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2,473,565

SWITCH

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2 Sheets-Sheet 1

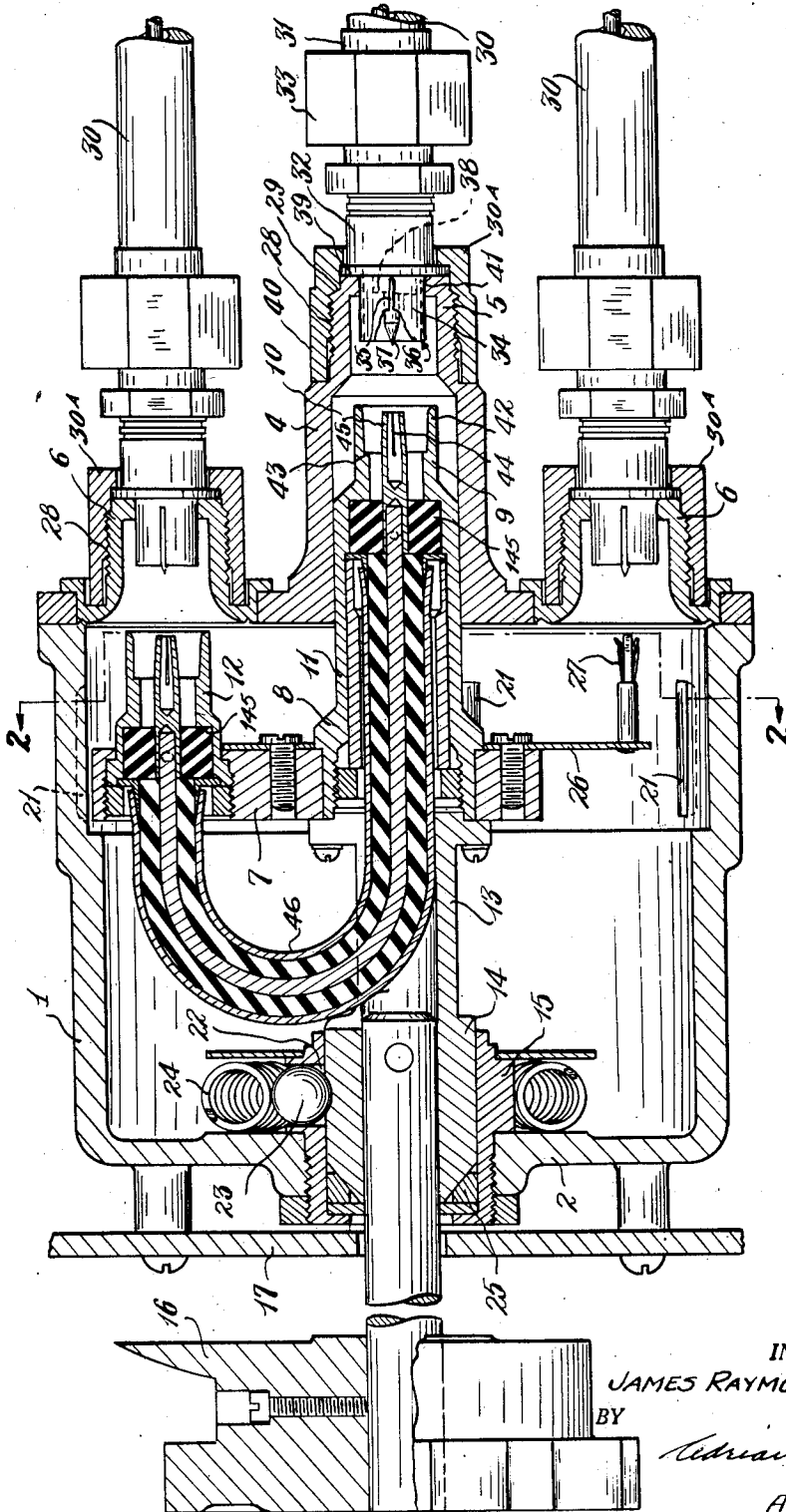


FIG. 1

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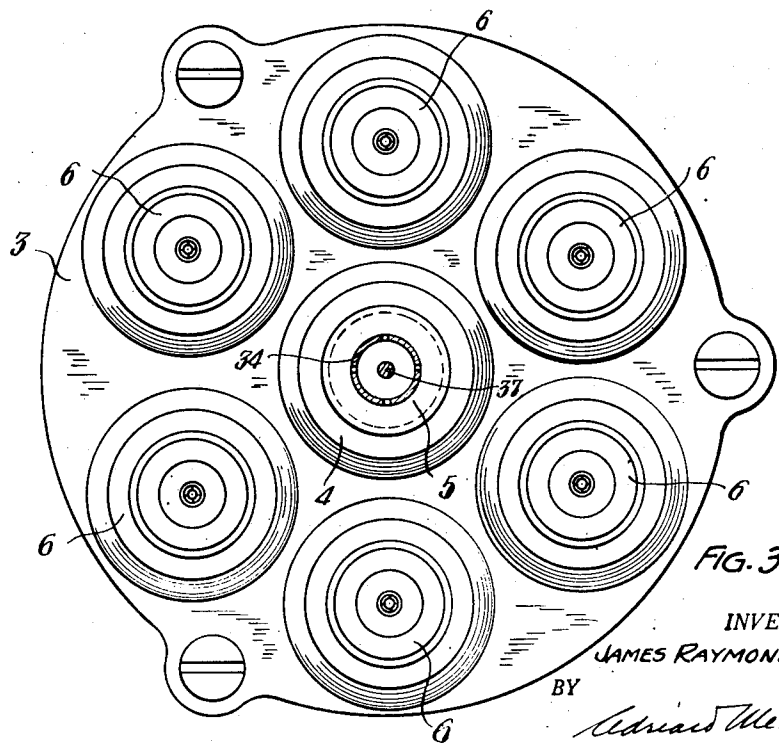
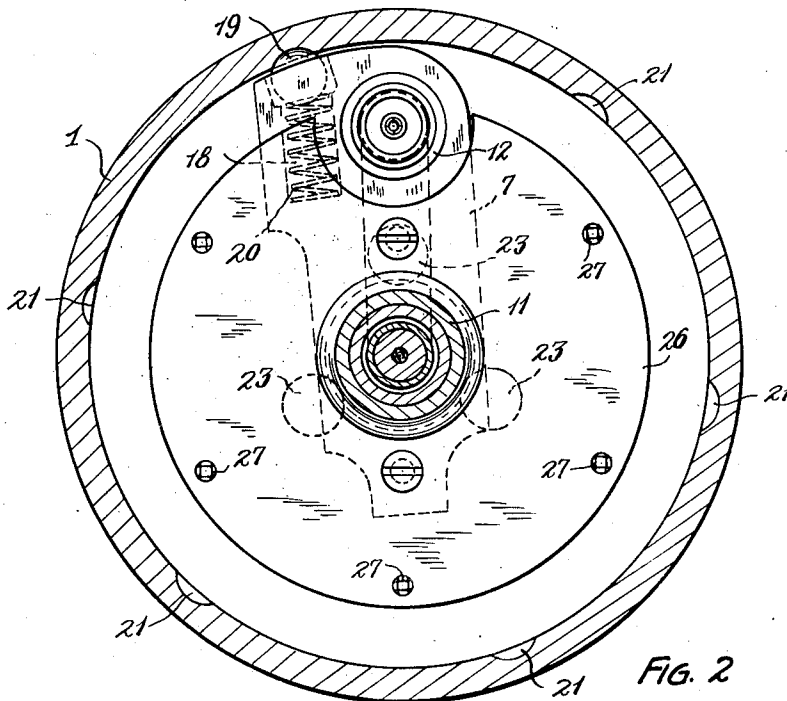
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2 Sheets-Sheet 2



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SWITCH

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5 Claims. (Cl. 200—4)

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This invention relates to electric switches and more particularly to a switch for connecting and disconnecting coaxial cables to and from each other, respectively.

In coaxial circuit transmission it is highly desirable that the characteristic impedance of the circuit be maintained uniform throughout its extent. Considerable difficulty is encountered in obtaining this condition when inserted components such as connectors, switches and the like are incorporated into the circuit. Reflections are set up wherever an inserted component does not match the characteristic impedance of the cables between which it is inserted. Although the characteristic impedance of a circuit can be maintained through a coaxial cable, by proper design of the cable during manufacture, suitable switches for such cables have not been provided heretofore, wherein the characteristic impedance of the circuit therethrough is maintained consistent with that of the circuit through the cables connected thereto. To provide such a switch requires careful design of the contact parts of the switch so that such parts are maintained in fixed relation to each other during the operation of the switch. Furthermore, to maintain uniform characteristic impedance in the circuit through the switch between two connected cables it is necessary that angles or abrupt changes in the internal circuit of the switch be avoided.

