Aug. 19, 1958 M. T. HARGES ET AL 2,848,693

STEP ATTENUATORS

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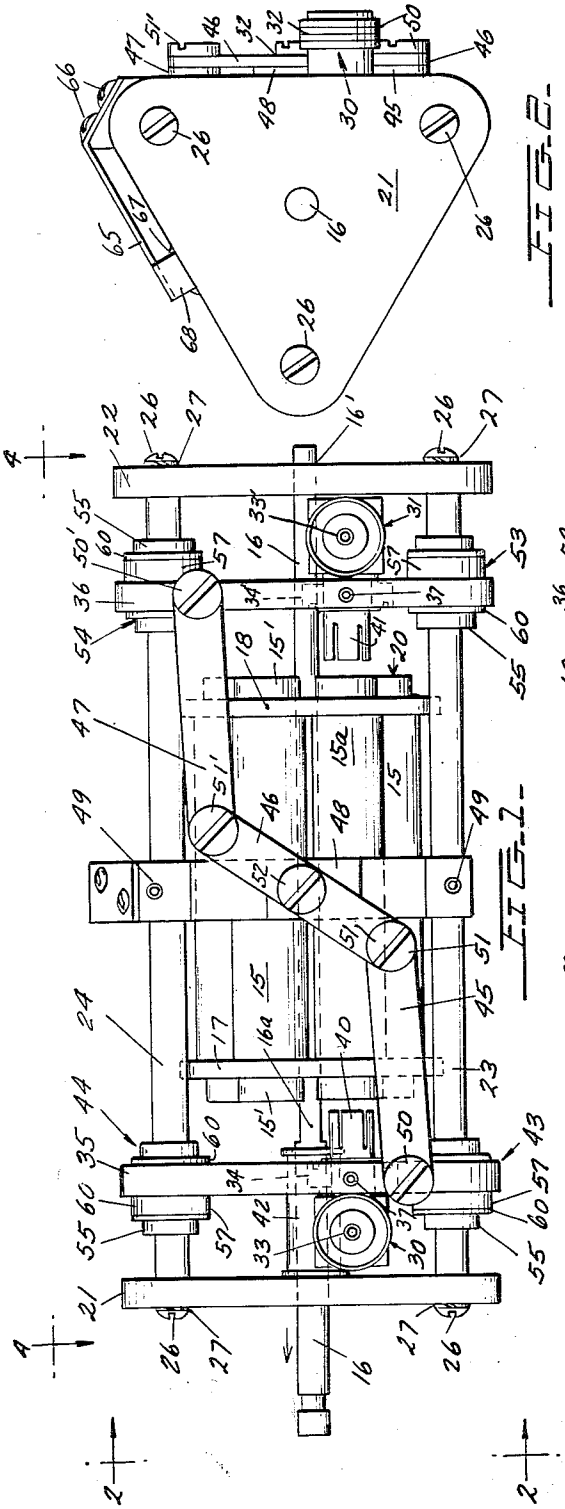


