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MULTIPLE POSITION COAXIAL SWITCH WITH ANGULARLY SPACED RADIAL CHANNELS

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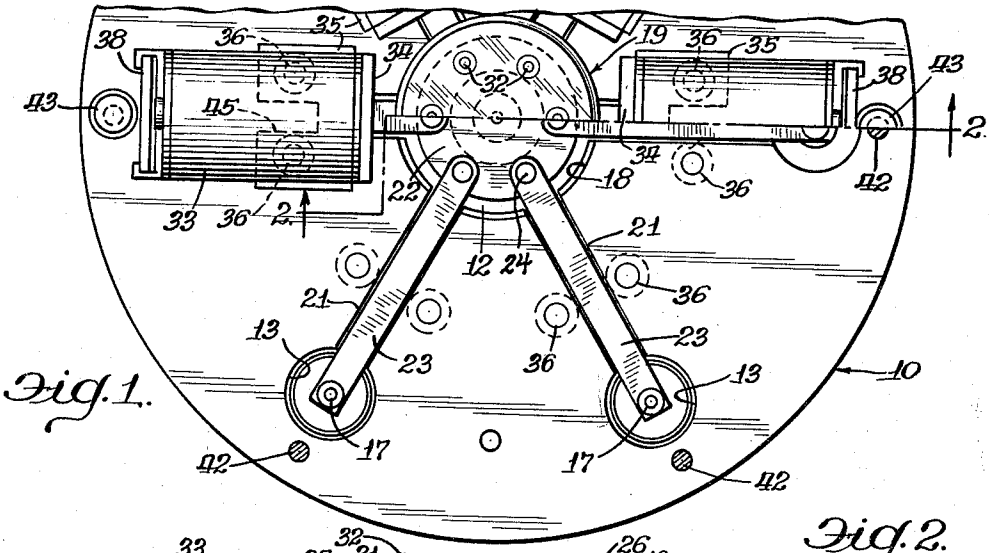


Fig. 1.

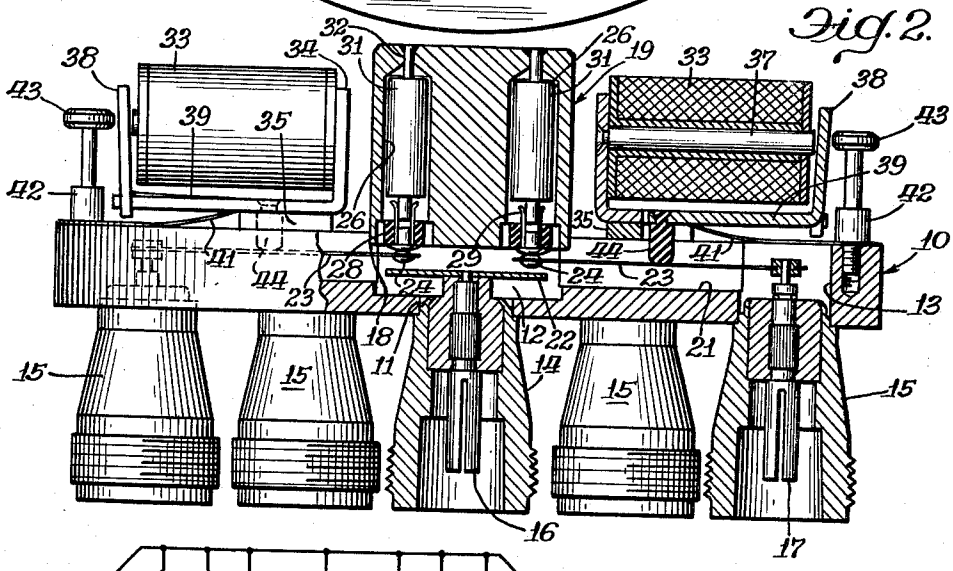


Fig. 2.

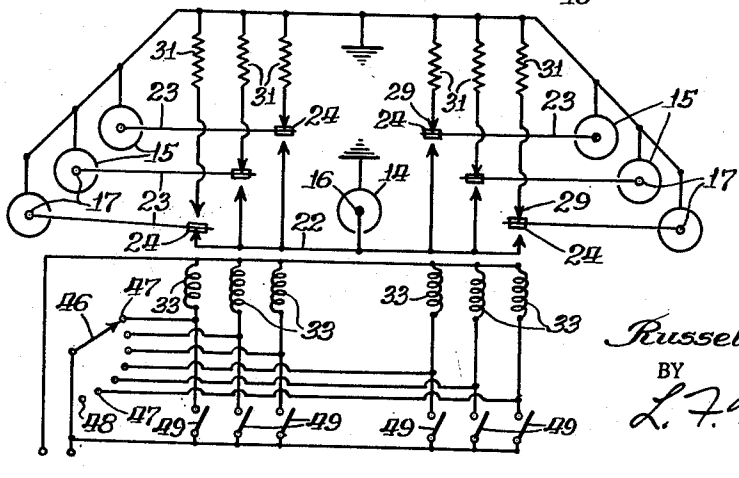


Fig. 3.

