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COAXIAL SWITCH HAVING MEANS TO REFLECTIONLESSLY
TERMINATE DISCONNECTED BRANCHES
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3,132,311

Fig. 1

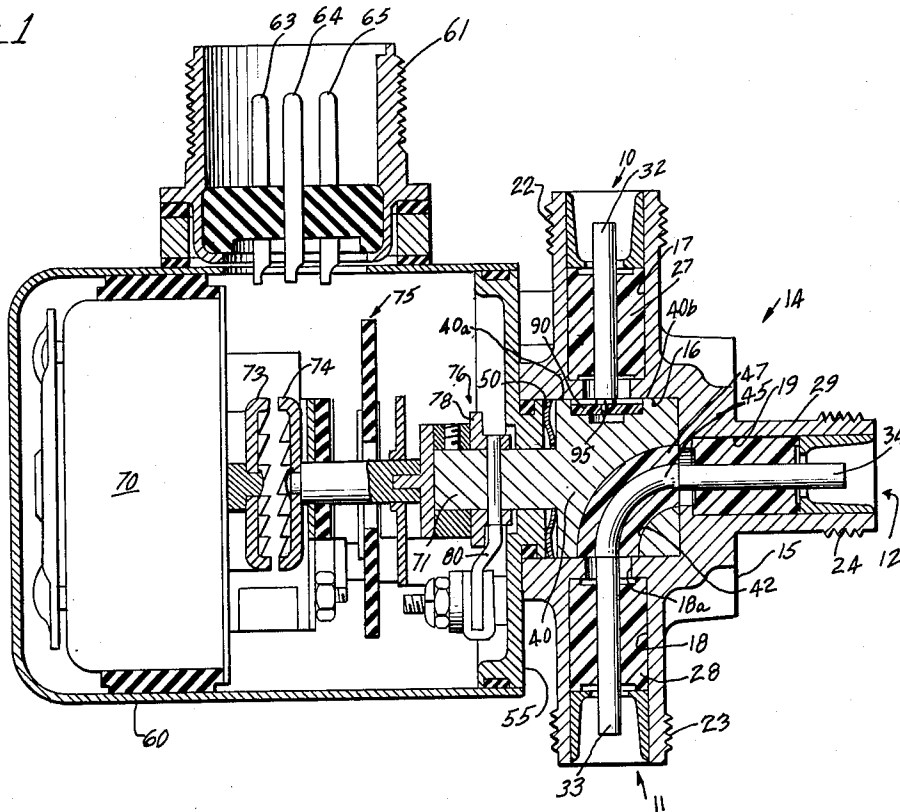
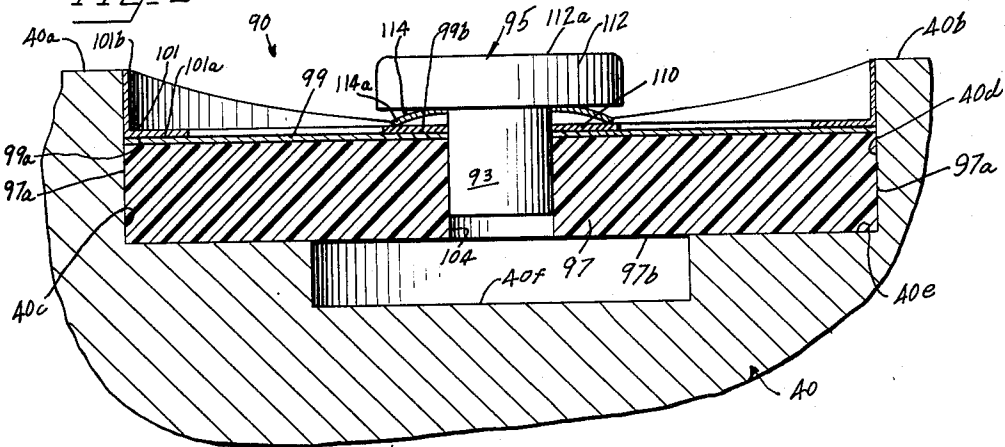


Fig. 2



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3,132,311 COAXIAL SWITCH HAVING MEANS TO REFLECTIONLESSLY TERMINATE DISCONNECTED BRANCHES

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This invention relates to a radio frequency switch and particularly to a switch for coaxial lines wherein unused lines are terminated in their characteristic impedance by means of the switch.

