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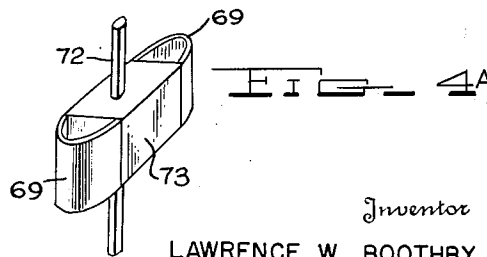
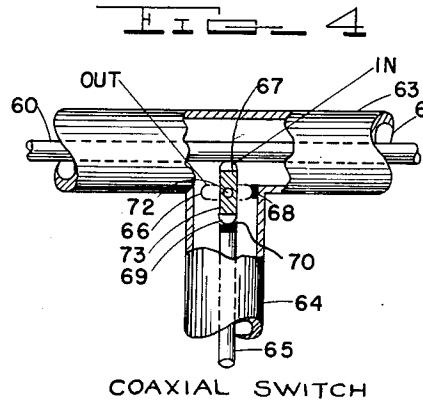
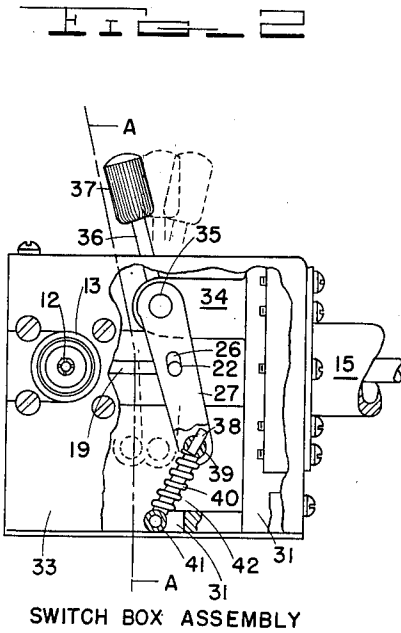
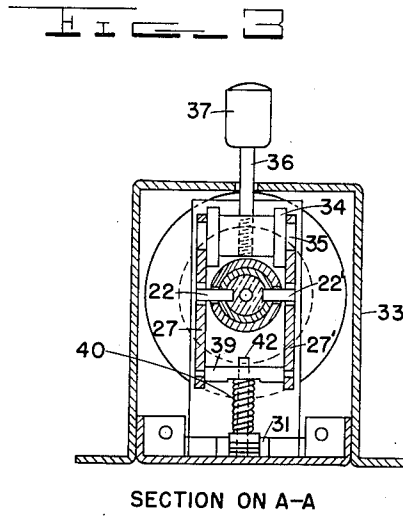
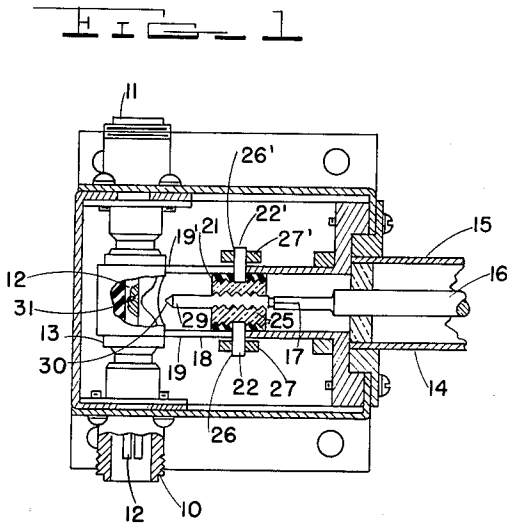
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2,690,540