In the illustrated embodiment of the invention herein set forth, the switch is described as applicable to the problem of switching, selectively, anyone of a number of antennas to a common receiver input or transmitter output circuit. The illustrated embodiment assumes that coaxial circuits are used as the transmission medium between the antennas and receiver or transmitter, and that the frequencies of the current to be transmitted lie roughly between 30 and 4000 megacycles per second. However, it is not contemplated that the invention shall be so limited and that its use for other purposes will be readily apparent from the description of the invention as hereinafter set forth.

One of the principal objects of the present invention is to provide a switch for coaxial circuits which is compact and simple in structure yet provides the proper connections in the internal switch circuit whereby the characteristic impedance of the circuit is maintained through the contacts and internal circuit of the switch.

Another object is to provide a switch for the purposes described by which a plurality of external coaxial cables can be connected selectively to another coaxial cable and in which the connecting parts are constrained to movement into proper relation for maintaining through the switch the fixed characteristic impedance of the circuits through the cables.

Other objects and advantageous features of

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the invention not at this time more particularly enumerated, will become more apparent as the nature of the invention is better understood from the following detailed description taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a longitudinal sectional view through a switch embodying the principles of the present invention, with coaxial cables of an external circuit connected thereto;

Figure 2 is a cross sectional view taken on the line 2—2 of Figure 1; and

Figure 3 is an end elevation of the switch and attached cables illustrated in Figure 1, part of one of the cable connections thereof being shown in section for clearness in illustration.

With reference to the accompanying drawings, the switch of the present invention comprises a housing 1 which may be made of any suitable material and is in the form of a cylinder which is closed at one end by an integral wall 2 and at the other end by a detachable cable connector plate 3. Carried by and integral with the plate 3 is a central hollow post 4 terminating in an adaptor 5 which extends endwise of the housing 1 and is coaxial therewith. Spaced laterally and equidistantly from the hollow post 4 are a plurality of adaptors 6, each of which is in the form of a hollow boss with its axis parallel to the axis of the central post 4. The adaptors 6 may be formed integral with the plate 3, or may be formed separately and accurately fitted therein, as illustrated.

Mounted within the housing 1 is a movable switch member or rotor, broadly indicated by the numeral 7, having a depending hollow shaft portion 8 terminating in a contact 9. The central post 4 is provided with an axial bore 10 which opens through the inner end of the post and the wall of which is accurately formed to a true cylinder to provide a guide and bearing for the shaft portion 8. The shaft portion 8 is provided with an external cylindrical wall 11 which is ground to a precise fit with the wall of the bore 10. The shaft portion 8 is accommodated in the bore 10 in coaxial telescopic relation for independent axial movement along and rotary movement about the common axis of the post 4, and the shaft portion 8 and thus acts also as a means for supporting the rotor 7 for independent rotary and axial movement within the housing. The rotor 7 carries a lateral coaxial contact 12 having its axis parallel to the axis of the central contact 9 and offset therefrom a sufficient distance so that, upon rotation of the rotor 7, the contact 12 can be moved to positions in which it is coaxial with the adaptors 6, selectively.

Mounted on the rotor 7 opposite from and in coaxial relation to the central shaft portion 8 is an operating shaft 13 which is rigid with the rotor and has formed thereon, an enlarged co-

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axial bearing portion 14. The bearing portion 14 is telescopically received in a complementary bearing 15 which is fixedly mounted in the housing 1 in coaxial relation with the shaft portion 8. The operating shaft 13 extends out through the end 2 of the housing 1 and is provided with the usual operating and indicating knob 16. An indicator plate 17 is secured on the end of the housing 1 and bears suitable indicia so as to cooperate with the knob 16 for indicating the relative rotated position of the rotor within the housing.

Thus the rotor 7 is supported accurately in coaxial alignment with the post 4 for independent axial and rotary movement within the housing 1. At the same time, the contact 12 is accurately supported for movement to a plurality of positions in each of which it is in accurate alignment with one of the adaptors 6 and can be received therein by axial movement of the rotor. The bearing surface of the cylindrical wall 11 of the shaft portion 3 is of sufficient length as to remain in guiding and bearing contact with the wall of the bore 10 in all rotated and axial positions of the rotor.

In order to yieldably arrest the rotation of the rotor in final positions in which the contact 12 is in accurate axial alignment with the selected one of the members or adaptors 6, a suitable detent is provided. In the form illustrated, the rotor is provided with a suitable radial bore 19 (see Figure 2) in the end of which is carried a ball 19 which is urged outwardly by a coil spring 20. Elongated grooves 21 are formed at spaced points in the inner wall of the housing 1 and are engaged by the ball 19 for yieldably arresting rotation of the rotor in the proper positions. For maintaining the contacts 3 and 12 in advanced operative position there is provided in the bearing 15 a plurality of openings 22 in which are mounted balls 23. The balls 23 are urged into engagement with the bearing portion 14 of the operating shaft 13 by a coil spring 24 which embraces all of the balls. The bearing portion 14 is provided with a tapered surface 25 along which the balls bear as the shaft 13 is moved into its advanced position.