FIG. 2

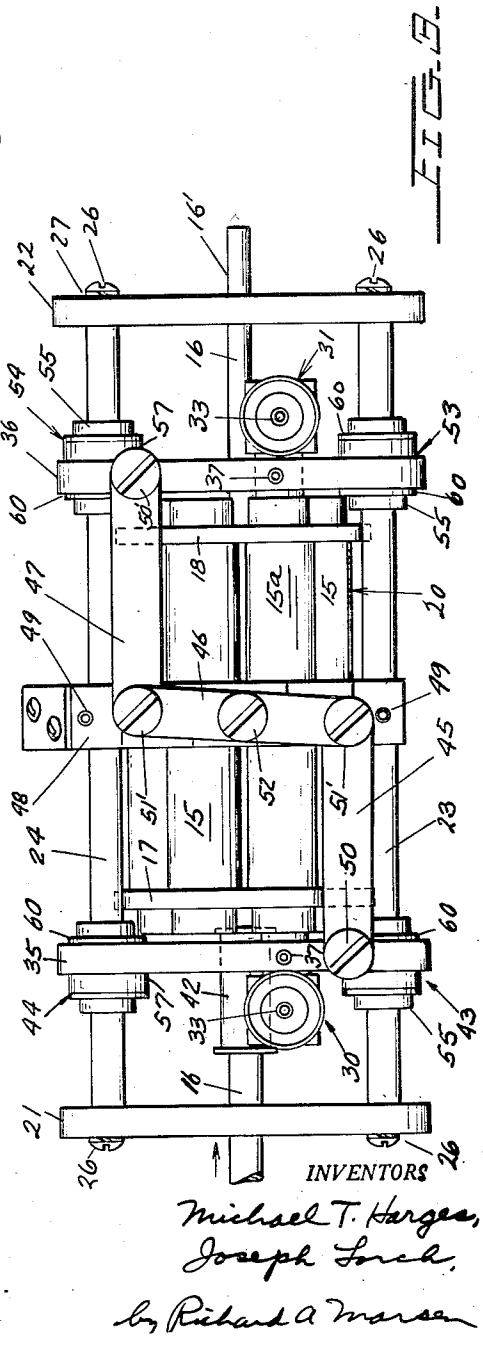


FIG. 3

FIG. 1

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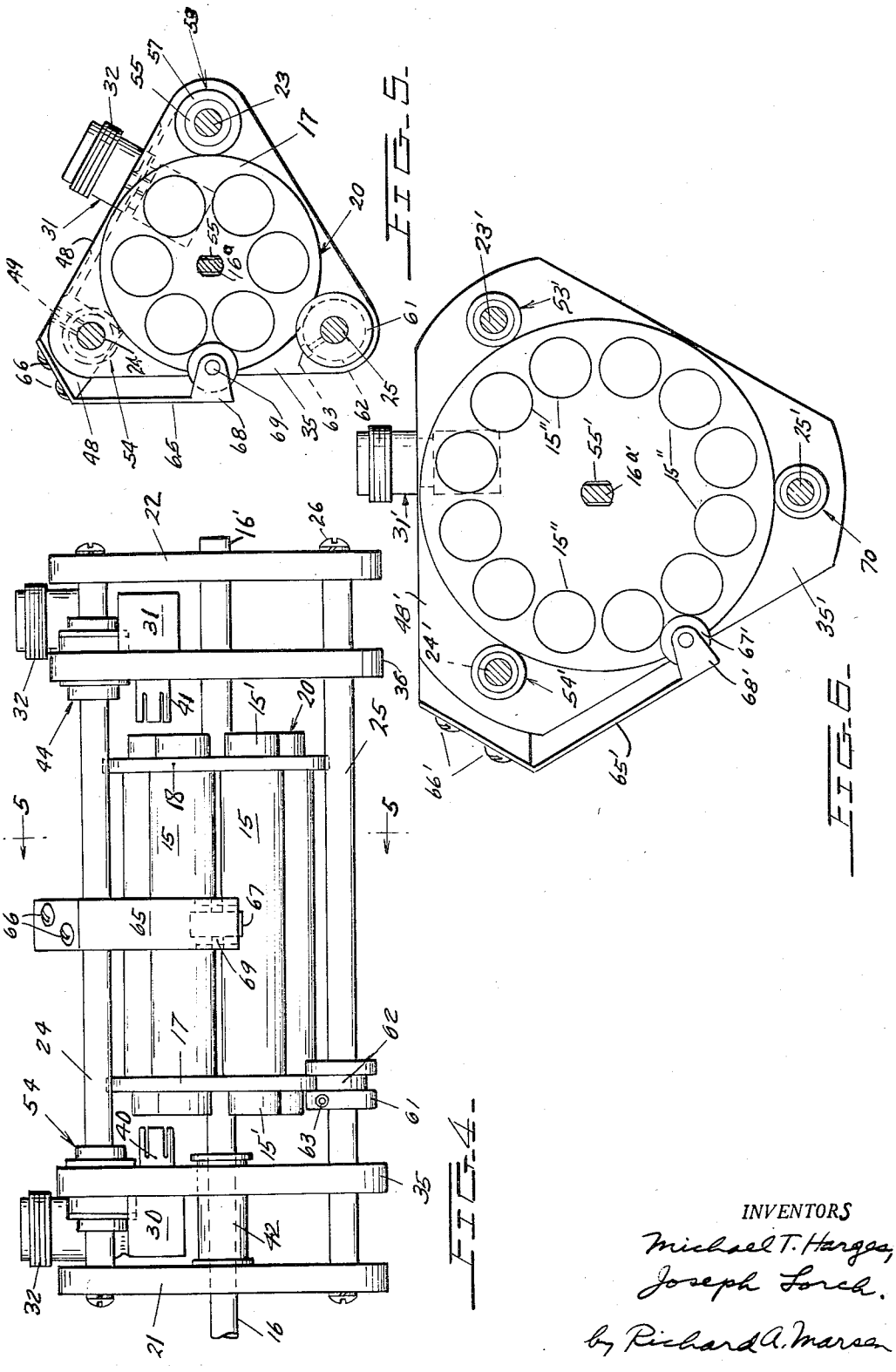


