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COAXIAL CABLE SWITCH

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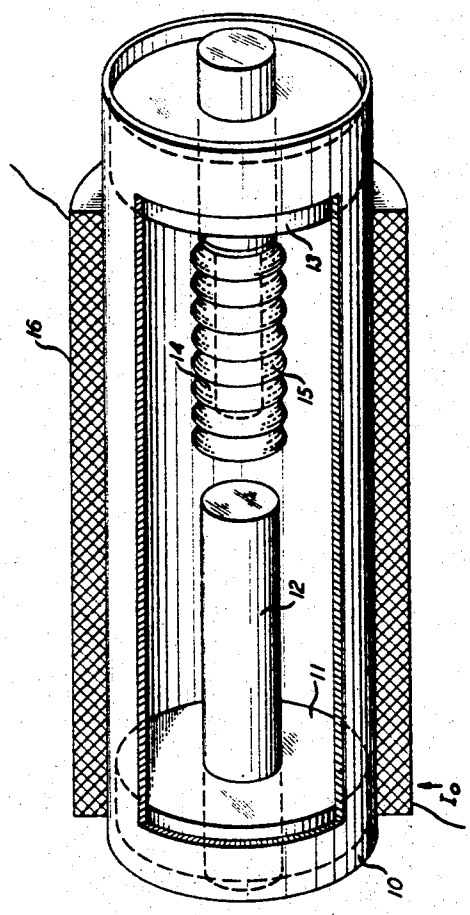

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COAXIAL CABLE SWITCH

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This invention relates to coaxial cable switches.

One form of coaxial cable switch uses a reed switch in series with the center conductor of a cable. Although this is a relatively simple structure, the capacitive coupling occurring when the switch is open results in isolation which is inadequate in some uses.

Coaxial cable switching arrangements that provide greater isolation in their open states appear in T. Slonczewski Patent No. 2,666,100 and D. S. Church et al. patent application Ser. No. 590,897, filed on Oct. 31, 1966, now Patent No. 3,355,684. The arrangements shown in the Slonczewski patent and the Church et al. application use two or more switches connected in series with the center conductors of cables. These switches are spaced with respect to one another and are operated simultaneously in each of the arrangements. Greater isolation is produced, however, at the expense of the over-all length of the coaxial cable switching arrangement.

An object of the present invention is to provide relatively high open circuit isolation in coaxial cable switches that are relatively short in length.

In accordance with the present invention, a pair of elongated magnetizable members form a discontinuous center conductor of a coaxial switch. A bellows formed of material having both magnetizable and springlike properties is mounted on a first of these members so that in its expanded state the bellows makes physical contact with the other member and, furthermore, has relatively small corrugations. In at least one embodiment, expansion of the bellows is achieved by magnetic fields produced by energizing one or more coils surrounding the outer conductor of the switch. When the magnetic field is removed, the springlike property of the bellows causes it to contract to its original state, thereby opening the center conductor.

With the bellows expanded, a relatively low loss transmission path is provided. Furthermore, the relatively small corrugations in the bellows introduce a relatively small electrical discontinuity in the transmission path. On the other hand, with the bellows contracted the large spacing between the members permits little capacitive coupling, thereby providing high isolation.

Other objects and features of the invention will become apparent from the following description of a specific embodiment.

The embodiment shown in sectionalized form in the drawing includes an outer conductor **10** formed of tubularly-shaped nonmagnetizable metal. A cylindrically-shaped piece of dielectric material **11** positions a center-conductor segment **12** in outer conductor **10**. Similarly, a cylindrically-shaped piece of dielectric material **13** positions a center-conductor segment **14** in outer conductor **10**. Segment **12** and segment **14** each has a closed-loop magnetic characteristic (that is, when a magnetizing force is removed, it will return to its original state). Furthermore, a portion of segment **14** is undercut so that its diameter is less than that of segment **12**.

A bellows **15** is mounted over the undercut portion of segment **14** and affixed at the junction between the normal and undercut portions so that in its extended state it makes physical contact with segment **12** and, furthermore, has relatively small corrugations. Bellows **15** has a springlike characteristic which causes it to assume the illustrated position in the absence of any external force. Bellows **15**

also has a closed-loop magnetic characteristic like segments **12** and **14**.

A winding **16** surrounds outer conductor **10**. When this winding is energized by passing a current I_0 through it (by means not shown), a magnetic field is produced which is concentrated in segments **12** and **14** and bellows **15**. This, in turn, causes bellows **15** to expand and to come into contact with segment **12**.

In its expanded state, the corrugations in bellows **15** virtually disappear so that only a relatively small electrical discontinuity is produced. In its contracted state, the gap between segment **12** and bellows **15** is sufficiently great so that relatively little coupling occurs across the gap as a result of capacitive coupling.

The switch shown in the drawing may be inserted in a coaxial cable, for example, by the use of conventional coaxial connectors.

Embodiments of the invention may take forms other than that illustrated. When it is desirable to use embodiments for crosspoint switches in a matrix, for example, a pair of coils (i.e., a row coil and a column coil) may be provided in place of single coil **16**. Furthermore, if constant currents are not available for maintaining the switch in a closed position, a memory feature is easily incorporated. For matrix purposes, this memory feature may be readily incorporated, for example, by making segment **12** of material having a square-loop magnetic characteristic (i.e., material which may be pulsed into a particular magnetic state and will remain in that state until pulsed into another state) and replacing winding **16** with a pair of differential windings of the type disclosed in FIG. 5(*a*) of the article "The Ferreed" by A. Feiner, The Bell System Technical Journal, January 1964, pp. 1–14. Still further, the switch lends itself to the easy and compact construction of switching matrices by mounting a plurality of these switches as crosspoints between a pair of stripline printed circuit boards using, for example, conventional solder connections between the switches and the stripline structures. Such techniques are well known to those skilled in the art. It should be understood, therefore, that various embodiments other than that disclosed may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A coaxial cable switch comprising

an annular sheath of nonmagnetic electrically-conductive material,

a pair of magnetizable members coaxially aligned in said sheath with a separation between said members to form a discontinuous center conductor,

a bellows formed of material having both magnetizable and springlike properties and mounted on a first of said members so that in its expanded state it makes physical contact with the other of said members, and

means for expanding said bellows.

2. A coaxial cable switch in accordance with claim **1** in which said means for expanding said bellows comprises means for producing a magnetic field.

3. A coaxial cable switch in accordance with claim **2** in which said magnetic field producing means comprises coil means surrounding the outer periphery of said sheath in the vicinity of said bellows.

References Cited

UNITED STATES PATENTS

2,709,728	5/1955	Tancred	335—163
2,794,087	5/1957	Jennings et al.	
3,067,304	12/1962	Bergstrasser et al.	335—3
3,253,098	5/1966	Perry	335—170

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