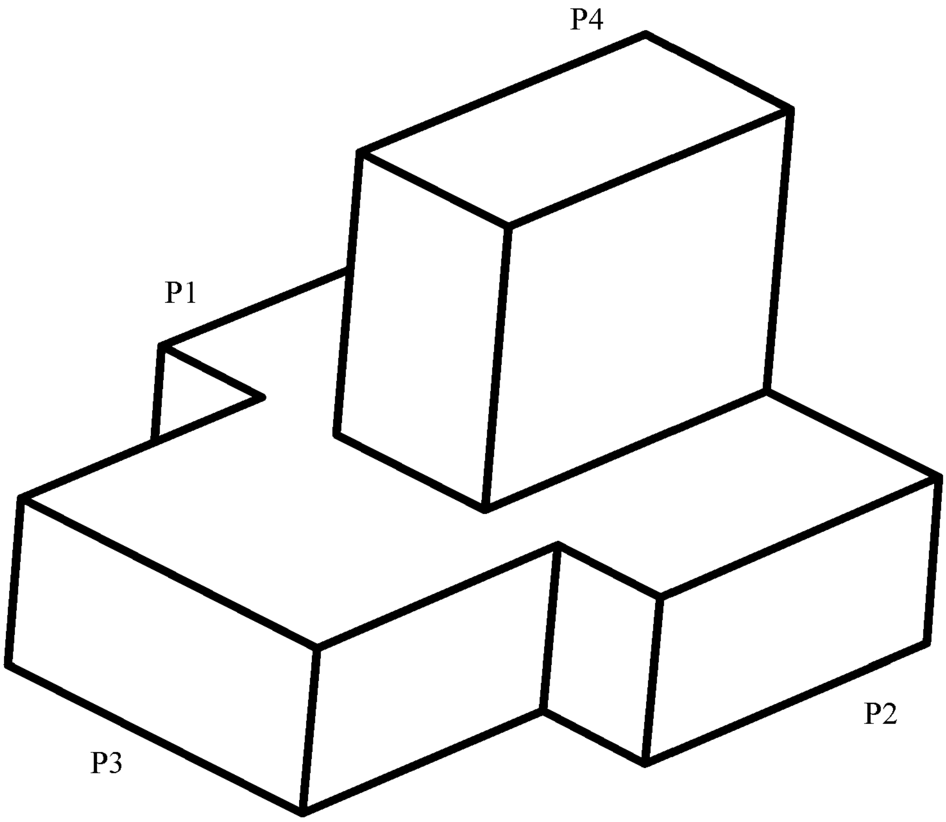

FIG. 3

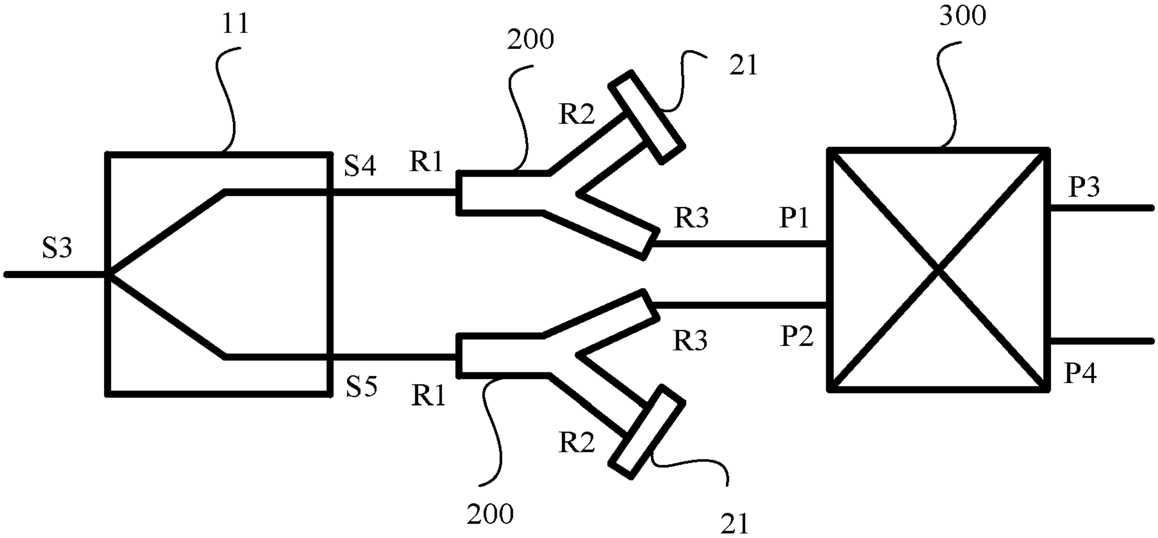

FIG. 4