In some applications of the switch it is desirable to ground the central contact of inactive coaxial cables. For this purpose a plate 26 is mounted on the rotor 7 and provided with a plurality of grounding contacts 27, the contacts 27 and plate 26 being of electrically conductive material. The grounding contacts 27 are arranged in laterally spaced relation to the central contact 9 with their axis parallel thereto so as to effect contact with the cables connected to the adaptors 6 when the lateral contact 12 is aligned with one of the adaptors 6 and is moved axially into proper contact relation with the end contacts of the cable carried thereby.

The adaptors 5 and 6 are externally threaded as indicated at 28, at their outer ends and their end surfaces 29 are finished to form an annular seat.

As aforementioned, coaxial cables are attached to the adaptors of the switch, respectively. With reference to Figure 1 each coaxial cable 30 is provided with a connector 30A for connecting the cable to the adaptors 5 and 6. Coaxial cable connectors 30A as illustrated in Figure 1 are well known in microwave coaxial circuits and comprise a metal ferrule 31 which is fixedly secured to the end of the cable, a metal sleeve 32 and a screw cap 33 which engages a shoulder on the ferrule 31

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and is in threaded engagement with the sleeve 32 and operative to draw the sleeve 32 into fixed position relative to the end of the cable 30. The sleeve 32 is provided at its end with a contact sleeve 34 which is rendered radially resilient by suitable circumferentially spaced longitudinally extending slots 35. The contact sleeve 34 formed with a contact end 36 is cylindrical and so positioned as to be in exact coaxial relation to a cylindrical male pin 37 of the coaxial cable. The male pin of the cable is provided with an annular shoulder 38 spaced from the end of the plug.

The sleeve 32 is provided with an external annular flange 39 engageable by the shouldered portion of a sleeve nut 40 which is received by the threaded portion 28 of the adaptor 5 for firmly connecting the cable fitting to the adaptor 5 in fixed axial position.

The adaptor 5 at its outer end has a guiding portion 41 which engages the outer surface of the contact sleeve 34 of the connector and constrains it to accurate coaxial relation with the adaptor 5.

The contact 9 is provided with contact means complementary to those of the cable fitting connected to the adaptor 5. This contact means comprises a sleeve portion 42 on the end of the central shaft portion 8 and which is coaxial with and adapted to receive telescopically and snugly accommodate the contact sleeve 34. The contact 9 has an internal annular shoulder 43 which is finished to a seat for engagement with the end of the contact sleeve 34. The contact 9 also includes a contact sleeve 44 coaxial with the sleeve 42 and arranged to receive snugly in frictional contact the male pin 37 of the connector. It is desirable also that the end 45 of the contact sleeve 44 be accurately positioned relative to the shoulder 43 so that when the central contact 9 is moved axially into engagement with the fitting of the cable, the shoulder 43 and seating area 45 of the contact engage, respectively, the end 36 and shoulder 38 of the cable fitting, thus accurately positioning the parts axially and radially with respect to each other. An enlarged insulation block 45 is positioned around the axially inner end of the contact sleeve 44 and this maintains the characteristic impedance of the circuit constant throughout that portion of the switch.

By this arrangement, the characteristic impedance of the circuit through the particular cable is maintained through the cooperating contacts of the switch and cable. The parts of the contact 12 which operate with the connectors of the cables connected to the adaptors 6 are the same as those provided on the contact 9.

The contact 12 terminates axially at its outer end a sufficient distance from the outer end of the contact 9 so that, while the contact 9 is received in and guided by the walls of the bore 10 in the maximum withdrawn position of the rotor 7, the contact 12 may clear the plate 3 and may be moved laterally thereof by rotation of the rotor 7. Likewise, the contacting parts of the contact 12 and the cable fittings associated with the adaptors 6 are so positioned that they effect concurrently the same contacting portions of the contact 9 with the contacting parts of its associated cable.

As mentioned in the objects, it is necessary that the central contact 9 and the contact 12 be connected together by a cable having the same characteristic impedance as the cables of the external circuit. It is also necessary in order to maintain uniform characteristic impedance in the circuit to eliminate any abrupt angles in the path of the

current from the contact 9 to the contact 12 of the internal circuit of the switch.

