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MINIATURE CO-AXIAL SWITCH

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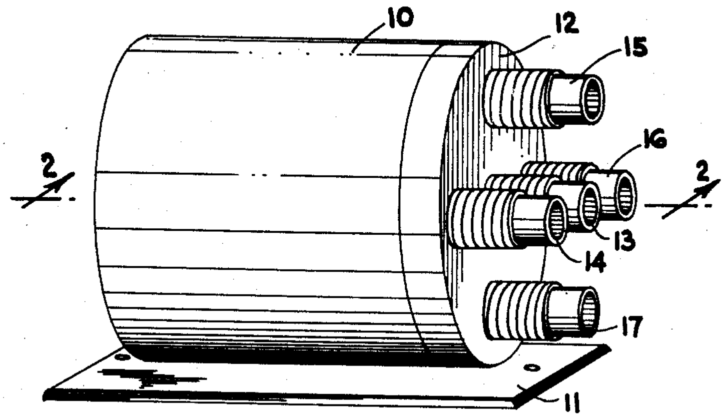

FIG. 1

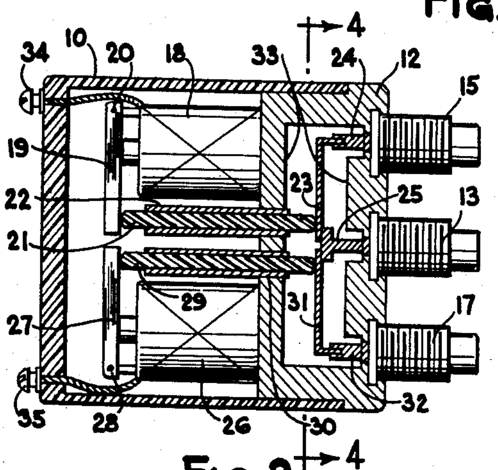

FIG. 2

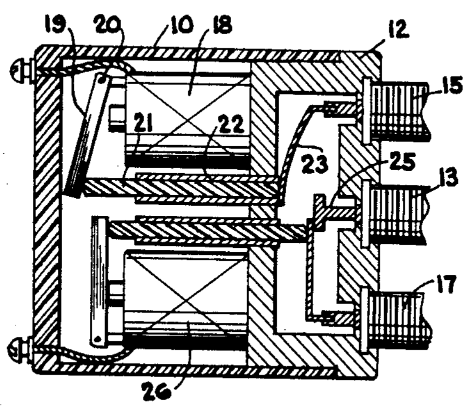

FIG. 3

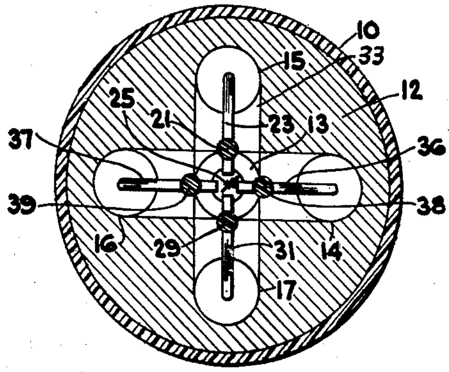

FIG. 4

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MINIATURE CO-AXIAL SWITCH

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This invention relates generally to broadband radio frequency switches and more particularly, to a miniature co-axial switch for passing R.-F. energy from an input co-axial connector to one or more output co-axial connectors.

High frequency co-axial switches are well known in the art and have been developed to a high degree of reliability. In all such switches, the physical layout and design of the switch components themselves are extremely important inasmuch as the wave lengths of the R.-F. energy involved are often of the order of magnitude of the physical dimensions of the components. It is extremely important, therefore, that the switches be physically designed to insure both a good impedance match between the various connectors and maximum isolation between an unused connector and an adjacent operating connector.

Several of the better known types of co-axial switches rely on a rotating switch arm which is arranged to make individual contact with the center conductor of a plurality of co-axial output connectors. An energy input connector forms a part of the switch arm so that by rotating the arm, the input may be connected to any one of the outputs. While a fairly good impedance match may be achieved with switches of this type, it is usually necessary to provide a relatively large amount of power to operate the switch. For example, the rotating arm usually makes contact with the various output connectors in a fixed pattern so that it may be necessary to move over several connectors before it can make contact with a desired output connector. In other words, there is no means for directly connecting the input to a desired output without first passing through the other sections. Therefore, different physical movements are necessary depending upon the particular output connector to which a connection is to be made. In the event of electrically operated co-axial switches of this type, a relatively complicated index stepping system must be employed to insure that a desired co-axial output connector is placed in operation. The bulk and size of such switches also often pose a cooling problem.