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MULTIPLE POSITION COAXIAL SWITCH WITH ANGULARLY SPACED RADIAL CHANNELS

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6 Claims. (Cl. 333—7)

The present invention relates to electrical switches and more specifically to a multiposition switch adapted to selectively interconnect a plurality of coaxial radio-frequency transmission lines.

It is among the objects of the invention to provide a multiple-position coaxial switch of mechanical and electrical design such that it is well suited to operation in relatively high frequency ranges without excessive losses and with a relatively low voltage standing wave ratio, yet nevertheless capable of practically instantaneous switching from one line to another, and adapted to remote control without direct manual manipulation.

A further object of the invention is the provision of a multiple-channel coaxial switch having the features indicated above, yet so designed that each of the several outputs have the same physical structure and identical electrical characteristics.

Another object of the invention is the provision of a multiple-channel coaxial switch wherein the several output transmission lines may be automatically terminated through identical resistors of preselected value when said lines are not in use, whereby cross talk or other interference from the unused channels are reduced to an insignificant value.

A still further object of the invention is the provision of a resistor terminated switch having the characteristics indicated above, wherein the terminal resistors are compactly grouped from a mechanical standpoint, and adequately shielded electrically.

A further object of the invention is the provision of a remote control multiple-channel coaxial switch so designed as to be capable of selectively shifting between channels, while also adapted to simultaneous interconnection with all or any selected number of the channels provided.

These and other related objects are accomplished by the preferred embodiment of the invention illustrated in the drawings, wherein:

FIGURE 1 is a fragmental plan view of a single-pole, six-position switch constructed in accordance with the present teachings;

FIGURE 2 is a side elevational view of the switch illustrated in FIGURE 1, shown partially in section along the line 2—2 of FIGURE 1; and

FIGURE 3 is a schematic diagram showing the internal circuitry between the several coaxial transmission lines entering the switch and the terminating resistances therefor, and an illustrative embodiment of the control circuitry for effecting operation by remotely located electrical control switches.

The illustrated embodiment of the invention includes a circular base plate or housing 10, the lower face surface of which has a central bore 11 entering a shallow, wide central cavity 12. A plurality of similar peripheral bores or cavities 13 are spaced equally around the housing. The central cavity is arranged to receive a central coaxial connector 14, and a plurality of identical peripheral connectors 15 are mounted in the peripheral bores, as best illustrated in FIGURE 2. The connectors 14 and 15 each comprise a short segment of coaxial transmission line of the same characteristic impedance as the cables for which the switch is designed, and the outer conductive sleeves of each connector may be press-fitted,

soldered or other-wise firmly mounted in their respective bores. Each of the connectors are also provided with internal insulating mountings for their central conductors 16, 17. The connectors may be of any conventional type adapted to provide satisfactory transmission of radio frequency power in the upper frequency ranges. The upper surface of the housing 10 is counterbored around the cavity 12 to provide a seat or step 18 in the central cavity, adapted to receive the closure plug 19. The central cavity 12 is interconnected with each of the drilled apertures 13 by radial slots 21 milled or otherwise provided in the base plate of the housing.

The central cavity 12 serves to house a central contact disc 22 mounted on the upper extremity of the metallic contact 16 within the sleeve of connector 14. The several contacts 17 of the peripheral connector fittings 15 are each provided with a relatively long, thin, slender, yieldable switching reed 23, the outer end of which is secured to one of the contacts 17 by any suitable fastening means. The inner end of each of the reeds 23 is provided with paired contact buttons 24 on its upper and lower surfaces.