In various switching applications it is important for unused lines connected to a switch to be terminated in their characteristic impedance. The present invention provides an extremely simple and effective means for terminating unused lines connected with a coaxial switch in a desired impedance. In accordance with a preferred embodiment of the invention, the rotor is provided with a pocket opposite an unused terminal of the switch which receives an insulating medium having a carbon film sprayed thereon. A conductive band overlying the outer periphery of the carbon film makes contact with the outer conductor of the unused terminal and an inner conductive band overlying the inner portion of the carbon film makes contact with the inner conductor of the unused terminal. Preferably, the inner conductive band is connected to the inner conductor of the unused terminal by means of a button reciprocally carried by the insulating material and urged into contact with the inner conductor by means of a conductive spring washer interposed between the head of the button and the inner conductive band on the carbon film.

It is therefore an important object of the present invention to provide a novel and extremely simple means for terminating unused terminals of a coaxial switch in their characteristic impedance.

Another object of the invention is to provide a resistance termination for unused terminals of a coaxial switch which is readily applied to existing switches.

A further object of the present invention is to provide a resistance termination for unused terminals of a switch which is of a precise and stable predetermined value.

Other objects, features and advantages of the present invention will be apparent from the following detailed description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a somewhat diagrammatic longitudinal sectional view of a commercial coaxial switch to which an embodiment of the present invention has been applied;

FIGURE 2 is an enlarged fragmentary view partly in section and illustrating a terminating element associated with a coaxial switch rotor in accordance with the present invention.

As shown on the drawings:

FIGURE 1 illustrates a commercially available coaxial switch to which the teachings of the present invention have been applied. The switch comprises a series of radially extending terminals such as indicated at 10 and 11 for threaded receiving coaxial lines which are to be selectively connected with an axial terminal 12 of the coaxial switch 14. The switch 14 may comprise a housing 15 of electrically conductive material having a central rotor chamber 16, a series of radial passages such as 17 and 18 opening into the rotor chamber 16 and an axial passage 19 opening into the rotor chamber. The terminals 10, 11 and 12 may be externally threaded as indicated at 22, 23 and 24 to receive suitable couplings of the coaxial lines associated with the switch. Continuity is thus provided between the outer conductors of the

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respective coaxial lines and the interior walls of the passages 17, 18 and 19, which in effect provide extensions of the coaxial lines within the housing. The terminals may have suitable insulating sleeves such as indicated at 27, 28 and 29 mounting inner conductors 32, 33 and 34, whose outer ends are suitably configured to be coupled with the inner conductors of the coaxial lines connected with the terminals. By way of example, the outer ends of the inner conductors may have reduced diameter bores extending axially therein from their outer ends for receiving reduced diameter pins on the ends of the inner conductors of the coaxial lines connected with the terminals to provide firm electrical continuity between the inner conductors of the lines and the inner conductors of the respective terminals. Generally speaking, the terminals provide coaxial line sections having the same characteristic impedance as the coaxial lines to be connected with the terminals.

The rotor 40 of the coaxial switch comprises a substantially cylindrical body portion of electrically conductive material fitting snugly within the rotor chamber 16 so that the walls of the housing 15 defining the motor chamber 16 are in electrical continuity with the outer walls of the rotor 40. The rotor, in the illustrated embodiment, is provided with a curved interior passage 42 of configuration to register with one of the terminals such as 10 and 11 and to electrically connect the line associated with such terminal with the line connected to the terminal 12. The passage 42 has a curved inner conductor member 45 mounted therein by means of a curved insulating sleeve 47, so that the respective ends of the inner conductor member 45 are adapted for electrical continuity with the inner end of the axial inner conductor 34 of terminal 12 and selectively with the inner ends of the radial inner conductors 32 and 33 of terminals 10 and 11, for example. In the position shown in FIGURE 1, terminal 11 is connected with terminal 12 by means of the rotor coaxial line section including the outer conductor formed by passage 42 and the inner conductor formed by curved member 45. By way of example, there may be six radial terminals such as 10 and 11, so that a different radial terminal is connected with the axial terminal 12 for each 60 degrees of rotation of the rotor 40. When rotor 40 is rotated through 180°, conductor 45 is in electrical continuity with the inner end of inner conductor 32 of terminal 10 and terminal 10 is electrically connected with terminal 12 by means of the rotor coaxial line section. A spring washer is indicated at 50 interposed between the lower end face of the rotor body and a cover member 55 for urging the rotor 40 axially against the opposite end wall of the housing. This spring washer 50 may serve to provide firm electrical contact between the inner conductor 34 of terminal 12 and the adjacent end of rotor inner conductor 45, as well as providing firm electrical continuity between the rotor axial end face and the adjacent wall of the rotor chamber 16.