In many present day switches, the physical design is such that all of the various co-axial connectors are not conveniently disposed for making rapid connections to auxiliary apparatus. The input co-axial connector may be facing in a direction different from the output co-axial connectors making it difficult to mount the switch on a convenient working panel. Further, in the case of electrically operated co-axial switches, failure of the electrical actuating means, may leave the input connected to at least one of the output connectors; that is, there is no "fail safe" provision.

Bearing the above in mind, it is a primary object of the present invention to provide a vastly improved co-axial switch which is small and compact and in which very little power is necessary for operating the switch.

More particularly, an object of the invention is to provide a miniature co-axial switch of the above type in

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which physical movement for effecting the switching between an input co-axial connector and any one of several output co-axial connectors is individual to each output connector and extremely small, whereby it is not necessary to pass through other sections before a desired connection is made and very rapid operation is achieved.

Still another important object is to provide a co-axial switch in which the switching components are of relatively short electrical length and suitably dimensioned to insure an excellent impedance match between the input co-axial connector and the various output co-axial connectors.

Another object is to provide a miniature co-axial switch in which those output co-axial connectors not in use are grounded out whereby cross-talk is minimized and a high degree of isolation is attained.

Still another object is to provide an electrically operated miniature co-axial switch which will "fail-safe" should the actuating electrical power fail.

Another object is to provide a switch of the above type in which all co-axial connectors face forward for convenience in making connections thereto.

Still another object is to provide a miniature co-axial switch which is completely sealed against dirt and dust and which has an extremely long life whereby it may also serve as an antenna lobing switch.

These and many other objects and advantages of the present invention are attained by providing a sealed casing having a flat front connector plate. An input co-axial connector for passing R.-F. energy to various co-axial output connectors is centrally located on the plate and the various output co-axial connectors are radially and symmetrically spaced about the center of the plate facing in the same direction as the input connector. The plate itself includes a plurality of internal radial passages passing from the central co-axial connector to each of the radially spaced output co-axial connectors. These radial passages have inside diameters corresponding to the inner dimensions of the co-axial connectors whereby a proper impedance match is maintained between the input co-axial connector and the various output co-axial connectors.

The inner conductor of each of the various output co-axial connectors is in the form of a resilient conductor or reed passing centrally down each of the radial passages to a position adjacent to but out of contact with the center conductor of the input central co-axial connector. Each of these reeds are arranged to be independently operated by a suitable electro-magnet and insulated push rod so that any one or more may be placed in contact with the central conductor. The reeds are normally biased to their out of contact position such that when the electro-magnets are de-energized, no connections are made between the connectors. Preferably, each of the push rods for actuating the reeds are arranged to slide in metallic bearing sleeves electrically grounded to the front plate so that when an electro-magnet is de-energized and the corresponding reed springs back to its out of contact position it simultaneously contacts the metallic sleeve to ground itself to the front plate. Thus, all of the various output co-axial connectors that are in disconnect position have their center conductors grounded out whereby excellent isolation is obtained between the connected output co-axial connector and the remaining output connectors.

By providing an individual electro-magnet for actuating the reed associated with each output co-axial connector, each connector may be individually connected to the center conductor of the central co-axial input connector and thus it is not necessary to switch through various sections before a desired connection is effected. Further, the relative movement for making or breaking a connection is extremely small so that a very rapid switching operation is possible.

A better understanding of these and other features and advantages of the present invention will be had by referring to a preferred embodiment as illustrated in the accompanying drawings, in which:

Figure 1 is a perspective view showing the miniature co-axial switch of the present invention;

Figure 2 is a cross section taken in the direction of the arrows 2—2 of Figure 1;

Figure 3 is a cross section similar to Figure 2, illustrating the relative positions of the components upon de-energizaton of one of the actuatng electro-magnets; and,

Figure 4 is a cross section taken in the direction of the arrows 4—4 of Figure 2.

Referring now to Figure 1, the miniature co-axial switch is shown as comprising a cylindrical outer casing **10** positioned on a mounting bracket **11**. A metallic or conducting front plate **12** is secured to the case **10** and serves to support a centrally disposed input co-axial connector **13** and a plurality of radially spaced output co-axial connectors **14**, **15**, **16** and **17**. The output connectors are preferably symmetrically positioned with respect to the central connector and may be provided in any number which may be easily accommodated by the front plate **12**.