The central cavity 12 is closed by the generally cylindrical metallic plug 19, which may be soldered or otherwise secured on the counterbored step 18. The plug 19 has a series of internal vertical cavities 26 which may be bored inwardly from the lower end thereof, as illustrated, and which are oriented in the same angular pattern as the peripheral connectors 15 so that the vertical axis of each of the cavities 26 is directly above and in alignment with one of the contact buttons 24 on the reeds 23. The lower ends of each of the cavities 26 are counterbored to receive an insulator 28 having a terminal contact 29 centrally secured therein and the cavities 26 each serve to house an identical electrical resistor 31, the lower terminal of which is electrically joined to a terminal contact 29 and the upper terminal of which extends through an aperture 32 and is soldered or otherwise grounded to the metallic plug member 19. Each of the switching reeds 23 is so arranged that it will normally exert a reasonable biasing pressure between the button contacts 24 and the corresponding terminal contact 29, yet the reeds are flexible and may easily be deflected downwardly sufficiently to break the electrical connection 24, 29 and establish electrical contact between the contacts 24 and the central contact disc 22. This operation is selectively accomplished by energizing one or more of a plurality of relay windings generally indicated by the numeral 33, wherein each of the relay assemblies includes an L-shaped magnetic frame 34 (FIGURE 2), mounted adjacent the upper face of the body 10, but spaced therefrom by a spacer 35 and secured in position by paired fastening screws 36 (FIGURE 1). The relay windings 33 each surround a central magnetic core 37 arranged to act on the upright end portion of a pivoted armature 38 so that its inwardly extending arm 39 (FIGURE 2) may be moved slightly downwardly against the spring pressure of leaf spring 41. The springs 41 may conveniently be secured by screws 42 received in housing 10 and provided with enlarged head portions 43, whereby the same screws which serve to mount the springs 41 also function as outward limit stops for the upwardly extending portions of the armature 38. The lower arm portions 39 of each of the armatures is provided with a downwardly extending insulating pin 44 positioned to extend through suitable notches 45 in the spacers 35 (FIGURE 1) so that whenever the windings of any of the relay magnets are energized, the inward movement of the armature portion 38 will result in downward pressure exerted by the pins 44 upon the corresponding reed members 23 to break the connection between the contacts 24 and 29 and establish connection between selected contact 24 and the central contact disc 22.

It is contemplated that the switch of the present invention may be remotely controlled by any appropriate circuitry adapted to energize the several relay magnets. The present design also makes possible interconnection of any one of the peripheral connectors with the central connector, while the other channels remain grounded through resistors 31. Interconnection of two, three or even all of the peripheral connectors at the same time may also be accomplished, if desired. A simplified circuit for accomplishing this is included in FIGURE 3, wherein selective individual control of the several magnet windings 33 may be accomplished by switch 46 movable over six operating contacts 47 and an "off" contact 48, while ganged operation of the switch may be accomplished by closing as many of the single channel switches 49 as desired.

From the foregoing it will be apparent that the present invention provides a unique and improved coaxial switching device which, while comparatively simple in design, construction and operation, is nevertheless capable of providing a high degree of flexibility in the connection of plural radio-frequency transmission lines. Each of the several channels through the switch is so designed and constructed as to provide the same mechanical structure and identical electrical characteristics, with each of the unused lines terminated by a resistor of preselected value. The several parts of the switch assembly are arranged and constructed in a manner to provide quick and positive remote control switching with minimum attenuation and cross talk, and with VSWR characteristics considerably better than generally encountered in devices of this type.

It should be recognized, of course, that while the drawings of this disclosure illustrate the present preferred embodiment herein, it is obviously subject to modifications and variations in accordance with general practice in the art (as by drectly grounding the unused channels or leaving the terminal contact circuits of unused lines open) and it is accordingly pointed out that the drawings are intended by way of illustration rather than by limitation, and that the scope of the invention should be regarded as limited only by the appended claims.

Having thus described my invention, what I claim as new and desire to secure by United States Letters Patent is:

1. A multiple-position coaxial switch comprising, in combination,

a metallic housing having a central cavity of generally cylindrical shape and of shallow, wide conformation with

a central connector comprising a short coaxial radio-frequency transmission line segment of predetermined characteristic impedance having an outer conductive sleeve mounted in said housing and a central conductor entering said cavity on the axis thereof and terminating in

a thin, flat, circular central contact disc coaxial with respect to the cavity and centrally disposed therein;

a plurality of peripheral cavities in said housing arranged around the central cavity therein and each being of generally cylindrical shape, with

a plurality of peripheral connectors each comprising a short coaxial radio-frequency transmission line segment of characteristic impedance matching the central connector with an outer conductive sleeve mounted in said housing; said peripheral connectors being spaced from and arranged around the aforesaid central connector and each having a central conductor thereof entering one of said peripheral cavities on the axis thereof and having a terminal portion thereof centrally disposed therein, with

