Feb. 13, 1968 Y. GATTAZ 3,369,096

COAXIAL-CIRCUIT CHANGE-OVER SWITCH FOR HIGH FREQUENCY

Filed Nov. 22, 1966

Fig. 1.

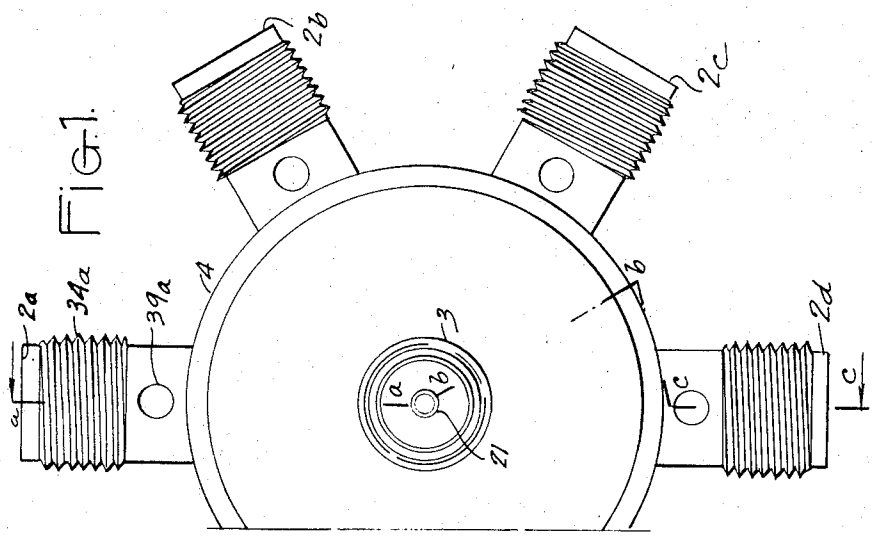


Fig. 2.

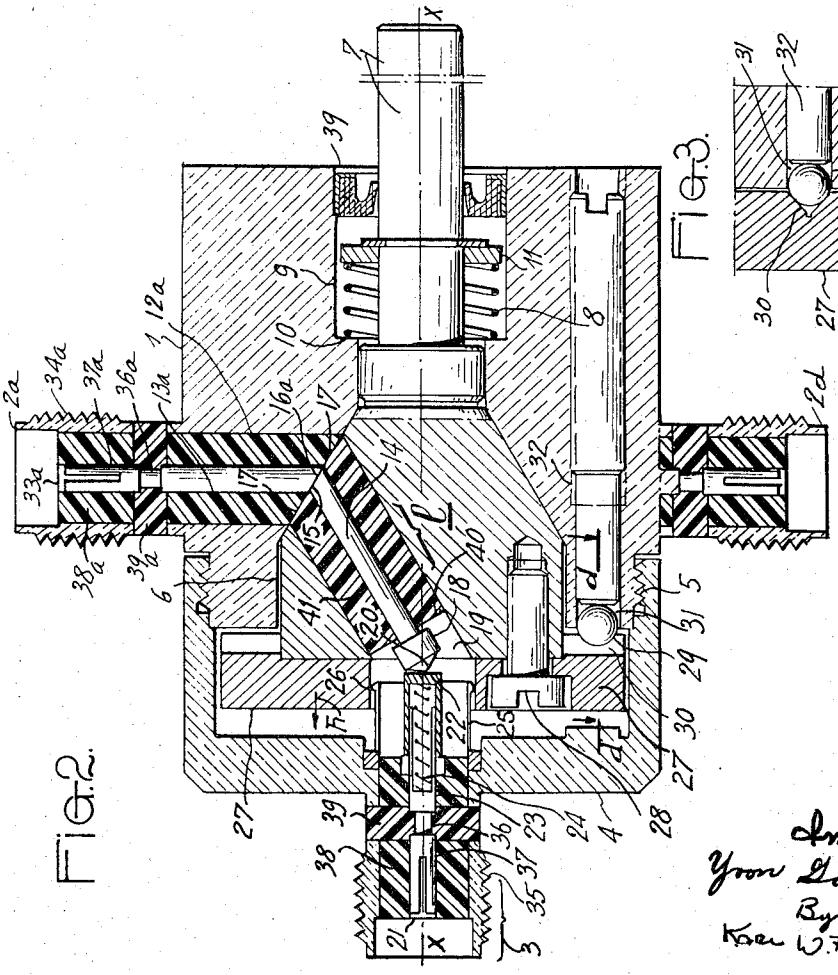


Fig. 3.