COAXIAL SWITCH

Filed Sept. 17, 1945

2 Sheets-Sheet 1



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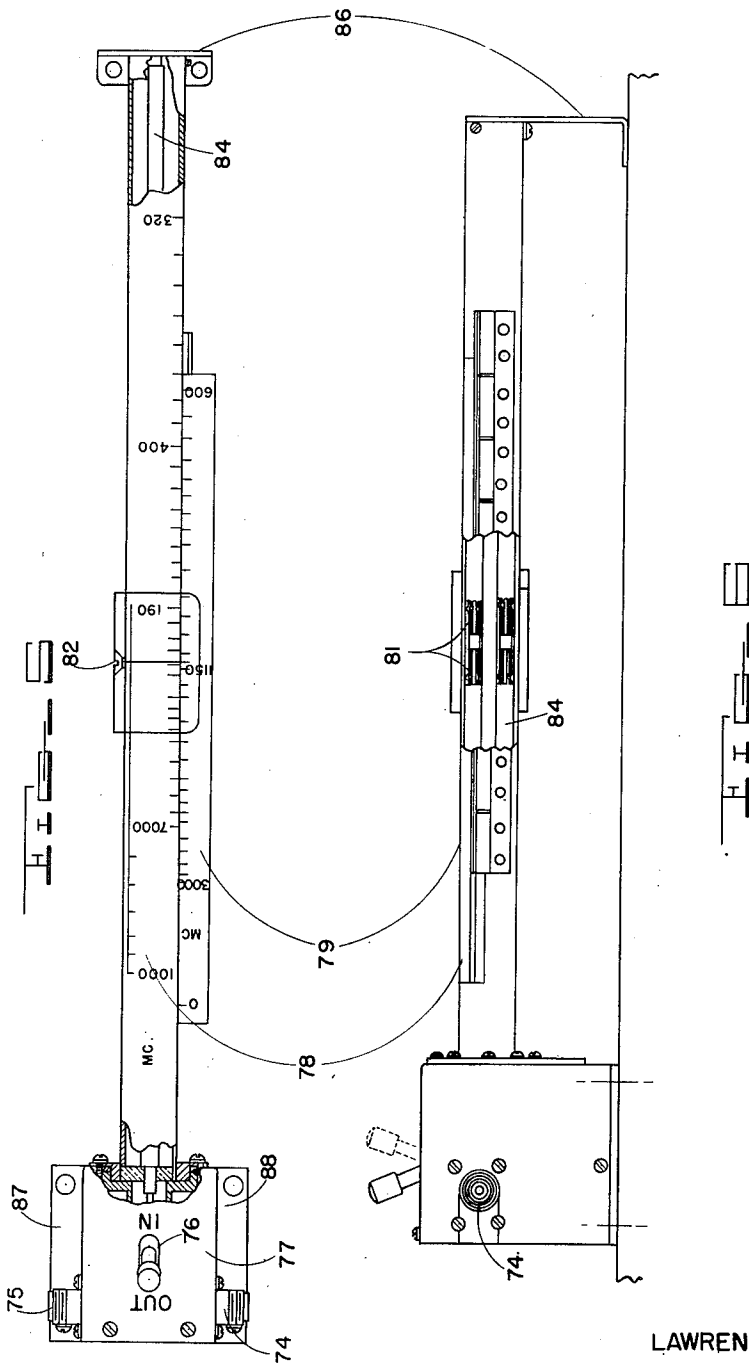
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COAXIAL SWITCH

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2 Sheets-Sheet 2



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COAXIAL SWITCH

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9 Claims. (Cl. 333-7)

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sec. 266)

1

This invention relates in general to ultra high frequency switches and, more particularly, to an ultra high frequency switch for use with coaxial transmission lines.

In the ultra high frequency art, it is often desired to employ a stub along a coaxial line, for example, as a series resonance element, or as a matching device, and under these circumstances it is frequently necessary to conveniently connect or disconnect the stub from the coaxial line. Also to accomplish the purpose of intermittently tapping off from a coaxial field line a portion of the ultra high frequency energy, or, of feeding ultra high frequency energy into a coaxial line, a means of connecting or disconnecting the stub at the T connection must be provided along the coaxial line.

Accordingly it is an object of this invention to provide a coaxial switch, which will have a positive action; that is, a make or break contactor action which can occur with sufficient rapidity to be termed a snap switch operation.

It is another object of this invention to provide an ultra high frequency coaxial switch suitable for conveniently connecting or disconnecting a coaxial line from a feeder line such as, for example, at a T connection therewith.

It is a further object of this invention to provide a low reactance coaxial switch at the T connection between a coaxial feeder line and another coaxial line; such that, a minimum insertion loss will occur and particularly when the switch disconnects the coaxial line from the feeder line.

