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ELECTRIC MOTOR POSITIONED ROTARY WAVEGUIDE SWITCH HAVING ABSORBER TO INCREASE ATTENUATION

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Fig. 1

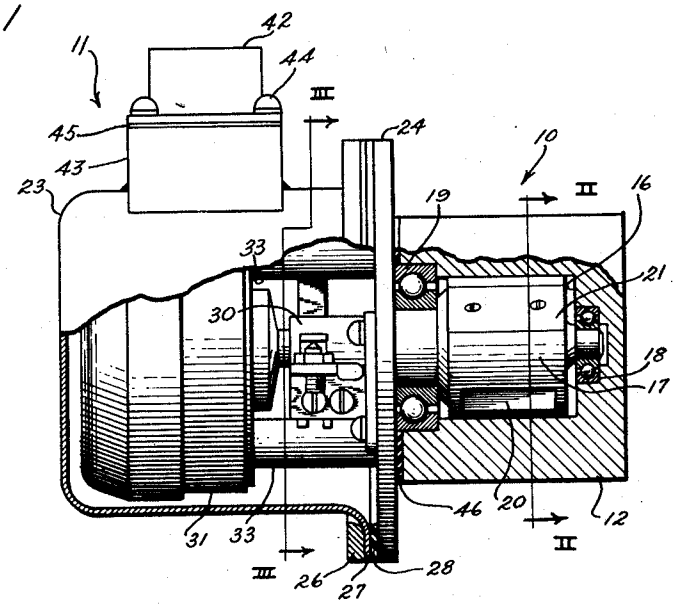


Fig. 3

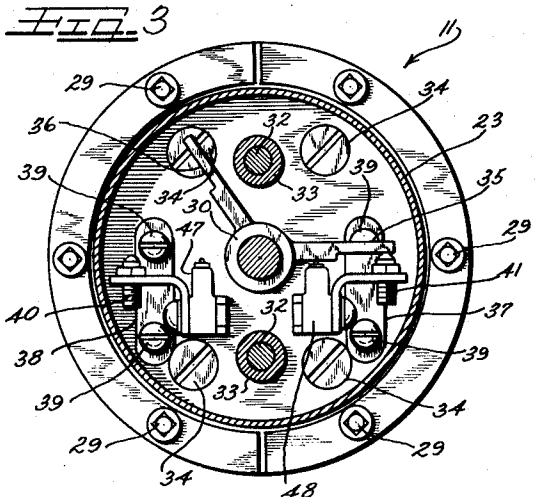


Fig. 2

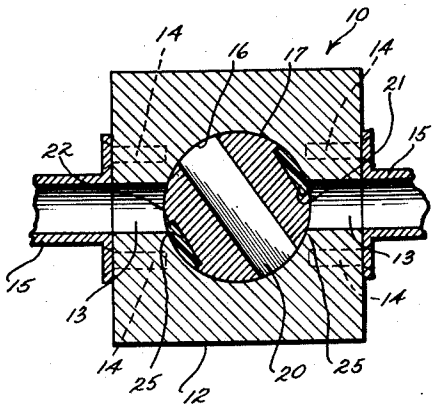
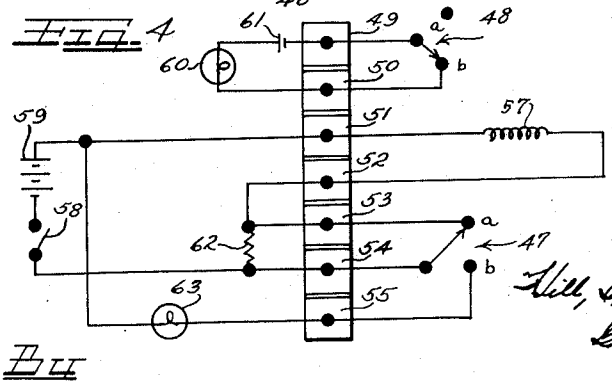


Fig. 4



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ELECTRIC MOTOR POSITIONED ROTARY WAVEGUIDE SWITCH HAVING ABSORBER TO INCREASE ATTENUATION

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This invention relates to attenuators and, more particularly, to a mechanism for switching a microwave attenuating material into a waveguide transmission path.