Inventor
Yvon Gattaz
By
Karl W. Flocks
Attorney

United States Patent Office

3,369,096

Patented Feb. 13, 1968

3,369,096

COAXIAL-CIRCUIT CHANGE-OVER SWITCH FOR HIGH FREQUENCY

Yvon Gattaz, Paris, France, assignor to Radiall, Paris, France, a joint-stock company of France

Filed Nov. 22, 1966, Ser No. 596,264
Claims priority, application France, Jan. 5, 1966, 44,952
9 Claims. (Cl. 200—153)

The present invention relates to a coaxial-circuit change-over switch for high frequency, with rotary control, of the type comprising a coaxial input and a plurality of coaxial outputs uniformly divided over the periphery of the body of the switch.

Change-over switches of this kind are known which effect coaxial switching at high frequency, and in which the rotation of a control shaft permits the input of the switch to be coupled at will to a selected output.

Now, the problems, both electrical and mechanical, due to the requirements of a change-over switch for a high-frequency circuit are such as to render defective and frequently difficult the practical constructions of such apparatus at the present time. There may be cited, in particular:

The necessity of providing coaxial lines in the interior of the switch, which have no coaxial discontinuity capable, by modification of the line impedance, of generating reflections of the high-frequency wave and in consequence resulting in losses, that is to say attenuation for the high-frequency transmission;

The necessity of having a highly efficient screening effect in the actual interior of the switch, in order to ensure adequate de-coupling between the output utilized and the other outputs which are not connected to the input, or a minimum rejection attenuation;

The necessity for the change-over switch to have minimum wear of the moving contacts caused by their relative movements, for breaking and/or establishing the line concerned of the change-over switch.

Present-day change-over switches in particular, which generally comprise a movable intermediate line for switching between the input and the various outputs, are subject to not-negligible friction during their operation, resulting in rapid wear of the contacts and also necessitating the application, for operating the switch, of a greater rotation couple in order to overcome the said friction. In addition, the quality of the electrical contact is itself often defective and may introduce troublesome disturbances in the transmission of a high-frequency wave or signal.

The present invention has for its object to provide a coaxial circuit change-over switch for high frequency which does not have any of the foregoing disadvantages, and the construction of which is simple and the operation reliable.

To this end, the coaxial-circuit change-over switch for high frequency and with rotary control according to the invention, is essentially characterized by the fact that it comprises a conical core rigidly fixed to the control shaft and fitted in the body of the switch, an intermediate coaxial line passing through the conical core and intended to effect the electrical connection between the input connector and the switched output, means for ensuring a pressure contact between the central conductor of the intermediate coaxial line and the respective central conductors of the coaxial input and the switched output, and means for ensuring the various positions of coaxial switching, whereby the rotation of the control shaft causes simultaneously a displacement along its axis of the conical core and in consequence a frictionless break of the contact between the central conductor of the previously-connected output and the central conductor of the intermediate line.

According to other characteristic features of the present invention:

The intermediate coaxial line is essentially constituted by an insulating cylinder rigidly fixed to the conical core, and in the axis of which a central conductor is free to slide, the extremity of the said conductor corresponding to each of the outputs of the change-over switch having an elliptical surface coupled with an accurate fitting to a similar surface on the extremity of the central conductor of the switched output;

The body of the change-over switch is constituted by a cylindrical conducting mass coaxial with the control shaft and provided along its axis with a hollow internal cone in which is fitted coaxially the conical core containing the intermediate line, a restoring spring arranged in the body of the switch and along the common axis maintaining, for each switching position, the conical core in the interior of its housing;

The extremity of the intermediate line which effects in a constant and continuous manner the coupling to the input of the change-over switch, is connected to this latter, on the one hand through the intermediary of a central contact belonging to the central conductor of the input and applying a pressure on the corresponding surface of the central conductor of the intermediate line by means of a spring, and on the other hand by means of an elastic earth contact which continuously effects the connection between all the earthing points of the system;

The means for angular positioning of the conical core with respect to the body of the switch and in consequence the means for ensuring the various switching positions, are constituted essentially by a positioning ring, coaxial with the conical core and fixed rigidly to this latter, and by as many balls as there are coaxial outputs of the switch, each of the balls being arranged in a circular slot formed on the corresponding surface of the positioning ring.