In the illustrated embodiment the radial passages such as 17 and 18 and axial passage 19 may be cylindrical and of the same diameter as the interior diameter of the outer conductors of the lines with which they are connected. Similarly the inner conductors such as 32, 33 and 34 may be of cylindrical cross section and have the same outside diameter as the outside diameter of the inner conductors of the lines with which the terminals are connected. The rotor conductor 45 may be cylindrical in cross section and of the same external diameter as the inner conductors 32, 33 and 34, and the rotor passage 42 may be of circular cross section and dimensioned so as to provide a continuation of the switch terminals introducing minimum electrical discontinuities.

While, within the scope of the present invention, the coaxial switch rotor 40 may be manually actuated be-

tween successive switching positions, for example by means such as illustrated in the Gates U.S. Patent No. 2,745,917, issued May 15, 1956, an electrically energized actuating system has actually been diagrammatically shown in FIGURE 1 similar to that shown in Schunemann and Thoren U.S. Patent No. 2,840,786, issued June 24, 1958. The details of this actuating system are not material to the description of the present invention, but it may be noted generally that the actuating mechanism is enclosed within a casing 60 sealed to the cover plate 55. The cover plate 55 may be secured to the switch housing 15 by suitable screws. An electric control cable may be connected to the actuating mechanism by means of the fitting 61 sealed to the casing 60 and including electrical conductors 63, 64 and 65 for connection with corresponding conductors of the electric control cable. The actuating mechanism itself comprises a rotary type solenoid 70 which is coupled to the shaft 71 of the rotor 40 by suitable clutch means 73 and 74. Suitable electric indexing switch means is generally indicated at 75. Detent means is indicated at 76 for precisely positioning the rotor 40 in each of its switching positions and may comprise a detent wheel 78 fixed to the rotor shaft 71 and cooperating spring urged detent arms such as indicated at 80. For a six position coaxial switch, there would be six pins such as 63 and 65 in addition to a center pin such as 64 associated with the fitting 61, so as to actuate the switch to any of six selected positions under the control of the indexing mechanism indicated generally at 75. In operation, it will be understood that the rotary solenoid 70 may be successively energized to move the rotor 40 between successive detent positions. By way of example, detent wheel 78 may have 12 stable positions, so that the solenoid 70 is actuated twice to step the rotor between adjacent switching positions, where a total of six switching positions are provided.

In accordance with the present invention, one or more of the unused terminals such as terminal 10 in FIGURE 1 is terminated in its characteristic impedance by means of a resistance element designated generally by the reference numeral 90 and shown in detail in FIGURE 2. As seen in FIGURE 2 the rotor 40 includes cylindrical surface portions 40a and 40b engaging the adjacent wall of the rotor chamber 16. At locations about the periphery of the rotor corresponding to unused terminals, the rotor 40 is provided with cylindrical recesses such as indicated at 40c. The recesses 40c are defined by cylindrical walls 40d of diameter substantially corresponding to the diameter of the outer conductors such as 17 of the terminals such as 10 in FIGURE 1. The recess 40c is also provided with an annular end wall 40e which may have a circular area in a single plane, but it is shown broken by a reduced diameter recessed portion 40f. In the illustrated embodiment, the recess 40f serves to insulate the end of the shaft portion 93 of contact button 95 from the rotor 40. The recess 40f enables the shaft 93 to be of greater length than the axial dimension of annular supporting member 97 when desired.

The supporting member 97 may be of suitable dielectric material fitting snugly within the recess 40c with its cylindrical outer periphery 97a in engagement with the cylindrical wall 40d and with its axial end face 97b in snug engagement with the annular wall 40e of the rotor. In the preferred embodiment, the annulus 97 has a coating or film of carbon resistive material 99 sprayed thereon. At the outer perimeter 99a of the film 99 a conductive band 101 is provided which may include a portion 101a of annular or ring configuration overlying the film portion 99c and an axially extending portion 101b in firm electrical contact with the wall 40d of recess 40c in the rotor 40. The band or ring 101 may be of silver or other highly conductive material and constitutes one terminal of the resistance element. The band 101 is electrically connected with the outer conductor of the unused

terminal with which the terminating element 90 is registered.

Centrally of the terminating element 90, member 97 is provided as a central cylindrical aperture 104 and the film 99 is similarly apertured. Surrounding the aperture in the film at an inner peripheral portion 99b of the film is provided a conductive band or ring 110 of silver which overlies the portion 99b of the resistive film 99 and forms an inner terminal for the film. The film 99 may, for example, provide a resistance equal to the characteristic impedance of the terminals such as 10 and 11 between its inner and outer terminals 110 and 101. Contact button 95 has its head 112 disposed for engagement with the inner conductor such as 32 of the unused terminal and a suitable spring washer such as indicated at 114 has its outer periphery 114a in electrical contact with the conductive band 110 and its inner portion in engagement with the underside of the head 112 to provide a firm electrical connection between the button 95 and the terminal 110 of the resistance film 99. The shaft 93 may fit snugly in the bore 104 so as to be guided for axial movement under the urging of the spring member 114.