FIG. 4

FIG. 5

FIG. 6

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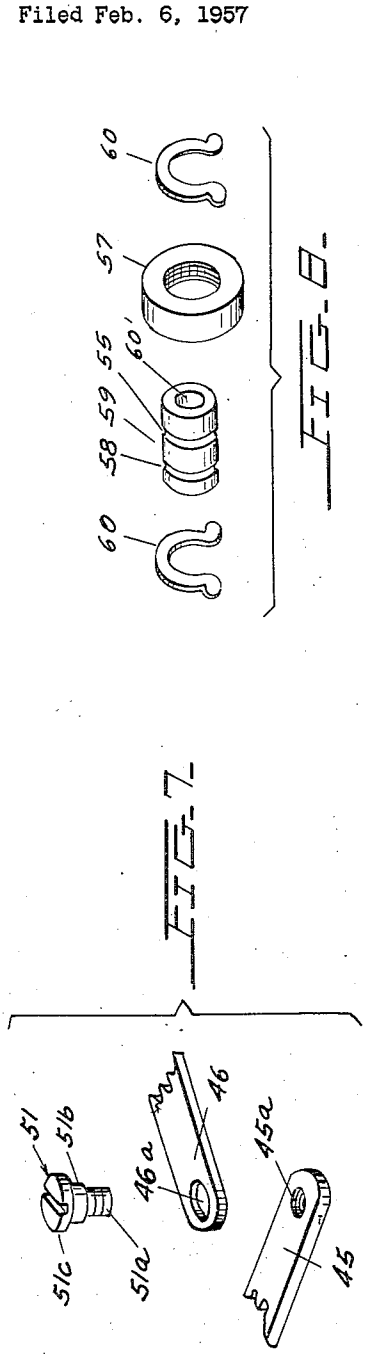


FIG. 7

FIG. 8

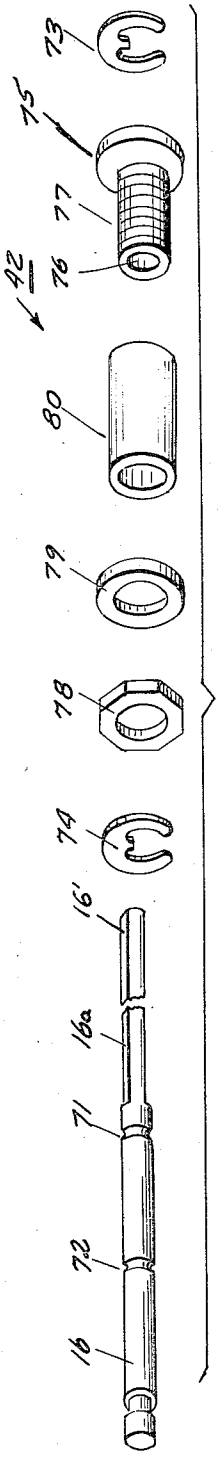


FIG. 9

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2,848,693

STEP ATTENUATORS

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Application February 6, 1957, Serial No. 638,539

16 Claims. (Cl. 333—81)

This invention relates to improvements in step attenuators for selectively engaging an array of coaxial unitary attenuators.

