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(54) MICROWAVE-SIGNAL TRANSMISSION PATH ASSEMBLY AND SINGLE-POLE SIX-THROW COAXIAL ELECTROMECHANICAL SWITCH

(57) Disclosed are a microwave signal transmission path component and a single-pole six-throw coaxial electromechanical switch belonging to the field of radio frequency relays. The single-pole six-throw coaxial electromechanical switch includes a control circuit component, an electromagnetic driving component and a microwave signal transmission path component, wherein the control circuit component controls whether there is an electric current flowing through a solenoid of the electromagnetic driving component; when there is the electric current flowing through the solenoid, a magnetic field is generated on a duplex iron core. A generated electromagnetic force attracts an armature to press an ejector rod, and further drive a transmission spring sheet to act, so that an intermediate joint and a peripheral joint of the microwave signal transmission path component are connected or disconnected. In this case, a microwave signal is input from the intermediate joint and output from any one of the six peripheral joints, thereby realizing a function of gating the microwave signal. The single-pole six-throw coaxial electromechanical switch has an advantage of high frequency, and a use frequency is capable of reaching 50 GHz. As a result, special requirements of a switch matrix in an automatic test system for an electromechanical switch are satisfied.

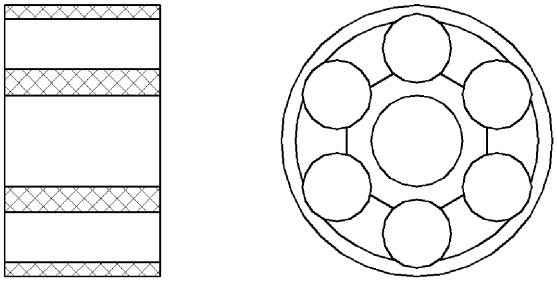

FIG.1

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Description

TECHNICAL FIELD

[0001] The present disclosure belongs to the field of radio frequency relays, and in particular to a microwave signal transmission path component and a single-pole six-throw coaxial electromechanical switch.

BACKGROUND

[0002] With continuous rising of an analog signal frequency and a digital signal rate, high-frequency high-performance electromechanical switches are more and more widely used in wireless communication, satellite communication, satellite navigation, radar systems, automatic control systems, automatic test equipment (ATE), and the like. In a situation that electronic devices are currently developed based on intelligentization, modularization and high frequency, high-performance electromechanical switches with high frequency, small loss and good anti-vibration performance gain more favors from people, and now become one of the important elements in radio frequency microwave devices in the world. For example, a large number of broadband electromechanical switches produced by companies such as Agilent, Dowkey and Teledyne in America and Radiall in France are widely used in aviation, aerospace, communication and automatic test systems. With the development of technology, these devices require a transmission switching frequency of the electromechanical switch to reach 50 GHz.

[0003] An existing technical solution is described below.

[0004] A single-pole six-throw electromechanical switch is usually formed by components such as a control circuit component, an electromagnetic driving component, a microwave signal transmission path component and a shell. At present, the frequency of the existing single-pole six-throw electromechanical switch can only reach 40 GHz at most, which cannot satisfy use requirements. Therefore, it is required to design a new high-frequency coaxial electromechanical switch.

[0005] The core of the transmission path of the coaxial electromechanical switch is to provide matching designing for a joint, i.e. a connection of a coaxial line structure, and a strip line structure formed by a spring sheet and a cavity, so that a impedance mismatch of a conversion part is offset by adding a through hole on a dielectric support inside the joint. As shown in FIG. 1, the switch cannot achieve matching at the frequency of 50 GHz in a matching compensation manner of such structure. Further, a new mismatch may be caused since external impurities easily enter the cavity through the through hole structure at the same time. Therefore, a new structure is required.

[0006] The highest frequency of the existing high-frequency electromechanical switch can only reach 40 GHz, therefore, the use requirements are not satisfied due to the low frequency.

SUMMARY

[0007] To solve the above technical problems existing in the prior art, the present disclosure provides a microwave signal transmission path component and a single-pole six-throw coaxial electromechanical switch, which are reasonably designed to overcome shortcomings in the prior art and achieve a good effect.