To accomplish these results a coaxial-cable 46 is used to connect the contacts 9 and 12. The cable 46 preferably is of the same structure as the cables 30. The end portions of the cable 46 are coaxial with their associated contacts 9 and 12 respectively, and the intermediate portion joining the coaxial portions is gradually and smoothly curved and free from any abrupt angles. Thus no abrupt changes in direction occur in the internal circuit.

It is to be understood that the form of this invention herein shown and described is to be taken as a preferred embodiment of the same and various changes and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

I claim:

1. A coaxial cable switch comprising a housing, a rotor mounted within said housing for rotative movement about a fixed axis, spaced members carried by said housing and adapted to receive the ends of coaxial cable connectors, coaxial conductor means carried by said rotor connecting said spaced members, said coaxial conductor means being of uniform cross-section throughout and so arranged as to maintain through the switch the characteristic impedance of the coaxial cables attached thereto and means to rotate the rotor and move it axially.

2. A coaxial-cable switch for high frequency electrical current comprising a housing, a rotor, a central coaxial-cable contact carried thereby and coaxial therewith, a lateral coaxial-cable contact carried by the rotor in offset relation to the central contact and having its axis parallel to the axis of the rotor, means supporting the rotor in the housing for rotation about the rotor axis and for bodily movement axially, coaxial-cable connectors carried by the housing and including a central connector coaxial with the central contact and a lateral coaxial-cable connector which is coaxial with the lateral contact in one rotated position of the rotor, a coaxial-cable connecting the contacts of the rotor, said coaxial-cable being of uniform cross-section throughout and coaxial with the contacts at its end portions and being smoothly curved therebetween and so arranged to maintain through the switch the characteristic impedance of the coaxial cables attached thereto, and means for rotating the rotor and for moving it axially, said coaxial cable connectors comprising a continuous U-shaped center lead having a continuous insulation sleeve positioned therearound.

3. A coaxial-cable switch comprising a housing, a rotor therein, a central coaxial-cable contact carried thereby and coaxial therewith, a lateral coaxial-cable contact carried by the rotor in offset relation to the central contact and having its axis parallel to the rotor axis, a coaxial-cable connecting said contacts, the cross-section through said cable being substantially concentric circles, a central coaxial-cable connector carried by the housing and coaxial with the rotor, a plurality of lateral connectors carried by the housing and having their axes parallel to the axis of the central connector and offset laterally therefrom so as to be coaxial with the lateral contact in different rotated positions of the rotor, respectively, said central connector and central contact being in telescopic relation to each other and accurately supporting the rotor for rotation

about their common axis and for movement bodily axially, and means for rotating the rotor said coaxial cable being so arranged to maintain through the switch the characteristic impedance of the coaxial cables attached thereto and for moving it axially said coaxial cable being of uniform cross-section and composition intermediate the ends thereof and having at its ends its center conductor of greater diameter and with a greater diameter insulation sleeve therearound than the remainder thereof.

4. A coaxial-cable switch for high frequency electrical current comprising a hollow housing, a rotor therein, a shaft coaxial with the rotor and extending endwise from one end thereof and through one end of the housing, coaxial-cable connectors on the opposite end of the housing and parallel to said shaft, a central one of said connectors being coaxial with the shaft and the other connectors being spaced equidistantly laterally from the central connector, a central contact means carried by the rotor and coaxial with the central connector, complementary guide surfaces on the central connector and central contact means for supporting the rotor for rotation and movement axially, a lateral contact on the rotor parallel to the central contact and positioned to align with the laterally spaced connectors, respectively, upon rotation of the rotor and to be movable into and out from said laterally spaced connectors upon axial movement of the rotor, and a coaxial-cable of uniform cross-section connecting the contacts of the rotor said coaxial cable being so arranged to maintain through the switch the characteristic impedance of the coaxial cables attached thereto, said coaxial cable connectors comprising a continuous U-shaped center lead having a continuous insulation sleeve positioned therearound.

5. In a combination including coaxial cables and a coaxial-cable switch, a housing, connectors for coaxial-cables thereon and having their axes parallel to each other, a member in the housing, means supporting the member for bodily movement parallel to said axis, an internal circuit carried by said member adapted to connect said connectors internal circuit contacts on the housing, contacts on the coaxial cables, respectively, and engageable by the internal circuit contacts upon axial movement of the said member, cooperating means on said contacts of the cables and of the internal circuit to effect accurate relative positioning thereof for providing point to point uniformity of the characteristic impedance of the cable through cooperating contacts, and coaxial-cable means connecting the contacts of the internal circuit and being smoothly curved between its ends said coaxial-cable means being of uniform cross-section throughout whereby the characteristic impedance of the circuit through the switch is maintained the same at all points.

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