In the high frequency or microwave fields, attenuators are used which are individually shielded and are generally in a cylindrical form with a central conductor. The outer metallic or shielded tubular portion of the attenuator unit or pad is generally grounded, and constitutes the return terminal thereof. Such microwave attenuator units are generally constructed to attenuate uniformly over a wide frequency band, by a predetermined amount.

Individual cylindrical attenuator units are built for attenuating in a predetermined step, e. g. 5 db, 10 db, and 20 db, etc. The individual attenuators are inserted in a microwave circuit with firm electrical connection at either end. Attenuators of this class are shown and described in the copending patent application, Serial No. 617,551 entitled "Microwave Attenuators," although other types are usable in the invention step attenuator.

The step attenuator of the present invention provides for the ready selection of any one of a number of coaxial attenuating units arranged for individual selection and circuital engagement. The step attenuator provides means for ready selection and circuit engagement of any one of a plurality of attenuator pads contained therein.

In accordance with the present invention, the cylindrical attenuator pads are arranged in a circular array, and held stationary longitudinally within the step attenuator unit. The attenuator pad array is rotatable by a protruding front control shaft. Terminal connectors, for the coaxial cables connecting the microwave circuit with the step attenuator, have nipples which are engageable with the selected attenuator pad. Novel mechanical arrangements are provided to readily engage and disengage these nipples with an attenuator pad that is selected by rotation of the control shaft.

The terminal connectors of the step attenuator are mounted on individual plates. These connector plates are readily slidable along the axial direction of the step structure. The extent of motion, for engagement and disengagement of the connectors with the individual attenuator pads, is such as to permit the connection of flexible shielded coaxial cables directly to the input and output terminal connectors of the step attenuator. The short movements of the connectors in the step attenuator operation does not affect the microwave circuit.

The present invention is particularly directed to provide a novel relatively inexpensive and rugged step attenuator construction which does not lose its alignment or accuracy of engagement. The invention step attenuator provides simple detent means for holding the multiple attenuator pad assembly in its selected position. The multiple attenuator pad assembly is held against longitudinal displacement, enhancing accuracy of engagement and minimizing wear at the terminal connectors.

The longitudinally movable members of the invention step attenuator are of relatively low mass. Also, by making the disengaging and engaging displacements of each terminal connector equal, the overall longitudinal motion of the push-pull control shaft is reduced as compared to prior constructions. A plurality of axial bearings are used for the longitudinal movable members of the step attenuator over fixed rods to reduce wear and minimize the force required for the push-pull control action. The step attenuator of this invention is a pull-turn-push structure, effecting full disengagement, ready selection, and firm reengagement of a desired attenuator pad.

It is accordingly an object of the present invention to provide a novel step attenuator having a plurality of attenuator pads arranged centrally, and with no axial displacement.

Another object of the present invention is to provide a novel step attenuator with two terminal connectors displaceable by equal amounts to engage and disengage with centrally held attenuator pads.

A further object of the present invention is to provide a novel mechanical arrangement for effecting ready engagement and disengagement of terminal connectors with an array of attenuator pads in a step attenuator.

Still a further object of the present invention is to provide a novel step attenuator of simplified and rugged construction.

These and further objects of the present invention will become more apparent in the following description of an exemplary embodiment thereof illustrated in the following drawings, in which:

Fig. 1 is a top plan view of the exemplary step attenuator in its disengaged position.

Fig. 2 is an end elevational view of the step attenuator of Fig. 1, as seen along the line 2—2, in the direction of the arrows.