[0008] To achieve the above objects, the present disclosure adopts the following technical solution.

[0009] A microwave signal transmission path component includes one intermediate joint, six peripheral joints, six transmission spring sheets and a cavity, where each joint is formed by an inner conductor, an outer conductor and a dielectric support; the inner conductor is fixed by the dielectric support and placed inside the outer conductor to form a coaxial line structure with the outer conductor; six transmission spring sheets are placed inside the cavity to form a strip line structure with the cavity; the cavity is connected together with the outer conductor, and the six transmission spring sheets are all in contact with the inner conductor. Thus, connection of the coaxial line structure and the strip line structure is realized and a transmission function of a microwave signal is also realized. The intermediate joint and the six peripheral joints are used as an input end and an output end of the microwave signal transmission path component respectively to realize a function of one input and six outputs or six inputs and one output.

[0010] Preferably, the dielectric support adopts a groove structure configured to compensate a path mismatch.

[0011] Preferably, the dielectric support of the intermediate joint adopts a groove different from the grooves of the dielectric supports of the six peripheral joints in depth and radius.

[0012] In addition, the present disclosure further provides a single-pole six-throw coaxial electromechanical switch, including a control circuit component, an electromagnetic driving component and a microwave signal transmission path component, where the electromagnetic driving component includes an armature, an ejector rod, a duplex iron core, a solenoid and a mounting seat; the ejector rod is placed inside the duplex iron core, the armature is located in an upper part of the duplex iron core and in contact with the ejector rod, the duplex iron core is placed inside the solenoid, and the solenoid is arranged inside the mounting seat; the control circuit component includes three printed boards and is configured to control whether there is an electric current flowing through the solenoid of the electromagnetic driving component; the microwave signal transmission path component is the microwave signal transmission path component as described above.

[0013] The control circuit component controls whether

there is an electric current flowing through the solenoid of the electromagnetic driving component. If there is an electric current flowing through the solenoid, a magnetic field is generated on the duplex iron core, a generated electromagnetic force attracts the armature to press the ejector rod, and further drive the transmission spring sheet to act. In this way, the intermediate joint and the peripheral joint of the microwave signal transmission path component are connected or disconnected. Therefore, a microwave signal may be input from the intermediate joint and output from any one of the six peripheral joints, thereby realizing a function of gating the microwave signal.

[0014] The present disclosure has the following beneficial effects.

[0015] The present disclosure has an advantage of high frequency. The use frequency may reach 50 GHz, and special requirements of a switch matrix in an automatic test system for a miniaturized electromechanical switch may be satisfied.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a schematic diagram illustrating a structure of a dielectric support of a microwave signal path of a 40 GHz switch in the prior art.

FIG. 2 is a schematic diagram illustrating a structure of a single-pole six-throw coaxial electromechanical switch according to an example of the present disclosure.

FIG. 3 is a schematic diagram illustrating a structure of an electromagnetic driving component according to an example of the present disclosure.

FIG. 4 is a schematic diagram illustrating a structure of a microwave signal transmission path component according to an example of the present disclosure.

FIG. 5 is a schematic diagram illustrating a structure of a joint according to an example of the present disclosure.

FIG. 6 is a schematic diagram illustrating a structure of a dielectric support of an intermediate joint according to an example of the present disclosure.

FIG. 7 is a schematic diagram illustrating a structure of a dielectric support of a peripheral joint according to an example of the present disclosure.

[0017] Numerals of the drawings are described as follows: 1-a control circuit component, 2-an electromagnetic driving component, 21-an armature, 22-an ejector rod, 23-a duplex iron core, 24-a solenoid, 25-a mounting seat, 3-a microwave signal transmission path component, 31-an intermediate joint, 32-a peripheral joint, 33-a transmission spring sheet, 34-a cavity, 35-an inner conductor, 36-an outer conductor, and 37-a dielectric support.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0018] The present disclosure will be further described in detail below in combination with accompanying drawings and specific examples.