Referring now to Figure 2, each of the output co-axial connectors, such as the co-axial connectors **15** and **17**, are arranged to be respectively placed in electrical connection with the central input co-axial connector **13** by an electrical actuating means. This electrical system includes an electro-magnet coil **18** for the co-axial connector **15**, and a similar electro-magnet coil **26** for the co-axial connector **17**. Two other similar electro-magnetic coils and co-operating components therefor are associated with the output co-axial connectors **15** and **16** of Figure 1, but inasmuch as they are identical to the coils **18** and **26** description of these two will suffice for a proper understanding of the invention.

As shown in Figure 2, the electro-magnetic coil **18** is provided with a conventional armature **19** pivoted at **20** and arranged to engage one end of an insulated push rod **21** slidable within a metallic sleeve **22**. The other end of the push rod **21** is in engagement with a conducting resilient reed contact **23** shown in its actuated or connected position in Figure 2. This reed forms an extension of the center conductor **24** of the output co-axial connector **15** passing down a radial passage in the front plate **12** towards the central connector **13**. As shown in Figure 2, the push rod **21** is in its actuated or energized position holding the end of the reed contact **23** in engagement with a contact **25** connected to the center conductor of the input co-axial connector **13**.

Similarly, the electro-magnetic coil **26** is provided with an armature **27** pivoted at **28** for actuating a push rod **29** sliding within a metallic sleeve **30** for engaging a similar conducting resilient reed contact **31** connected to the center conductor **32** of the output co-axial connector **17**. In Figure 2, both the resilient reeds **23** and **31** are shown in their operated position, that is, in contact with the central conductor contact **25** whereby a T connection is provided in which R.-F. energy entering the input co-axial connector **13** is passed to both the outer co-axial connectors **15** and **17**. The reed **23** and internal radial passage **33** through which the reed passes are dimensioned similarly to the physical dimensions of the co-axial connector **15** such that a proper impedance match is provided between the co-axial connector **15** and the central co-axial connector **13**. The reed **31** and its associated radial passage are also similarly dimensioned. The electro-magnetic coils **18** and **26** are energized by applying electric current between the respective terminals **34** and **35** at the rear of the casing **10** and ground.

In Figure 3, the same components have been identified by identical reference numerals but the coil **18** is shown de-energized whereby the resilient reed **23** is out of contact with the center conductor contact **25** of the input co-axial connector **13**. The reeds **23** and **31** are normally biased to assume the position shown by the reed **23** in Figure 3 such that a positive force is necessary to urge the reed **23** into contact with the central conductor contact **25**. As shown in Figure 3, when the coil **18** is de-energized, the armature **19** is free to pivot about the pivot point **20** to its open position and the armature will be moved to this position by the biasing force of the reed transmitted through push rod **21**. The arrangement is such that the reed **23** makes electrical contact with the metallic sleeve **22** upon de-energization of the electro-magnetic coil **18**, whereby the center conductor **24** of the coaxial output connector **15** is grounded through the reed against the end of the sleeve **22**.

With the components in the positions shown in Figure 3, it will be noted that the input co-axial connector **13** is in electrical connection with the output co-axial connector **17**. If the coil **26** is now de-energized and the coil **18** energized, the central co-axial input connector **13** will then be disconnected from the connector **17** and connected to the connector **15**. It will be noted that the physical arrangement is such that the connection between the output co-axial connector **15** and input co-axial connector **13** may be effected before the contact between the output co-axial connector **17** and input co-axial connector **13** is broken. In other words, the contact may be made before broken whereby any arcing or interference noises created by the switching operation are minimized.

Referring to Figure 4, the physical arrangement of all four of the various output co-axial connectors and the manner in which they may be individually connected to the center conductor contact **25** of the central co-axial connector will be apparent. As shown, each of the output co-axial connectors **14** and **16** are provided with resilient reed contacts **36** and **37** arranged to be actuated by suitable push rods **38** and **39** operating in metallic sleeves similar to the sleeves **22** and **30**. Suitable radial passages through which these reeds centrally pass are also shown in Figure 4 whereby a proper impedance match is maintained between any one of the output co-axial connectors and the center co-axial connector.

From the above description it will be evident that all of the output co-axial connectors may simultaneously be connected to the center conductor contact **25** of the central input co-axial connector, or any one output individually may be connected.