As indicated in FIGURE 2, with the spring 114 in normal untensioned position, the outer surface 112a of the head 112 of button 95 is radially outward of the surfaces such as indicated at 40a and 40b of the rotor 40. When the rotor 40 is assembled within the rotor chamber, however, the button is depressed tensioning the spring 114 until the surface 112a is substantially flush with the surfaces such as indicated at 40a and 40b of the rotor 40. The head 112 of the contact button 95 is of substantially the same diameter as the inner conductors such as 32 and is of a diameter greater than the difference in radius between air match sections such as 18a of terminal 11 and the outer radius of the inner conductor 33 of the terminal, so as to slide smoothly from contact with the cylindrical wall of the rotor chamber 16 into contact with the inner ends of the inner conductors such as 32 and 33 of the terminals. The diameter of the head 112 is less than the diameter of the air match section such as 18a, so that the spring 114 is operative to resiliently press the head 112 directly against the inner end of the inner conductors such as 32 and 33 free of the adjacent wall portions of the rotor chamber 16. The button 95 and the spring 114 may be of a suitable highly electrically conductive material.

The silver band 101 is preferably applied to the outer perimeter 99a of the carbon film 99 after the member 97 with the film sprayed thereon is inserted in the rotor recess 40c in order that the band 101 may make secure electrical contact with the walls such as 40d of the rotor recess. The silver forming the band 101 may be applied in a molten state so as to actually be fused with the film 99 and with the side wall 40d of the rotor recess. In this event, not only is excellent electrical contact provided, but the band 101 serves to assist in retaining the member 97 in the recess 40c.

It will be apparent that many modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim as my invention:

1. A coaxial switch comprising a housing with an interior rotor chamber and a series of coaxial line terminals opening into said chamber, and a rotor in said rotor chamber and having a coaxial line section for interconnecting selective ones of said terminals, said rotor having an electrical impedance element carried at the periphery thereof for registration with at least one of said coaxial line terminals to provide a termination for said one terminal in one position of said rotor, said impedance element comprising an annulus of electrically resistive material having a central aperture, and an inner conductor contact button having a shaft portion extending through said aperture, means electrically connecting said contact button with the inner perimeter of said annulus

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of electrically resistive material, and means for resiliently pressing said button into contact with the inner conductor of the terminal with which it is registered.

2. A coaxial switch comprising a housing with an interior rotor chamber and a series of coaxial line terminals including inner and outer conductors opening into said chamber, a rotor in said rotor chamber having a coaxial line section including inner and outer conductors for interconnecting selected ones of said terminals, said rotor having a recess in the periphery thereof for registration with one of said terminals in a predetermined position of the rotor, and a resistive element comprising an insulating member in said recess, a film of resistive material on said insulating member, outer and inner conductive bands overlying an outer peripheral portion and an inner peripheral portion of said film in electrical contact therewith, and means providing for electrical continuity between said outer conductive band and the outer conductor of said one terminal and between said inner conductive band and the inner conductor of said one terminal when the terminal is aligned therewith.

3. A coaxial switch comprising a housing with an interior rotor chamber and a series of coaxial line terminals including inner and outer conductors opening into said chamber, a rotor in said rotor chamber and having a coaxial line section for interconnecting selected ones of

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said terminals, said rotor having a recess in the periphery thereof, and a resistive element in said recess and carried by said rotor comprising an insulating material having a film of resistive material at the outer surface thereof for alignment with one of the terminals of said housing in a predetermined position of said rotor, means providing electrical continuity between an outer peripheral portion of said film and the outer conductor of the terminal, said film having a central aperture and having a conductive band surrounding said aperture, an electrically conductive button having a shaft portion extending through said aperture and a head portion for contact with the inner conductor of said one terminal, and an annular spring interposed between said inner band and said head for resiliently urging said head into contact with the inner conductor of the terminal when the rotor is in said predetermined position.

References Cited in the file of this patent

UNITED STATES PATENTS

2,344,780	Kram	Mar. 21, 1944
2,473,565	Bird	June 21, 1949
2,629,048	Dyke	Feb. 17, 1953
2,782,377	Selby	Feb. 19, 1957
2,840,786	Schunemann et al.	June 24, 1958
2,958,054	Concelman	Oct. 25, 1960