a series of radial channels extending between said central cavity and each of the aforesaid peripheral cavities and

a plurality of switching conductors each consisting of a yieldable reed, with the outer end of each reed supported on one of the aforesaid terminal portions in one of the peripheral cavities and with each reed extending radially inwardly through one of the said radial channels to the aforesaid central cavity; each of said radial channels being of width substantially less than either the central cavity or the peripheral cavities aforesaid, with the walls of said channels parallel with and closely spaced with respect to the edges of said reeds, with

contact portions on each of said switching conductors each biased into engagement with one of a series of indivdual terminal contacts and selectively engageable with the aforesaid central contact disc;

said terminal contacts each being individually electrically interconnected to the outer sleeves of all of the transmission line segments entering the switch through one of a group of resistance elements, said resistance elements each having identical values substantially equal to the characteristic impedance of the aforesaid transmission line segments; together with

individual electromagnetic actuating devices to selectively shift each of the aforesaid contact portions between said central contact disc and one of said terminal contacts, and

selective switching devices for energizing said electromagnetic actuating devices.

2. A multiple-position coaxial switch comprising, in combination,

a metallic housing having a central cavity of generally cylindrical shape and of shallow, wide conformation, with

a central connector comprising a short coaxial radio-frequency transmission line segment of predetermined characteristic impedance having an outer conductive sleeve mounted in said housing and a central conductor entering said cavity on the axis thereof and terminating in

a thin, flat, circular central contact disc coaxial with respect to the cavity and centrally disposed therein;

a plurality of peripheral cavities in said housing arranged around the central cavity therein and each being of generally cylindrical shape, with

a plurality of peripheral connectors each comprising a short coaxial radio-frequency transmission line segment of characteristic impedance matching the central connector with an outer conductive sleeve mounted in said housing; said peripheral connectors being spaced from and arranged around the aforesaid central connector and each having a central conductor thereof entering one of said peripheral cavities on the axis thereof and having a terminal portion thereof centrally disposed therein, with

a series of radial channels extending between said central cavity and each of the aforesaid peripheral cavities and

a plurality of switching conductors each consisting of a yieldable reed, with the outer end of each reed supported on one of the aforesaid terminal portions in one of the peripheral cavities and with each reed extending radially inwardly through one of the said radial channels to the aforesaid central cavity; each of said radial channels being of width substantially less than either the central cavity or the peripheral cavities aforesaid, with the walls of said channels parallel with and closely spaced with respect to the edges of said reeds, with

contact portions on each of said switching conductors each biased into engagement with one of a series of individual terminal contacts and selectively engageable with the aforesaid central contact disc;

said terminal contacts each being individually electrically interconnected to the outer sleeves of all of the transmission line segments entering the switch through one of a group of resistance elements, said

resistance elements each having identical values substantially equal to the characteristic impedance of the aforesaid transmission line segments; together with

actuating devices to selectively shift each of the aforesaid contact portions between said central contact disc and one of said terminal contacts.

3. A multiple-position coaxial switch comprising, in combination,

a metallic housing having a central cavity with

a central connector comprising a short coaxial radio-frequency transmission line segment of predetermined characteristic impedance having an outer conductive sleeve mounted in said housing and a central conductor entering said cavity and terminating in

a central contact centrally disposed therein;

a plurality of peripheral cavities in said housing arranged around the central cavity therin with

a plurality of peripheral connectors each comprising a short coaxial radio-frequency transmission line segment of characteristic impedance matching the central connector with an outer conductive sleeve mounted in said housing; said peripheral connectors being spaced from and arranged around the aforesaid central connector and each having a central conductor thereof entering one of said peripheral cavities and having a terminal portion thereof centrally disposed therein, with

a series of radial channels extending between said central cavity and each of the aforesaid peripheral cavities and

a plurality of switching conductors each consisting of a yieldable reed, with the outer end of each reed supported on one of the aforesaid terminal portions in one of the peripheral cavities and with each reed extending radially inwardly through one of the said radial channels to the aforesaid central cavity; each of said radial channels being of width substantially less than either the central cavity or the peripheral cavities aforesaid, with the walls of said channels parallel with and closely spaced with respect to the edges of said reeds, with

contact portions on each of said switching conductors each biased into engagement with one of a series of individual terminal contacts and selectively engageable with the aforesaid central contact disc;

said terminal contacts each being individually electrically interconnected to the outer sleeves of all of the transmission line segments entering the switch through one of a group of resistance elements, said resistance elements each having identical values substantially equal to the characteristic impedance of the aforesaid transmission line segments; together with

individual electromagnetic actuating devices to selectively shift each of the aforesaid contact portions between said central contact disc and one of said terminal contacts, and

selective switching devices for energizing said electromagnetic actuating devices.