Other advantages and characteristic features of the present invention will be brought out below in the description which follows, of one advantageous form of construction, reference being made to the accompanying drawings, in which:

FIG. 1 is a partial front view of a preferred form of construction of a change-over switch according to the invention, comprising six coaxial outputs distributed at 60° along the periphery of the switch;

FIG. 2 is a view in cross-section taken along the lines *a—a*, *b—b*, *c—c* of the change-over switch according to the invention, as shown in FIG. 1;

FIG. 3 is a view in partial cross section along the line *d—d* of FIG. 2, of the angular positioning device for the conical core provided in the change-over switch according to the invention.

Referring now to FIGS. 1 and 2, the coaxial-circuit change-over switch shown comprises a body **1**, on the periphery of which are arranged a number of coaxial outputs **2**, uniformly distributed. The change-over switch of FIGS. 1 and 2 has six outputs (**2***a* to **2***f*) located at 60° around the longitudinal axis of symmetry X—X of the switch, it being understood that it may also comprise twelve outputs at 30° or three outputs at 120°, or any other possible combination.

The input **3** of the switch is rigidly fixed to a casing **4** which is in turn fixed on the body **1** by means of a threaded portion **5**. The body **1** further comprises in its

central zone, a conical portion with an axis X—X intended to house the conical core **6** with an accurate fitting. This conical core **6** is fixed to the control shaft **7** of the switch, and is held elastically in its housing by means of a restoring spring **8** arranged in a recess **9** of the body **1**, around the control shaft **7**.

The spring **8** is held between the shoulder **10** and the support or abutment **41** rigidly fixed on the control shaft **7**.

The conical core **6** is traversed by the intermediate coaxial line indicated in a general manner by the reference *l* in FIG. 2. This line is itself constituted by an insulating or dielectric cylindrical portion **11** fixed to the conical core **6** and which extends, in particular during a connection made for example with the coaxial output **2***a* of the switch, the similar cylindrical portion **12***a* containing an insulator which surrounds the portion **13***a* of the central conductor of the output **2***a*. The intermediate coaxial line *l*, further comprises a central conductor **14** which can slide in the insulating part **11** of the line.

In FIG. 2, the conical core **6** has an angular position with respect to the body **1** such that it effects a continuous electrical connection between the coaxial input **3** and the output **2***a*. To this end, one of the extremities **15** of the central conductor **14** of the intermediate line *l* is terminated by a skewed elliptical surface which is adjusted with an appropriate mechanical pressure, as will be seen later, against a similar skewed elliptical surface **16***a* of the central conductor **13***a* of the coaxial output **2***a*. Similarly, the insulating portions **14** and **12***a* respectively to the intermediate line *l* and of the coaxial output **2***a*, come into contact through the intermediary of a skewed elliptical surface **17** of the surface of the conical core **6**.

The extremity **18** opposite to **15** of the central conductor **14** of the intermediate line emerges into a recessed portion **19** of the core **6** and is formed by a small conducting cone **20**, the apex of which is located on the axis X—X of rotation and of symmetry, so that, during the rotation of the control shaft **7** and in consequence of the conical core **6**, the surface of the end cone **20** of the central conductor **14** remains constantly in contact with an adequate mechanical pressure on the central conductor **21** of the coaxial input **3**. This is obtained through the intermediary of the output extremity of the central conductor **21**, which is constituted by a hollow metal cylinder **22** elastically enclosing the portion **23** of the central conductor **21** of the coaxial input **3**. On the other hand, a spring **24** is housed inside the contact cylinder **22**, the bottom of which is thus pushed with a suitable pressure against the surface of the contact cone **20** of the central conductor **14** of the intermediate line. This same spring **24** ensures a sufficient contact pressure on the other extremity **15** of the central conductor **14** of the intermediate line *l*.

There has furthermore been constituted an elastic earth contact formed by a hollow metal cylinder **25** which, through the intermediary of a circular contact **26**, ensures a constant coupling between the earth points of the system. The contact **26** rubs on the inner surface of a positioning ring **27** belonging to the angular positioning device provided on the change-over switch according to the invention, and which will now be described.

In addition to the positioning ring **27**, fixed to the conical core **6** by means of a number of clamping screws **28**, the angular positioning device also comprises three bearing balls **29**, uniformly distributed at 120° in housing **31** of the body **1** of the change-over switch. Each of the balls **29** passes also into a slot **30** formed in the surface facing the body **1** of the positioning ring **27**, as has been clearly shown in FIGS. 2 and 3. The play of the balls in the slots is adjusted to a minimum by means of adjustable abutments **32** arranged in the body **1** of the switch.