Fig. 3 is a top plan view of the step attenuator of Fig. 1, in its engaged position.

Fig. 4 is a side view of the step attenuator of Fig. 1, as seen from the line 4—4 thereof in the direction of the arrows, with the linkage portion omitted for clarity of illustration.

Fig. 5 is a cross-sectional view through the structure of Fig. 4, taken along the line 5—5 thereof.

Fig. 6 is a cross-sectional view corresponding to Fig. 5, of a modified step attenuator with twice the number of attenuator pads.

Fig. 7 is an exploded view of a portion of the linkage mechanism of the step attenuator.

Fig. 8 is an exploded view of an axial ball bearing assembly used in the exemplary step attenuator.

Fig. 9 is an exploded view of the control shaft bearing assembly of the exemplary step attenuator.

The exemplary step attenuator comprises a plurality of attenuator units or pads **15** of different db attenuation values. The pads **15** are arranged equidistantly, in a circular array, as seen in Fig. 5. Fig. 1 is a top plan view illustrating the cylindrical attenuator pads **15** arranged coaxially about control shaft **16**. The cylindrical attenuator units **15** are supported as an attenuator assembly by end members **17, 18** into which the end portions of the pads **15** are mounted. The ends **15'** of pads **15** are of reduced diameter. The attenuator pads **15** and the end members **17, 18** are assembled as an integral assembly constituting rotatable attenuator assembly **20**. The control shaft **16** passes through the center of attenuator assembly **20**, as seen in the drawings.

The step attenuator comprising end plates **21, 22** are interconnected by spaced longitudinal rods **23, 24, 25**. Rods **23, 24, 25** are of equal length, and threaded at their respective ends to receive machine screws **26** for fastening with end plates **21, 22**. Lock washers **27** are used between the heads of screws **26** and the respective plates **21, 22**. It is thus seen that the outer envelope of the step attenuator is fixed, consisting of end plates **21,**

22 held parallel and in fixed spaced relationship by rods 23, 24, 25.

The step attenuator embodies two connector terminals 30, 31. Each of the connectors 30, 31 have a threaded collar 32 for engagement with the threaded bushing of a connector (not shown) at the ends of the connecting flexible coaxial cables. The central connections of these cable connectors engage the sockets 33, 33' of connectors 30, 31 respectively, in the usual manner. Connectors 30, 31 have intermediate flanges 34, 34' which are set within corresponding recesses within movable connector plates 35, 36, as seen in Fig. 1. Set screws 37, 37 insure firm engagement of connectors 30, 31 with their respective connector plates 35, 36.

Axial displacement of plates 35, 36 carry the respective connector terminals 30, 31 in the axial direction. However, the aforesaid firm engagement of the respective coaxial cables (not shown) with connectors 30, 31 in no way interferes electrically or mechanically with the high frequency microwave circuit into which the step attenuator of the invention is included with such coaxial cables. Each terminal member 30, 31 has axially and inwardly projecting connector sections 40 and 41 respectively.

The connector sections 40, 41 comprise outer resilient slotted conductors for engagement with the end terminals at 15' of the attenuator pads 15. The projecting connector sections 40, 41 are in axial alignment, across the step attenuator, in order to be engaged selectively with the longitudinal ends of individual selected attenuator pads at the position 15*a*. The outer slotted conductors 40, 41 are at ground potential with respect to the outer conductors of their respective connectors 30, 31 and with ground of the step attenuator assembly. Connector portions 40, 41 make firm mechanical and electrical connection with the outer cylindrical conductors of the pad 15 to which it is connected. At the interior of the respective extensions 40, 41 are central connecting pins (not shown) for engaging with the corresponding central connecting conductors of the attenuator pads, as will be understood by those skilled in the art.

Longitudinal displacement of terminal connectors 30, 31 inwardly, effects engagement of the respective projecting terminals 40, 41 with a selected attenuator unit 15. The central connections of the selected attenuator unit 15 thereupon become electrically interconnected with the central socket connectors 33 and 33' of connectors, 30, 31 respectively, and in circuit with the coaxial cables to the step attenuator. Fig. 3 shows the step attenuator in such electrically engaged position, with the movable connector plates 35 and 36 in their innermost position, with connector portions 40, 41 in engagement with the selected attenuator pad 15*a*.