Still another object of this invention is to provide a coaxial switch of a type suitable for making a T connection into a coaxial feeder line, in combination with a series resonance stub having an adjustable frequency of series resonance, for example, suitable for use as a wavetrap, or as a matching device in the transmission of ultra high frequency energy.

Other objects of this invention will be apparent or will be specifically pointed out in the description, forming a part of the specification and it is not desired to be limited to the embodiment herein described as various forms may be adopted within the scope of the claims.

Referring to the drawings:

Fig. 1 is a plan view comprising a partial section through a coaxial switch constituting a preferred embodiment of the invention;

Fig. 2 is a side view of the device shown in Fig. 1 with its housing partially cut away to show the snap switch mechanism;

2

Fig. 3 is a front view of the device shown in Fig. 1, being a section along the line AA' of Fig. 2;

Fig. 4 is a plan view of another embodiment of this invention; Fig. 4a is a perspective view of the contact means of the second mentioned embodiment;

Fig. 5 shows a plan view of a particular embodiment of this invention, showing in combination a coaxial switch and a calibrated stub having an adjustable frequency of series resonance; and

Fig. 6 is a side view of the device shown in Fig. 5, partially cut away to show the detail of the shorting contactor within the stub.

Referring now to Figs. 1 and 2, reference numerals 10 and 11 designate the input and output terminals of the coaxial feeder line, respectively. The coaxial feeder line comprises the central or inner conductor 12 (see Fig. 2) and the outer conductor 13. As shown in Fig. 1 the outer conductor 13 of the coaxial feeder line makes a T connection with the outer conductor 14 of the coaxial stub 15. The coaxial stub 15 contains a central conductor 16 terminated with a slotted sleeve 17 within which is formed an axial bore. A conducting rod or pin 29 having a conical contactor surface 30 fits within the sleeve 17 and is insertable into the axial bore within the end of central conductor 16 shown in the Fig. 1 as 17. The slotted sleeve 17 applies pressure to the pin 29 while permitting it to be moved axially to establish contact between the inner conductor 16 and the inner conductor 12, when the surface 30 is brought forward so as to make pressure contact with the indentation 31 within inner conductor 12. The tubular member 18 within the switch box, forming an extension of the outer conductor 14 of the stub 15, is longitudinally slotted parallel to the axis of the stub, as indicated at 19 and 19' in Figs. 1 and 2. Within the tubular member 18 of the stub 15, there is fitted a sliding dielectric plug 21, having inserted therein the actuating pins 22 and 22', which are engaged by receptive slots 23 and 23' in a pair of arms, 27, 27', respectively of the switch actuating mechanism.

The pin 29, which forms an extension of the central conductor 16 of the stub 15, is shown attached to the dielectric plug 21 by means of a threaded section insert, 25, which may be molded within the dielectric plug 21. The pin 29 as shown has one end thereof of preferably cylindrical shape, conically pointed, and, preferably hardened in order to provide a durable contactor surface for making contact with the indented

3

conical surface 31 of the inner conductor 12. As thus arranged the pin 29 forms an extension on the central conductor 16 of the stub 15, which may be moved axially by means of the switch actuating bars 27, 27', above mentioned. The stub and the coaxial feeder line may be suitably supported by the sides of the sheet metal housing 33 as shown, which also acts as a shield to prevent pick-up or radiation from the coaxial switch.

In operation, the switch actuating members 27 and 27' function to drive the dielectric plug 21 and the contacting surface 30 of the pin 29 forward against the indented conical surface 31 within the central conductor 12 of the coaxial feeder line, thus making contact and completing the electrical circuit. To break contact, the action of the switch actuating members 27 and 27' is reversed.

An important problem in the design of coaxial switches of the type herein described, has been solved in connection with this invention. The aforementioned problem involved the design of a switch which would have negligible influence upon the electrical characteristics of the coaxial line when disconnected therefrom. The present invention accomplishes this purpose by eliminating all projecting surfaces on the inner conductor 12 and providing only a small window or aperture in the outer conductor 13 at the T connection of the stub 18. When the switch is thrown to the out position, the pin 29 is retracted beyond the radius of the inner surface of the outer conductor 13 of the coaxial feeder line. As a result there is a comparatively low insertion loss when the switch is in the "out" position, and consequently there is the least possible effect on the receiver sensitivity.