4. A multiple-position coaxial switch comprising, in combination,

a metallic housing having a central cavity with

a central connector comprising a short coaxial radio-frequency transmission line segment of predetermined characteristic impedance having an outer conductive sleeve mounted in said housing and a central conductor entering said cavity and terminating in

a central contact centrally disposed therein;

a series of at least three peripheral cavities in said housing arranged around the central cavity therin with

a plurality of peripheral connectors each comprising a short coaxial radio-frequency transmission line segment of characteristic impedance matching the

central connector with an outer conductive sleeve mounted in said housing; said peripheral connectors being spaced from and arranged around the aforesaid central connector and each having a central conductor thereof entering one of said peripheral cavities and having a terminal portion thereof centrally disposed therein, with

a series of radial channels extending between said central cavity and each of the aforesaid peripheral cavities and

a plurality of switching conductors each consisting of a yieldable reed, with the outer end of each reed supported on one of the aforesaid terminal portions in one of the peripheral cavities and with each reed extending radially inwardly through one of the said radial channels to the aforesaid central cavity; each of said radial channels being of width substantially less than either the central cavity or the peripheral cavities aforesaid, with the walls of said channels parallel with and closely spaced with respect to the edges of said reeds, with

contact portions on each of said switching conductors each biased into engagement with one of a series of individual terminal contacts and selectively engageable with the aforesaid central contact disc;

said terminal contacts each being individually electrically interconnected to the outer sleeves of all of the transmission line segments entering the switch through one of a group of resistance elements, said resistance elements each having identical values substantially equal to the characteristic impedance of the aforesaid transmission line segments; together with

actuating devices to selectively shift each of the aforesaid contact portions between said central contact disc and one of said terminal contacts.

5. A multiple-position coaxial switch comprising, in combination,

a metallic housing having a central cavity of generally cylindrical shape and of shallow, wide conformation, with

a central connector comprising a short coaxial radio-frequency transmission line segment of predetermined characteristic impedance having an outer conductive sleeve mounted in said housing and a central conductor entering said cavity on the axis thereof and terminating in

a thin, flat, circular central contact disc coaxial with respect to the cavity and centrally disposed therein;

a series of at least three peripheral cavities in said housing arranged around the central cavity therein and each being of generally cylindrical shape, with

a plurality of peripheral connectors each comprising a short coaxial radio-frequency transmission line segment of characteristic impedance matching the central connector with an outer conductive sleeve mounted in said housing; said peripheral connectors being spaced from and arranged around the aforesaid central connector and each having a central conductor thereof entering one of said peripheral cavities on the axis thereof and having a terminal portion thereof centrally disposed therein, with

a series of radial channels extending between said central cavity and each of the aforesaid peripheral cavities and

a plurality of switching conductors each consisting of a yieldable reed, with the outer end of each reed supported on one of the aforesaid terminal portions in one of the peripheral cavities and with each reed extending radially inwardly through one of the said radial channels to the aforesaid central cavity; with

contact portions on each of said switching conductors selectively engageable with the aforesaid central contact disc.

6. A multiple-position coaxial switch comprising, in combination,

a metallic housing having a central cavity of generally cylindrical shape and of shallow, wide conformation, with

a central connector comprising a short coaxial radio-frequency transmission line segment of predetermined characteristic impedance having an outer conductive sleeve mounted in said housing and a central conductor entering said cavity on the axis thereof and terminating in

a thin, flat, circular central contact disc coaxial with respect to the cavity and centrally disposed therein;

a series of at least three peripheral cavities in said housing arranged around the central cavity therein and each being of generally cylindrical shape, with

a plurality of peripheral connectors each comprising a short coaxial radio-frequency transmission line segment of characteristic impedance matching the central connector with an outer conductive sleeve mounted in said housing; said peripheral connectors

being spaced from and arranged around the aforesaid central connector and each having a central conductor thereof entering one of said peripheral cavities on the axis thereof and having a terminal portion thereof centrally disposed therein, with

a series of radial channels extending between said central cavity and each of the aforesaid peripheral cavities and

a plurality of switching conductors each extending radially inwardly through one of the said radial channels to the aforesaid central cavity; with

contact portions on each of said switching conductors selectively engageable with the aforesaid central contact disc.

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HERMAN KARL SAALBACH, *Primary Examiner.*