In accordance with the present invention, the movable connector plates 35 and 36 are operated in unison, but in opposite directions. The attenuator pad assembly 20 is held in fixed axial position in the step attenuator. Rotational displacement of the assembly 20, through the control shaft 16, positions a desired attenuator pad 15 in the engaging position 15*a* shown in Figs. 1 and 3. As is explained hereinafter, such rotational displacement of pad assembly 20 can occur only when connectors 30, 31 are disengaged from the assembly 20. This corresponds to the "pull" position of control shaft 16, as illustrated in Fig. 1. The "turn" operation of shaft 16 motivates assembly 20 in a manner to be described. The "push" action of shaft 16 engages terminal connectors 30, 31 with the selected attenuator unit 15*a*, as illustrated in Fig. 3.

A bearing 42 is secured to shaft 16. Bearing 42 permits shaft 16 to rotate therewithin. However, the bearing 42 is arranged on shaft 16 in a manner to prevent longitudinal displacement with respect thereto. This is accomplished by using transverse slotted sections in shaft 16, at the ends of the bearing 42, and engaging suitable washers or "E" rings therewithin, as is described in more detail in connection with the "exploded" illustration thereof, Fig. 9.

Movable connector plate 35 is also secured with bearing 42, and moves longitudinally therewith when shaft 16 is displaced longitudinally. Thus axial displacement of shaft 16 carries with it movable connector plate 35 due to such mechanical connection between shaft 16 and plate 35. The bearing 42 is connected to the central portion of plate 35, and there is no upsetting torque in its displacement by shaft 16. It is thus apparent that in the invention step attenuator, displacement of control plate 35 occurs during the "push" or "pull" actions of control shaft 16, corresponding to its extreme positions shown in Figs. 1 and 3; and that such displacements are provided without interfering with the rotational action of the control shaft 16 for its "turn" operation on attenuator pad assembly 20. Bearing 42, being anchored in plate 35, constitutes a bearing for shaft 16. The contiguous opening centrally of end plate 22 coacting with end 16' of shaft 16, constitutes the second bearing for the control shaft (see Fig. 3).

Connector plate 35 is supported by parallel longitudinal rods 23, 24 through axial bearings 43, 44. Bearings 43 and 44 are secured with movable plate 35, and have central "roller bearing" means coactable with the respective rods 23, 24 to minimize friction in longitudinal displacement of connector plate 35. Details of the bearings 43, 44 are shown in "exploded" view thereof, Fig. 8, described hereinafter. In place of roller bearings at 43, 44, bushings or Oilite bearings may be used. The use of roller bearings at 43, 44 has been found to minimize the forces required for the "push-pull" action of control shaft 16.

In practice, it is found that very little effort need be expended for such axial push-pull displacements when axial roller bearings 43, 44 are used on plates 35 and 36. The bottom rod 25 in the exemplary embodiment does not carry bearings. A simple clearance hole is provided in plate 35, with the rod 25 being a guide rod therefor. However, in larger or heavier units, such as the twelve pad unit of Fig. 6, a third axial bearing is used between plate 35 and bottom rod 25.

The "push" or "pull" actuation of connector plate 35 by the control shaft 36, is transmitted, in suitable reversed orientation to the opposite or remote connector plate 36. Towards this end linkage arms 45, 46, 47 are utilized. Central linkage arm 46 is the pivotal arm, and is pivotally mounted on a cross-bar 48. Cross-bar 48 is secured to rods 23, 24 by set-screws 49, 49. One end of arm 45 is pivotally secured to the top surface of movable connector plate 35 by a suitably constructed screw member 50. Screw member 50 has a collar engageable with arm 45 and screw threads secured with connector plate 35. In a similar manner, the far end of arm 47 is pivotally secured to connector plate 36 by screw member 50'. The linkage arm 45 is pivotally linked with one end of central pivotal arm 46 by screw member 51.