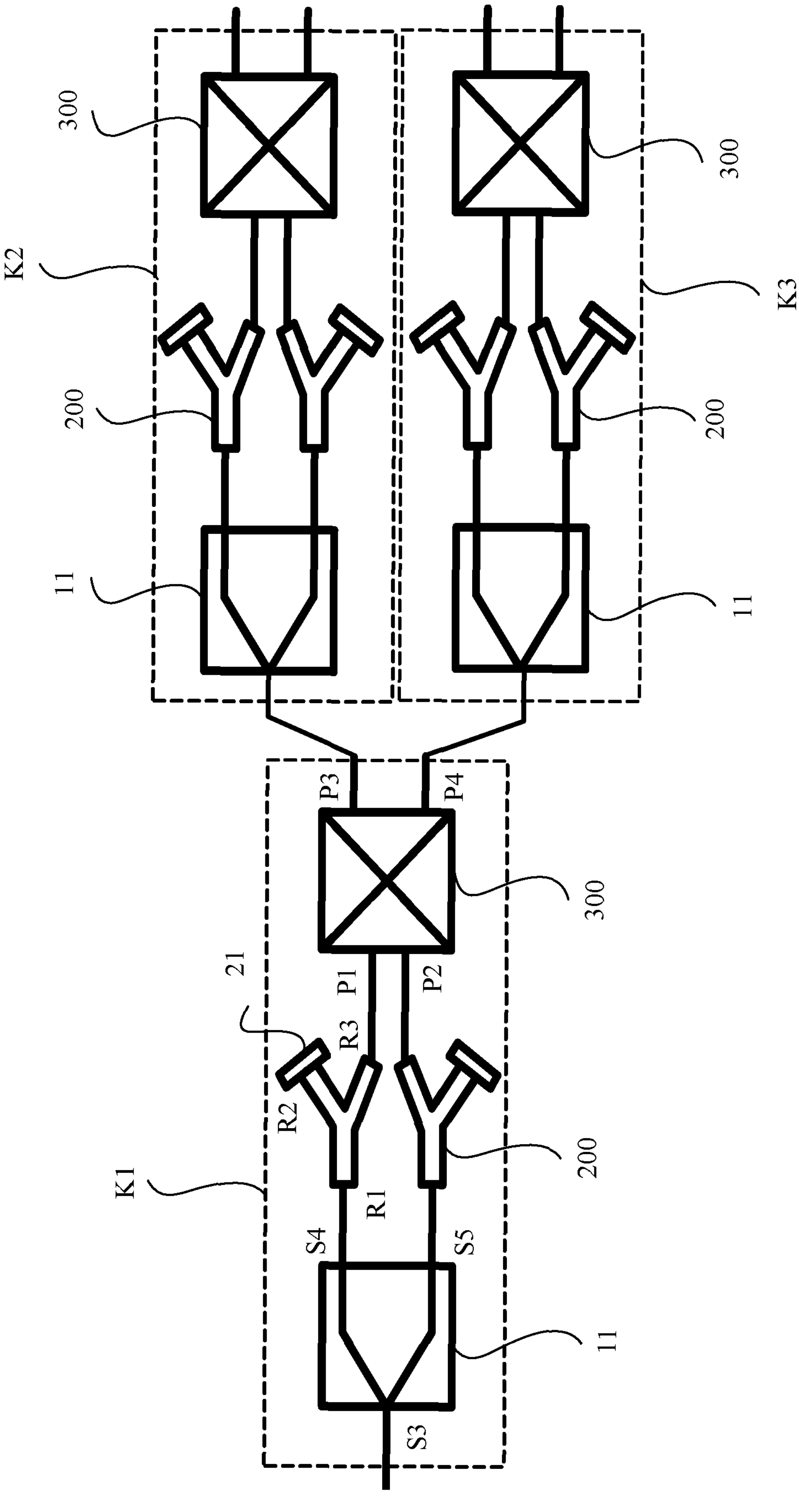
300
300
K2
K3
200
200
11
11
P3
P4
300
21
P1
P2
R3
R2
200
K1
R1
S4
S5
11
S3