Example 1

[0019] As shown in FIG. 4, a microwave signal transmission path component 3 includes one intermediate joint 31, six peripheral joints 32, six transmission spring sheets 33 and a cavity 34, where each joint is formed by an inner conductor 35, an outer conductor 36 and a dielectric support 37. As shown in FIG. 5, the inner conductor 35 is fixed by the dielectric support 37 and placed inside the outer conductor 36 to form a coaxial line structure. Six transmission spring sheets 33 are placed inside the cavity 34 to form a strip line structure. The cavity 34 is connected together with the outer conductor 36, and six transmission spring sheets 33 are all in contact with the inner conductor 35. In this way, connection of the coaxial line structure and the strip line structure is realized and a transmission function of a microwave signal is achieved. The intermediate joint 31 and the six peripheral joints 32 are used as an input end and an output end of the microwave signal transmission path component 3 respectively. The contact of six transmission spring sheets 33 and the six peripheral joints 32 may be controlled by the electromagnetic driving component 2 to realize a function of inputting the microwave signal from one path and outputting the microwave signal from any one of the six paths.

[0020] The dielectric support 37 adopts a groove structure to compensate a path mismatch.

[0021] As shown in FIG. 6 and FIG. 7, the dielectric support of the intermediate joint 31 adopts a groove different from the grooves of the dielectric supports of six peripheral joints 32 in depth and radius to improve a matching degree.

Example 2

[0022] Based on the above example, the present disclosure further provides a single-pole six-throw coaxial electromechanical switch, including a control circuit component 1, an electromagnetic driving component 2 and a microwave signal transmission path component 3, where the control circuit component 1 includes three printed boards and is configured to control whether there is an electric current flowing through a solenoid 24 of the electromagnetic driving component 2; the electromagnetic driving component 2 has a structure as shown in FIG. 3, and the electromagnetic driving component 2 includes an armature 21, an ejector rod 22, a duplex iron core 23, a solenoid 24 and a mounting seat 25. The armature 21 is located in an upper part of the duplex iron core 23 and in contact with the ejector rod 22 placed inside the duplex iron core 23, the duplex iron core 23 is

placed inside the solenoid 24, and the solenoid 24 is arranged inside the mounting seat 25.

[0023] The control circuit component 1 controls whether there is an electric current flowing through the solenoid 24 of the electromagnetic driving component 2. If there is an electric current flowing through the solenoid 24, a generated electromagnetic force enables the duplex iron core 23 to act, so that a magnetic field is generated on the duplex iron core 23. The generated electromagnetic force attracts the armature 21 to press the ejector rod 22, and further drive the transmission spring sheet 33 to act, so that the intermediate joint 31 and the peripheral joint 32 of the microwave signal transmission path component 3 are connected or disconnected. Therefore, a microwave signal may be input from the intermediate joint 31 and output from any one of the six peripheral joints 32, thereby realizing a function of gating the microwave signal.

[0024] Of course, the above descriptions are not intended to limit the present disclosure. The present disclosure is also not limited to the above examples. All variations, modifications, additions or substitutions made by persons skilled in the art within the scope of essence of the present disclosure shall also belong to the scope of protection of the present disclosure.

Claims

1. A microwave signal transmission path component, comprising one intermediate joint, six peripheral joints, six transmission spring sheets and a cavity, wherein each joint is formed by an inner conductor, an outer conductor and a dielectric support; the inner conductor is fixed by the dielectric support and placed inside the outer conductor to form a coaxial line structure with the outer conductor; the six transmission spring sheets are placed inside the cavity to form a strip line structure with the cavity; the cavity is connected together with the outer conductor, and the six transmission spring sheets are all in contact with the inner conductor to realize connection of the coaxial line structure and the strip line structure as well as a transmission function of a microwave signal; the intermediate joint and the six peripheral joints are used as an input end and an output end of the microwave signal transmission path component respectively to realize a function of one input and six outputs or six inputs and one output.

2. The microwave signal transmission path component according to claim 1, wherein the dielectric support adopts a groove structure and is configured to compensate a path mismatch.