Fig. 7 is an enlarged "exploded" view of the pivotal connection between linkage arms 45 and 46, by screw member 51. Arm 45 has a threaded opening 45*a* to receive the threaded section 51*a* of the screw member 51. Corresponding opening 46*a* of linkage arm 46 subtends the smooth intermediate section 51*b* of screw member 51. Accordingly, the arm 46 is free to pivot with respect to arm 45, with screw member 51 as the pivotal point. The head 51*c* of screw member 51 overlies the top surface of pivotal arm 46, to secure the pivotal connection between arms 45 and 46. In a similar manner the ends of linkage arms 46 and 47 are pivotally connected by screw member 51'. Finally, the central portion of pivot arm 46 is pivotally mounted by screw member 52 on the cross-bar 48. The threaded portion of screw member 52 (corresponding to portion 51*a* of Fig.

7), is engaged with a coacting threaded portion in cross-bar 48.

The action of the pivoted linkage 45, 46, 47, illustrated by the full "pull" position of Fig. 1, and the full "push" position of Fig. 3, is to cause remote connector plate 36 to move in a complementary manner with the connector plate 35, when actuated by control shaft 16. When control plate 35 is moved to the right, as in "push" position of Fig. 3, in order for its connector portion 40 to engage attenuator paid 15*a*, the companion remote connector plate 36 is motivated in the opposite direction, to the left, in order to establish connection between its connector portion 41 and the selected attenuator pad 15*a*. This is accomplished by the action of the linkages 45, 46, 47 between plates 35 and 36.

When the control shaft 16 is pulled to the left, for the "pull" position shown in Fig. 1, the connector plate 35 is moved to the left to disengage its connector section 40 from attenuator pad 15*a*. The linkages 45, 46, 47 simultaneously motivate the remote connector plate 36 to the right, to disengage its connector portion 41 from attenuator pad 15*a*. Such disengagement of the connectors 30, 31 from the attenuator assembly, permits the "turn" action on the attenuator assembly 20 for further selection through control shaft 16.

It is noted that the remote connector plate 36 is also mounted on axial bearings 53 and 54, corresponding to the bearings 43 and 44 of plate 35. In this manner the axial displacements of the remote connector plate 36 are facilitated, and the corresponding and complementary movement of the two connector plates 35 and 36 and their associated connectors 30, 31 are insured with only minor exertion on the control shaft 16 for the "push" and "pull" actions thereof. The pivotal screw members 50, 51, 52 maintain the linkage assembly in proper pivotal relation for the inverse actuation of connector plates 35, 36.

It is to be noted that the control shaft 16 is flattened at opposing sides, starting at 16*a* near the end of bearing 42. The engagement of shaft 16 with the pad assembly 20 is through suitable flattened openings centrally of the end members 17, 18 of the assembly 20. Such flattened opening associated with shaft 16 is shown at 55 in the member 17, in Fig. 5. Thus the rotation of the flattened control shaft 16*a* carries with it the attenuator pad assembly 20, through confining coacting openings 55 in respective members 17 and 18. Also, such engagement of shaft 16*a* and assembly 20 permits shaft 16 to move axially for its "push" and "pull" actuations of connector plates 35 and 36, without axially displacing the attenuator pad assembly 20. Further, the coaction of the opening 55 of members 17 and 18 constitutes central supports for the assembly 20.

Reference is made to Fig. 8 showing in an "exploded" view, the elements comprising an individual exemplary axial ball bearing as used at 43, 44 and 53, 54 of the step attenuator. Each of the axial bearings comprises an axial type of ball bearing 55, which is cylindrical in shape, with an internal opening 56 to fit over and ride along the associated rods 24, 25. The cylindrical body of ball bearing 55 is assembled within an opening of either of the movable connector plates 35, 36 as seen in Figs. 1 and 3. A filler ring 57 is fitted over the body of ball bearing 55 in order to fill in the space between grooves 58, 59 on bearing 55.