It will be evident from Figures 2 and 3 that the actual physical movement for effecting a switching operation is relatively slight whereby extremely rapid operation is assured and that either one of the various output connectors may be immediately placed in electrical connection with the central co-axial input connector without having to switch through the other sections. Because of the relatively small movement necessary to effect a connection or a disconnect, this extremely rapid operation renders the co-axial switch of this invention suitable for a lobing switch on an antenna system. Thus, R.-F. energy may be transferred, for example, between the output co-axial connectors **15** and **17** extremely rapidly by simply alternating energizing pulses between the coils **18** and **26**. By the construction of the case **10** and plate **12** the entire operating mechanism may be suitably sealed whereby dirt and dust is kept out of the moving components. Finally, it will be noted from this construction that all of the various connectors face forward and are, therefore, readily accessible for making necessary co-axial lead-in connections in a convenient manner.

Minor modifications within the scope and spirit of the present invention will occur to those skilled in the art. The co-axial switch is, therefore, not to be thought of as limited to the particular embodiment set forth for illustrative purposes.

What is claimed is:

1. A miniature co-axial switch comprising, in combination: a case having a front electrically conducting connector plate; a central co-axial connector passing into said plate; at least one co-axial connector passing into said plate and radially spaced with respect to said central connector, said plate including an internal radial passage passing from said central co-axial connector to said radially spaced co-axial connector; a flexible conducting L-shaped reed contact connected to the inner conductor of said radially spaced co-axial connector and passing through said passage and having its free end normally oriented in a first position adjacent to and spaced behind the inner conductor of said central co-axial connector; and actuating means for pushing the free end of said reed contact into a second position centrally disposed in said radial passage and in electrical engagement with said last mentioned inner conductor with said free end fulcrumed about the junction of the legs of said L-shaped reed contact, said reed contact and passage being dimensioned in accordance with the dimensions of said central co-axial connector and said radially spaced co-axial connector whereby an impedance match is provided therebetween when said reed contact is in engagement with said last mentioned inner conductor of said central co-axial connector; additional radially spaced co-axial connectors symmetrically positioned on said front plate with respect to said central co-axial connector; additional radial passages in said front plate respectively connecting said additional radially spaced co-axial connectors to said central co-axial connectors; additional reed contacts respectively connected to the inner conductors of said additional radially spaced co-axial connectors, and passing through said additional radial passages to terminate adjacent said last mentioned inner conductor; and additional actuating means for respectively urging said additional reed contacts into engagement with said last mentioned inner conductor individually or collectively.

2. A switch according to claim 1 in which said case is hermetically sealed to said front conductor plate and completely encloses said actuating means whereby a dirt and dust-tight switch is provided.

3. A coaxial switch comprising, a front plate; a plurality of coaxial connectors all on one side of said front plate and each having an inner conductor passing through said front plate; one of said connectors being centrally disposed with respect to the other connectors which are radially and circumferentially disposed with respect to said one connector; said plate including a plurality of internal coaxial passages, one for each of said other connectors, passing from said one connector to a corresponding one of said other connectors; a plurality of resilient conducting reed contacts, each having one end affixed to the inner conductor of a corresponding one of said other connectors; each one of said reed contacts extending radially inwardly through a corresponding one of said passages and each having its free end normally spaced behind and out of contact with the inner conductor of said one connector due to the inherent resiliency of said reed contacts; a plurality of actuating means, one for each of said reed contacts, for moving the free ends of corresponding reed contacts into engagement with the inner conductor of said one connector, each actuating means comprising an electromagnet coil coaxially disposed with respect to a corresponding one of said other connectors; and a plurality of push rods, one operated by a corresponding coil, and having their axes circumferentially disposed with respect to each other about the axis of said inner conductor of said one connector, for moving a corresponding reed contact into engagement with the last mentioned inner conductor, said rods being all normally urged out of operating position by said resilient reed contacts, each of said rods being slidably mounted in a metallic guide bushing which is electrically connected to said front plate, and each of said resilient reed contacts normally urges itself into engagement with a corresponding one of said sleeves, each of said resilient reed contacts comprising two legs of an L-shaped reed contact with the free end thereof fulcrumed about the junction of said legs, said actuating means moving said reed contacts either singly or collectively into engagement with said inner conductor of said one connector.

References Cited in the file of this patent

UNITED STATES PATENTS

2,432,230	Dorne	Dec. 9, 1947
2,472,274	Beleskas	June 7, 1949
2,498,907	Atwood	Feb. 28, 1950
2,584,901	Miller et al.	Feb. 5, 1952