FIG. 5

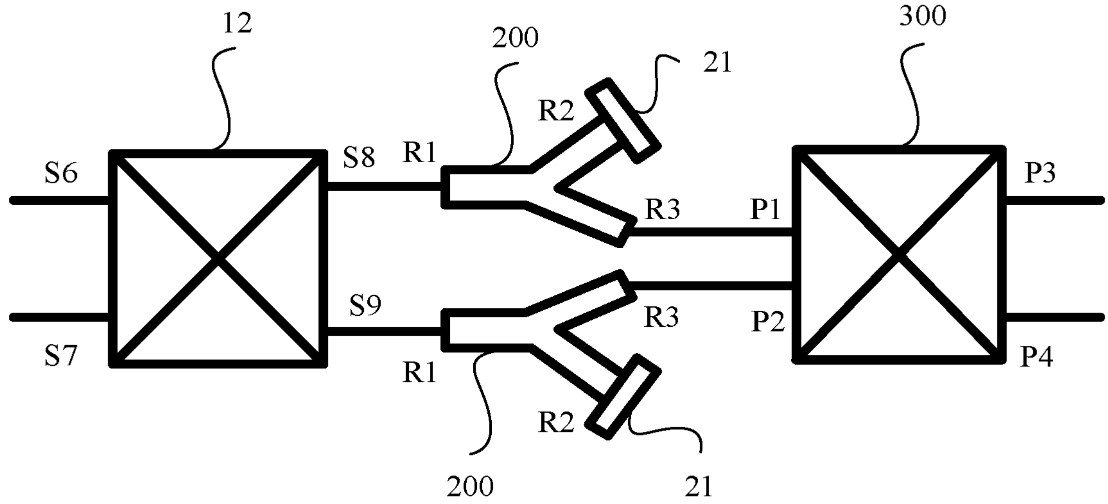
12
200
21
300
R2
S6
S8
R1
P3
R3
P1
S9
R3
P2
S7
R1
P4
R2
200
21

FIG. 6

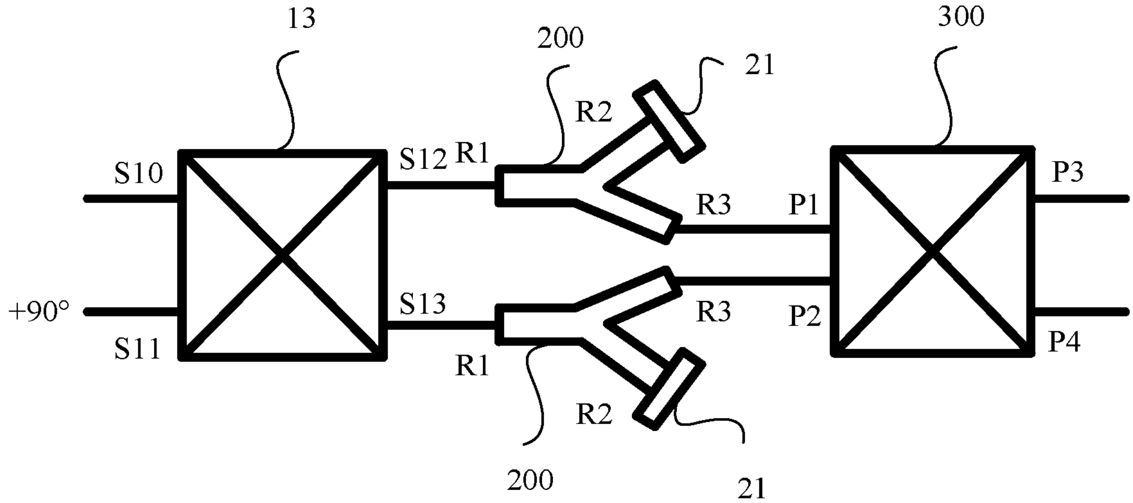
13
200
21
300
R2
S12
R1
S10
P3
R3
P1
S13
R3
+90°
P2
S11
R1
P4
R2
200
21

FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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