In Fig. 2 there are shown details of a conventional mechanism by which snap switch action may be obtained and which comprises a suitable means for driving the contactor elements of the coaxial switch apart or together. The snap switch mechanism illustrated comprises standards 34 which support bearings through which shaft 35 is passed. The switch actuating members 27 and 27' are shown fastened onto shaft 35 for movement therewith. Rod 36, which is rigidly attached to the center of the shaft 35, protrudes outwardly through a slot in the shield member 33 and terminates in the insulating handle 37. The lower ends of the switch actuating members 27 and 27' are connected by a supporting cross bar 39 against which the spring 40 presses. The spring 40 surrounds a rod 42 which passes through a hole 38 in the cross bar 39. Cross bar 39 is free to rotate with respect to the members 27 and 27'. The shaft 42 is affixed to shaft 41 which is free to rotate within a bearing in support member 31. Spring 40 is held under compression so that the switch actuating members 27 and 27' remain in either "make" or "break" position, and when activated, move rapidly between these extreme positions. It will be understood, of course, that various actuating mechanisms other than herein described may be employed to perform these functions without departing from the scope of the invention.

Referring now to Fig. 3 there is shown a front view of the snap switch actuating mechanism, and also a section on the line AA' of Fig. 2 through the coaxial line tubular member 18, the dielectric supporting member 21, and the central contactor pin 29 the operation of which will be

4

apparent in view of the foregoing description made in connection with the preceding figures.

In Fig 4 there is shown another embodiment of this invention, the arrangement being such that the snap switch action occurs by rotary action rather than by the linear motion which characterizes the device illustrated in the previously described Figs. 1 to 3 inclusive.

In addition to the rotary motion characterizing the Fig. 4 device certain other desired features are incorporated therein, particularly for the purpose of minimizing the disturbance of the coaxial line when the T connection is switched out of the circuit, and, also to provide a means of connection to the coaxial line which produces a low mutual inductance between the coaxial circuits which are to be connected. The Fig. 4 switch structure also possesses the advantages of mechanical simplicity and definiteness of action.

As depicted in Figs. 4, 4a rotary contactor block 73 is preferably supported on an insulating shaft 72, which may be composed of vulcanized hard rubber or other suitable insulating material, the supporting rectangular metal block 73 being secured with a force fit thereon. There is secured to the metal block 73 as for example by means of brazing, beryllium-copper "self wiping" contactor strips 69, bent into the shape shown. In Figure 4 the rotary contactor strips 69 are shown making a connection between the inner conductor 60 of the coaxial line 63, at contact 67, and the inner conductor 65 of the coaxial line 64, at the contact 70.

Upon rotating the contactor block 73 into its alternate position 66, shown in dotted line on the figure, contact is made with the wall contactor 68, thus shorting the contactor strip 69 and the block 73 to the wall. In this manner the contactor strip 69 substantially completes the "sealing-in" of the energy within the coaxial line 63 and prevents leakage from coupling between the coaxial lines. Suitable external mechanisms including a detent may be used to limit the rotation of the switch to 90°, and to provide definite "contact" and "non-contact" positions. The contactor element 69 is supported and actuated through a shaft 72 constructed of insulating material which avoids grounding the inner conductor in the "contact" position.

Well known snap switch mechanisms may be adapted to actuate this device and to provide the necessary 90° positive rotary motion. For simplification no supporting insulators have been shown for the central conductors 60 and 65, but these may be provided in the conventional manner.

In Figs. 5 and 6 there are shown plan and side views of a typical coaxial snap switch, of the type described in Figs. 1 to 3 inclusive, which is herein combined with a wavetrap device. Coaxial switch 77 has an input terminal 74, an output terminal 75, and switch handle 76. Stationary and movable scales 78 and 79 respectively and slider 82 are provided for the purpose of making measurements between the successive nulls, or positions which cause maximum attenuation by the wavetrap of the signal at output terminal 75, which may be obtained by moving the shorting contactor 81, attached to the indicating slider 82, along the coaxial line 84. In operation the movable scale 79 is set with its 0 opposite the index mark on the slider 82, when the slider is indicating a null. Then slider 82 is moved along until a second null is observed, whereupon the

reading opposite slider 82 on the scale 79 corresponds to the frequency of series resonance of the stub or wavetrap.