Finally, each of the coaxial output connectors and the coaxial input connector are formed respectively, in a manner known per se, by a central conductor **33***a* . . . **21**, a peripheral conductor **34***a* for the output **2***a* and **35** for the input, these peripheral conductors being connected to the earth of the system.

Similarly, the various portions **23**, **36** and **37** of the central conductor **21** of the input and the corresponding insulating portions **38** which surround them are fixed by a means which does not cause any discontinuity in the impedance of the coaxial line, for example by a keeper pin **39** of high frequency resin. This is also the case for the portions **36***a*, **37***a*, **13***a* of the central conductor of the input and the corresponding insulating portions **38***a*, **12***a*, which surround them.

There will now be described the operation of the change-over switch according to the invention, with particular reference to FIG. 2.

Starting from a pre-determined angular position of the conical core **6** ensuring for example a connection between the coaxial input **1** and one of the coaxial outputs **2***a*, as soon as the control shaft **7** of the switch is rotated, this shaft passing into the body **1** through the intermediary of an elastic joint **39**, the balls **29** become disengaged from the corresponding slots, which causes a forward movement in the direction F_1 of the positioning ring **27** and in consequence a corresponding axial displacement of the conical core **6** with respect to the body **1** of the change-over switch.

The insulating portion **41** of the intermediate line *l* then comes into abutment by its extremity **40** against the extremity **18** of the central conductor of the same intermediate line *l* and thus causes the interruption of the contact at the extremities (**15**–**16***a*), the possible backward movement of the central conductor **14** being less than the axial displacement of the conical core **6**. This breaking of the contact thus takes place without any harmful friction between the surfaces in contact, thus avoiding rapid wear of these latter.

Similarly, when the input **3** is connected to one of the outputs **2***a*, the conical core **6** forms an electric screen for the other outputs **2***b* . . . **2***f* which are not switched, thus preventing any phenomenon of re-injection into these latter.

It will of course be understood that the present invention has been described and shown purely by way of explanation and not in any limitative sense and that any alternative form may be given to it, without thereby departing from its scope.

I claim:

1. A coaxial-circuit change-over switch for high frequency, of the type comprising a central control shaft for the rotational control of the switching position between a coaxial input and a plurality of coaxial outputs distributed uniformly around the periphery of the main body of the switch, said change-over switch comprising:

a conical core rigidly fixed to said central control shaft and being fitted into the interior of the said switch body;

an intermediate coaxial line passing through said conical core, the two extremities of said line coming into contact respectively with the corresponding extremities of said coaxial input and of the switched output;

means for ensuring pressure contact between the extremity of the central conductor of the coaxial input in the interior of the switch and one of the extremities of the central conductor of said intermediate line, and between the inner extremity of the central conductor of the output switched and the other extremity of the central conductor of the intermediate line;

means for ensuring the passage from one switching position to another position by rotation of said control shaft of the switch so that the said rotation causes simultaneously a displacement of said conical core along its axis, thus causing a break without fric-

tion of the contact between said central conductor of the output previously switched-over to the input and the central conductor of said intermediate line.

2. A coaxial-circuit change-over switch for high frequency, as claimed in claim 1, in which the body of said switch is constituted by a cylindrical conducting mass coaxial with said control shaft and comprising in its interior a hollow cone having its axis coincident with the axis of rotation of said control shaft to which it is fixed.

3. A coaxial-circuit change-over switch for high frequency, of the type comprising a central control shaft for the rotational control of the switching positions between a coaxial input and a plurality of coaxial outputs uniformly distributed along the periphery of the main body of the switch, said switch comprising:

a conical core rigidly fixed to said central control shaft and being fitted in the interior of said switch body;

an intermediate coaxial line passing through said conical core and the two extremities of which come into contact respectively with the corresponding extremities of said coaxial input and of the switched output;

means for ensuring a pressure contact between the extremity of the central conductor of said coaxial input in the interior of said switch and one of the extremities of the central conductor of said intermediate line and between the inner extremity of the central conductor of the switched output and the other extremity of the central conductor of the intermediate line;

means for ensuring the passage from a switching position to another position by rotation of said control shaft of the change-over switch in such manner that said rotation causes simultaneously a displacement of said conical core along its axis which in consequence results in a break without friction of the contact between said central conductor of the output previously switched to the input and the central conductor of said intermediate line;

an elastic restoring means arranged in said switch body and applying a force along the axis of said conical core so as to maintain this latter inside its housing for each switching position.