In systems wherein microwave energy is transmitted along a waveguide transmission path, a compact mechanism having an attenuating element which can be inserted in the waveguide path in order to attenuate the microwave energy being transmitted is frequently very useful. In most applications, it is also desirable that such a mechanism be able to easily and rapidly remove the attenuating element from the waveguide path when attenuation is no longer necessary.

Accordingly, it is an object of this invention to provide a compact mechanism which can switch a microwave energy attenuator into and out of a waveguide transmission path.

It is another object of this invention to provide a compact mechanism that achieves extremely high microwave energy attenuation in one position and extremely low attenuation in a second position.

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

FIGURE 1 is an illustration of an attenuator switch mechanism constructed in accordance with the invention;

FIGURE 2 is a view taken along the line 2—2 of FIGURE 1;

FIGURE 3 is a view taken along the line 3—3 of FIGURE 1; and

FIGURE 4 is a schematic illustration of the electrical connections for the attenuator switch mechanism.

As shown in the drawings:

The mechanism illustrated in FIGURE 1 includes an attenuator 10 that is adapted to be connected in a waveguide transmission path, and an actuator 11 that is adapted to switch the attenuator 10 between two positions in response to electrical signals.

The attenuator 10 is best shown in FIGURE 2 and includes a housing 12 that has a passageway 13 and a plurality of threaded holes 14 formed therein. Two waveguides 15 are fastened to the housing 12 by a plurality of screws which are threaded through flanges formed on the waveguides and into the holes 14. The waveguides are positioned so that their interiors coincide with the passageway 13 in the housing 12.

Rotatably mounted in an enlarged recess 16 in the housing 12 is a rotor 17. The rotor 17 is mounted on ball bearings 18 and 19 and has a channel 20 formed through it which has the same dimensions as the passageway 13. Two pads 21 and 22 of a suitable microwave absorbing material are fastened in recesses 25 formed on opposite sides of the rotor 17. One microwave absorbing material that has been found suitable is the synthetic resin commercially available under the trademark "Radite No. 75" sold by Radar Design Corporation, of Syracuse, New York.

The actuator 11 includes an enclosure 23 that is fastened to a bearing plate 24 by a plurality of screws 29 that are inserted through a locking ring 26, a flange 27 formed on the enclosure 23, a gasket 28, and the bearing plate 24. Four screws 34, FIGURE 3, are inserted

through holes formed in the bearing plate 24 and threaded into the housing 12 in order to fasten the attenuator 10 to the actuator 11.

As a means of limiting the rotational movement of the rotor 17 and the coupling 30, two wings 35 and 36 formed on the coupling 30, are adapted to contact members fastened to the bearing plate 24. These two members include brackets 37 and 38 which are fastened to the bearing plate 24 by screws 39 and have adjusting screws 40 and 41 mounted thereon. Also mounted on the brackets 37 and 38 are two microswitches 47 and 48.

The electrical connections to the solenoid 31 and the microswitches 47 and 48 are made through a pin connector 42 that is mounted on an upstanding portion 43 of the enclosure by a plurality of screws 44. A gasket 45 is positioned between the connector 42 and the portion 43 to make the enclosure air tight.

The electrical circuitry includes a plurality of pins 49–55 of the connector 42, illustrated schematically in FIGURE 4, which are electrically insulated from each other and are mounted in the connector 42. The wiring diagram and the position of the rotor 17 are for the unenergized position of the solenoid. The apparatus is normally urged in the clockwise direction to the position illustrated by a flat coil power spring that is mounted in the solenoid casing at 56, FIGURE 1.

The switching cycle to the low attenuation position of the device is as follows: The winding 57, FIGURE 4, for the solenoid 31 is energized by applying power to the pins 51 and 54 which is accomplished by closing a switch 58 to a potential source 59. Current then flows through the microswitch 47 and the winding 57 causing the coupling 30 and the rotor 17 to rotate in the counterclockwise direction.

When the wing 35 lifts off of the switch 48 it switches from its *b* position to its *a* position and opens a circuit through a signal light 60 and a potential source 61. The deenergization of the light 60 indicates that the device is no longer in the high attenuation position. Instead of being a signaling switch the microswitch 48 could also be used as an interlock circuit switch.