3. The microwave signal transmission path component according to claim 1, wherein the dielectric support of the intermediate joint adopts a groove different from the grooves of dielectric supports of the six peripheral joints in depth and radius.

4. A single-pole six-throw coaxial electromechanical switch, comprising a control circuit component, an electromagnetic driving component and a microwave signal transmission path component, wherein the electromagnetic driving component comprises an armature, an ejector rod, a duplex iron core, a solenoid and a mounting seat; the ejector rod is placed inside the duplex iron core, the armature is located in an upper part of the duplex iron core and in contact with the ejector rod, the duplex iron core is placed inside the solenoid, and the solenoid is arranged inside the mounting seat; the control circuit component comprises three printed boards and is configured to control whether there is an electric current flowing through the solenoid of the electromagnetic driving component; the microwave signal transmission path component is the microwave signal transmission path component according to claim 1.

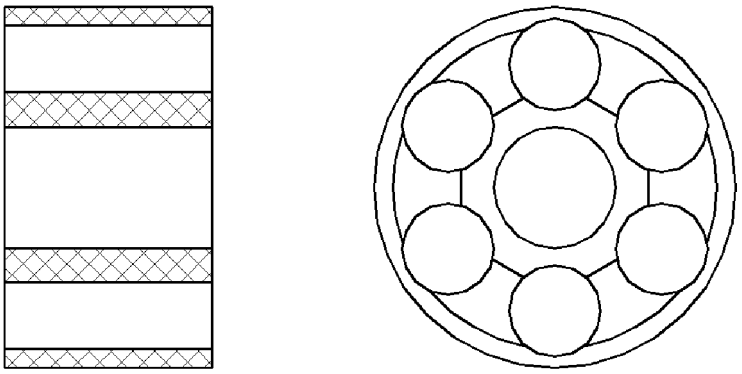

FIG.1

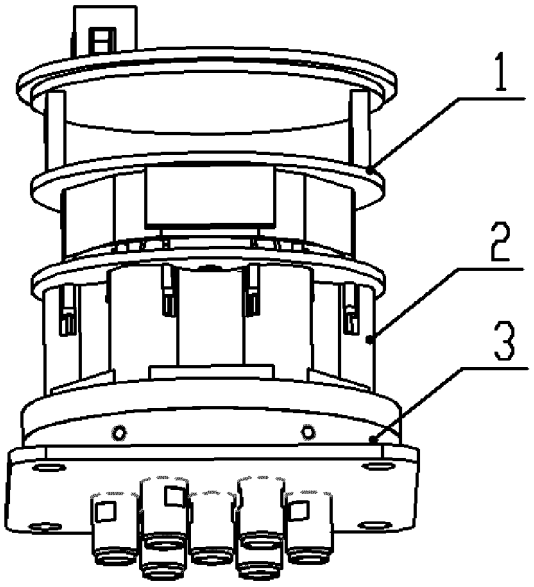

FIG.2

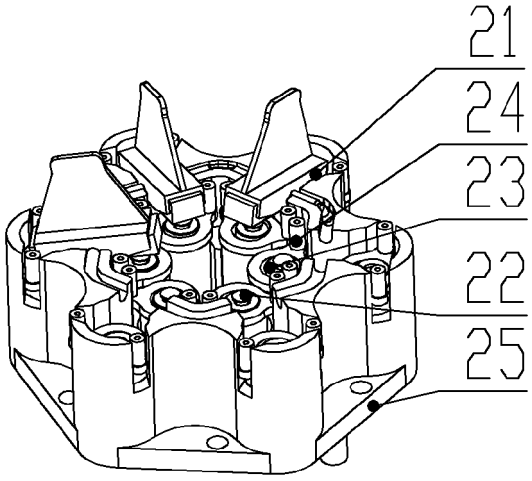

FIG.3

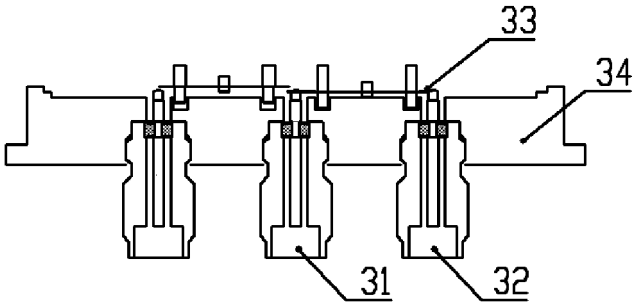

FIG.4

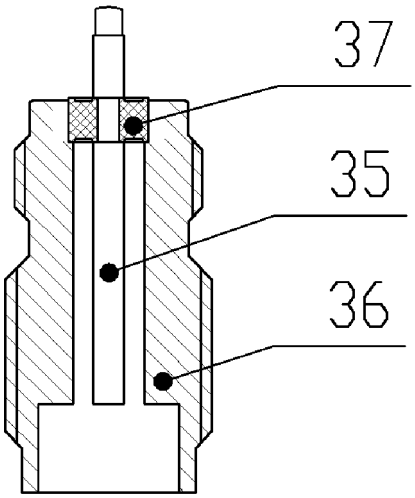

FIG.5

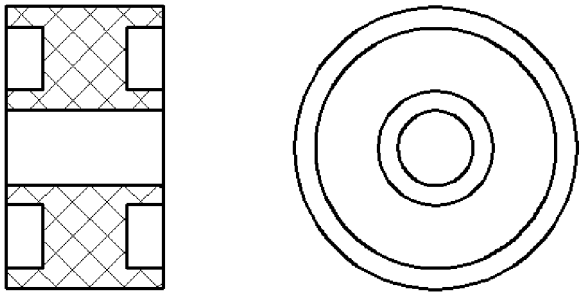

FIG.6

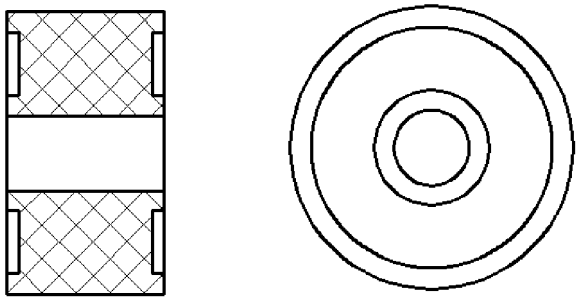