4. A coaxial-circuit change-over switch for high frequency, of the type comprising a central control shaft for the rotational control of the switching positions between a coaxial input and a plurality of coaxial outputs uniformly distributed along the periphery of the main body of the switch, said change-over switch comprising:

a conical core rigidly fixed to said central control shaft and being fitted into the interior of said switch body;

an intermediate coaxial line constituted by an insulating cylinder rigidly fixed to and arranged inside said conical core, the central conductor of said intermediate line being arranged inside and along the axis of said insulating cylinder, in which it can slide freely, the two extremities of said central conductor coming respectively into contact with the corresponding extremities of the central conductor of said coaxial input on the one hand and of the central conductor of the switched output on the other;

means for ensuring a pressure contact between the extremity of the central conductor of the coaxial input in the interior of the switch and one of the extremities of the central conductor of said intermediate line and between the inner extremity of the central conductor of the switched output and the other extremity of the central conductor of the intermediate line;

means for ensuring the passage from one switching position to another position by rotation of said control shaft of the switch, so that said rotation causes simultaneously a displacement of said conical core along its axis, thereby resulting in a break without friction of the contact between said central conductor of the output previously switched to the input and the central conductor of said intermediate line;

elastic restoring means arranged in said switch body and adapted to apply a force along the axis of said conical core in such manner as to maintain this latter in the interior of its housing for each switching position.

5. A coaxial-circuit change-over switch as claimed in claim 4, in which the extremities of the central conductor of each switched output and of the central conductor of said intermediate line intended to come into contact with each other are provided with similar elliptical surfaces fitted with precision.

6. A coaxial-circuit change-over switch as claimed in claim 4, in which said elastic means for returning said conical core to the interior of its housing is constituted by a spring arranged round the control shaft in a recess of the switch body between two abutments.

7. A coaxial-circuit change-over switch for high frequency, of the type comprising a central control shaft for the rotational control of the switching positions between a coaxial input and a plurality of coaxial outputs uniformly distributed along the periphery of the main body of said switch, said change-over switch comprising:

a conical core rigidly fixed to said central control shaft and being fitted into the interior of said switch body;

an intermediate coaxial line constituted by an insulating cylinder rigidly fixed to and arranged inside the interior of said conical core, the central conductor of said intermediate line being arranged in the inside and along the axis of said insulating cylinder in which it can slide freely, one extremity of the central conductor of said intermediate line being formed by a small conducting cone, the apex of which is located on the axis of rotation and symmetry so as to obtain continuous contact with the corresponding extremity of the central conductor of the switch input, which comprises a spring compressing said extremity with sufficient pressure against the above extremity of the central conductor of said intermediate line;

means for ensuring the passage from one switching position to another position by rotation of said control shaft of the change-over switch, in such manner that said rotation causes simultaneously a displacement along its axis of said conical core, thereby resulting in a break without friction of the contact between said central conductor of the output previously switched to the input and the central conductor of said intermediate line;

elastic restoring means arranged in said switch body and adapted to apply a force along the axis of said conical core so as to maintain this latter in the interior of its housing for each switching position.

8. A coaxial-circuit change-over switch for high frequency, as claimed in claim 7, in which said switch comprises an elastic earth contact so as to obtain constantly an electrical connection between all the earth points of said switch.

9. A coaxial-circuit change-over switch for high frequency, of the type comprising a central control shaft for the rotational control of the switching positions between a coaxial input and a plurality of coaxial outputs uniformly distributed along the periphery of the main body of the switch, said change-over switch comprising:

a conical core rigidly fixed to said central control shaft and being fitted to the interior of said switch body;

an intermediate coaxial line passing through said conical core, and of which the two extremities come into contact respectively with the corresponding extremities of said coaxial input and of the switched output;

means for ensuring a pressure contact between the extremity of the central conductor of the coaxial input in the interior of said switch and one of the extremities of the central conductor of said intermediate line, and between the inner extremity of the central

conductor of the switched output and the other extremity of the central conductor of the intermediate output;

means for ensuring the various switching positions, said means being essentially constituted by a positioning ring coaxial with said conical core and rigidly fixed to this latter, and by as many balls as there are coaxial outputs of the switch, each of said balls being arranged in a circular slot formed on the corresponding surface of said positioning ring.

References Cited

UNITED STATES PATENTS

2,360,219	10/1944	Goddard	200—153.18 XR
2,473,565	6/1949	Bird	200—153.18 XR
2,475,647	7/1949	Spriggs	200—153.18
3,141,943	7/1964	Lanctot	200—153.18

ROBERT K. SCHAEFER, *Primary Examiner.*

H. BURKS, *Assistant Examiner.*