When the maximum stroke is completed the wing 36 switches the microswitch 47 from its *a* position to its *b* position. The winding 57 is then energized through a resistor 62 which drops the voltage across the winding 57 and permits continuous energization of the solenoid 31 without overheating.

The switch 47 can also be connected to a signaling circuit which includes a signal light 63 connected between the source 59 and the pin 55. Energization of this light indicates that the device is in the low attenuation position.

To return the device to the high attenuation position the winding 57 is deenergized by opening the switch 58. This allows the coil power spring to rotate the rotor 17 in the clockwise direction. It can be seen that the device is fail-safe since it will automatically return to its high attenuation position if the power fails.

As can be seen in FIGURE 2, the disposition of the pads 21 and 22 is such that at the high attenuation position of the rotor the microwave energy meets both a portion of the metallic rotor material 17 and a portion of the attenuating pads 21 and 22. It has been found that maximum attenuation of the microwave energy is achieved when the area facing this energy is composed of about one sixth attenuating material and five sixths rotor material. The exact proportion to be used will depend upon the characteristics of the transmission line being terminated, the composition of the pads 21 and 22, and the composition of the rotor 17, and can be varied by the adjusting screws 40 and 41.

In the position where practically no attenuation is achieved, the chanel 20 coincides with the passageway 13

and forms an electrically continuous transmission path through the housing 12 from one waveguide to the other. The angular rotation between the two positions is between 50° and 60°.

A gasket 45 is positioned between the connector 42 and the enclosure portion 43 and a gasket 46 is positioned between the housing 12 and the bearing plate 24. These two gaskets, along with the gasket 28 between the bearing plate 24 and the flange 27, make the mechanism air tight so that it can be pressurized.

It can be seen that a novel attenuator switch mechanism has been provided. In one position of the mechanism, the unique position of the attenuating pads 21 and 22 causes the mechanism to exhibit an insertion loss in excess of 80 db. In the second position, the channel 20 in the rotor coincides with the passageway 13 and the mechanism exhibits a very low voltage standing wave ratio and insertion loss. The external circuitry for this mechanism can also be connected to permit operation with a waveguide switch for the purpose of enhancing the crosstalk characteristics of that waveguide switch.

It will be apparent that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention. For example, the construction of the enclosure 23, and the bearing plate 24 and the manner of mounting the solenoid on them could be changed. The enclosure could be made without the flange 27 and the bearing plate could be inserted into its open end and fastened by radially extending screws. The ring 26 and the gasket 28 could then be dispensed with and a sealant used to make an air tight coupling.

Obviously, the elements could be constructed in the reverse order so that the rotor would rotate in the clockwise direction to the low attenuation position and still obtain identical results.

I claim as my invention:

1. An actuator mechanism comprising a housing, a passageway formed in said housing, a member rotatably mounted in said passageway, a channel formed in said member and a microwave absorbing material fastened to said member, electrical actuator means for rotating said member between first and second limits when energized by electrical signals, said channel being positioned in said member so that it coincides with said passageway when said member is at said first limit, and said microwave absorbing material being positioned on said member such that a portion of said member and a portion of said absorbing material coincide with said passageway when said member is at said second position, first and second extended portions fastened to said rotatably mounted member, first switch means disposed such that it will be contacted by said first extended portion when said member is at said first limit, and electrically connected to energize a first lamp and second switch means disposed such that it will be contacted by said second extended portion when said member is at said second limit and electrically connected to energize a second lamp, one of said first and second switch means being connected to connect a resistive element in series with said actuator means when it is contacted.

2. An attenuator mechanism comprising a housing, a passageway having an inlet port and an outlet port formed in said housing, a member rotatably mounted in said passageway, said member being adapted to be rotated to at least first and second positions, a channel formed in said member which places said inlet port in communication with said outlet port when said member is at said first position, microwave absorbing material fastened to said member at a position such that said passageway is terminated by an area that is composed approximately of five sixths of said member and one sixth of said absorbing material when said member is at said second position and providing an insertion loss in said passageway of at least about 80 decibels, and means for automatically rotating said member to at least said first and second positions.

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