In Fig. 6 there is shown a side view of the wavetrap shown in Fig. 5, with a section cut away to show the shorting contactor on the slider within the coaxial line 84. The wavetrap may be supported at one end by suitable bracket 85 and at its other end by means of flanges 87 and 88 on the face of the coaxial switch.

The operation of the wavetrap above described in connection with the switching device of Figs. 5 and 6 will be better understood by reference to copending applications Serial No. 613,410, filed August 29, 1945, now Patent Number 2,546,147, Serial No. 622,659, filed October 16, 1945, now Patent Number 2,598,371, and Serial No. 614,533, filed September 5, 1945, now Patent Number 2,636,935, the patentable subject matter of which is closely related to the present invention. In these applications there are described and claimed methods and means for determining the fundamental carrier frequency of a received signal from amongst a group of spurious responses obtained on an ultra high frequency superheterodyne receiver. While this constitutes an important use of this invention, it will be understood that the description in connection therewith is purely illustrative of the utility of this device and is not to be considered in any way limiting.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. In a switch device between a pair of coaxial lines, a switch comprising a first and a second section of coaxial line, central conductors within said coaxial line sections, said central conductor of said second coaxial line having a bore at one end thereof, a rod having a sliding pressure-fit within said bore, an insulating body attached to said rod, said insulating body having a sliding-fit within the said second coaxial line, drive pins attached to said insulating body normal to the axis of said second coaxial line, thus enabling constrained motion of said drive pins axially along said coaxial line, a snap switch mechanism engaging said drive pins, a first contactor element on the central conductor of the first coaxial line and a second contactor element at the end of said rod, whereby the snap switch mechanical action alternately provides "make-contact" or "no-contact" positions between said pair of coaxial lines.

2. A switch as set forth in claim 1 in which said second coaxial line makes a T-connection through said switch into said first coaxial line.

3. A switch as set forth in claim 1 in which said second coaxial line comprises a part of a tunable series resonant stub, said stub making a T-connection through said switch into said first coaxial line.

4. In an ultra-high frequency switch for a first and a second coaxial line having first and second outer conductors and first and second inner conductors, respectively, said first outer conductor provided with an opening, means securing one

end of said second outer conductor to said first outer conductor coincident with the periphery of said opening to form a T-connection, mounting means supported in said one end of said second outer conductor, contactor means supported by said mounting means for movement between two positions of stability, in one of which positions said contactor means extends from one end of said second inner conductor to a point protruding beyond said one end of said second outer conductor and into electrically conducting contact with said first central conductor, and in the other of which positions said contactor means is withdrawn from contact with said first central conductor and confined wholly within said second outer conductor, said contactor means movable between said two positions responsive to the actuation of a rapid acting mechanism.

5. A switch as defined in claim 4 wherein said mounting means comprises a rotatable shaft formed of insulating material.

6. A switch as defined in claim 4 wherein said mounting means comprises a shaft formed of insulating material journaled in said one end, said contactor means adapted for rotatable movement into either one of said two positions, and said contactor means comprising self wiping spring elements at the points of contact with the two inner conductors.

7. A switch as defined in claim 4 wherein said mounting means comprises an insulating body having a sliding fit within said second outer conductor, and adapted to move longitudinally thereof.

8. A switch as defined in claim 7 wherein said rapid acting mechanism comprises a toggle switch.

9. In a coaxial line switch comprising first and second coaxial lines, one end of the outer conductor of said second coaxial line joined to the outer conductor of said first coaxial line to form a T connection, contact means movably mounted in said one end of said second coaxial line, said contact means being adapted to be moved into two positions, in one position said contact means extends between the inner conductors of said coaxial lines to provide electrical contact therebetween, in the other position said contact means is withdrawn from contact with the inner conductor of first coaxial line and is wholly confined within said outer conductor of said second coaxial line, and rapid acting means to move said contact means to either of said positions.

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