FIG.7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2017/116813

A. CLASSIFICATION OF SUBJECT MATTER

H01H 50/00 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNKI, CNPAT, WPI, EPODOC: 微波，传输，接头, microwave, transfer, connection

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 104183423 A (THE 41ST RESEARCH INSTITUTE OF CHINA ELECTRONICS TECHNOLOGY GROUP CORPORATION) 03 December 2014 (03.12.2014), description, paragraphs [0027]-[0036], and figures 1-6	1-4
A	CN 104008921 A (THE 40TH RESEARCH INSTITUTE OF CHINA ELECTRONICS TECHNOLOGY GROUP CORPORATION) 27 August 2014 (27.08.2014), entire document	1-4
A	CN 204230162 U (THE 41ST RESEARCH INSTITUTE OF CHINA ELECTRONICS TECHNOLOGY GROUP CORPORATION) 25 March 2015 (25.03.2015), entire document	1-4
A	CN 106558458 A (SUZHOU CIMING TECHNOLOGY CO., LTD.) 05 April 2017 (05.04.2017), entire document	1-4

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search	Date of mailing of the international search report
16 May 2018	30 May 2018

Name and mailing address of the ISA	Authorized officer
State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	MA, Yongxiang Telephone No. (86-10) 53961496

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2017/116813

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 104183423 A	03 December 2014	CN 104183423 B	25 May 2016
CN 104008921 A	27 August 2014	CN 104008921 B	24 February 2016
CN 204230162 U	25 March 2015	None	
CN 106558458 A	05 April 2017	US 9508513 B1	29 November 2016

Form PCT/ISA /210 (patent family annex) (July 2009)