As seen in Figs. 1 and 3, the thickness of connector plates 35, 36 is "filled in" by a filler ring 57, in order that the end retaining rings 60, 60 may be positioned over the grooves 58, 59 of ball bearings 55 to effectively lock the assembly together and constitute the axial bearings 43, 44 and 53, 54 as will now be understood. The axial bearings ride with the movable plates 35, 36 to which they are attached, and roll or glide readily over the associated supporting rods 23, 24 as will be understood by those skilled in the art. The degree of reduction in frictional resistance to movement of the connector plates 35, 36 is determined by the character and design of these axial bearings.

Fig. 4 illustrates how the central attenuator pad assembly 20 is held against axial displacement while permitting rotational displacement for the attenuator pad selection. A simple collar 61 with a groove 62 engages the peripheral edge of circular end member 17 at one end of the attenuator unit assembly 20. Fig. 5 illustrates the engagement of circular member 17 with groove 62 of collar 61. The fit of groove 62 about member 17 is made relatively precise, in order to minimize axial play of the assembly 20. In this way the respective attenuator pads 15 are maintained in their desired position for engagement with the projecting connectors 40, 41 of the terminals 30, 31 as aforesaid.

The collar 61 is secured to rod 25 by set-screws 63. An additional collar may be used in conjunction with the other circular end member 18 where desired. The collar 61 maintains the attenuator pad assembly 20 in its proper axial position. The assembly 20, as stated above, is carried by the axial shaft 16 coacting with the central openings in members 17, 18 (corresponding to opening 55 as seen in Fig. 5). The flattened sections of control shaft 16 permit longitudinal displacement of the control shaft for its "push" and "pull" action, without displacing the attenuator assembly 20 due to its longitudinally locked relation by collar 61.

Extending centrally of the step attenuator is a spring arm 65 which serves as a detent to retain the pad assembly 20 in its preset angular positions. Spring arm 65 is mounted from one end of the cross-bar 48 through machine screws 66. A roller 67 is supported in ears 68 depending from arm 65 by means of a pin 69. The roller 67 is proportioned to fit between adjacent attenuator pads 15, as seen in Fig. 5. Roller 67 is tangent between adjacent attenuator pads 15, and serves to arrest rotational displacement through spring pressure of spring arm 65 transmitted to roller 67.

Accordingly when the control shaft 16 rotates the attenuator pad assembly 20, it is maintained in the desired angular positions selected for electrical engagement with connectors 30, 31. It is thus apparent that an integrated step attenuator is provided by the invention herein, which maintains its angular position after the "turn" action of the control shaft 16; and wherein the selected attenuator pad (15*a*) is readily connectable to the terminal connectors 30, 31 by means of extending connections 40, 41.

The end elevational view of the terminal connectors 30, 31 clearly illustrates the relationship of the internal longitudinally projecting connections 40, 41 for engagement with the attenuator pads 15, and the external connectable portions at the threaded sections 32 thereof, in the direction perpendicular thereto. The internal construction of the connectors 30, 31 to accomplish suitable microwave transmission of the signals between the sections of connectors 30, 31 forms no part of the present invention, and are accordingly not detailed. Their design is in accordance with conventional practice, to minimize attenuation and reflection of the signals passing therethrough.

Fig. 6 is a transverse sectional view through a modified step attenuator unit, corresponding to the illustration of Fig. 5 but with twice the number of attenuator pads, 15''. The unit of Fig. 6 contains twelve attenuator pads. It is to be understood that more or less than the exemplary six attenuator pads 15 may be used. The larger step attenuator is of greater dimensions, and the movement of the corresponding end plates (as 35') which carry the terminal connectors (as 31') for selective engagement with the attenuator pads 15'', require somewhat greater force for displacement than the six pad structure. However, provision is made to minimize such force. Towards this end it is preferred to employ

an extra set of axial bearings, namely a bearing **70** as shown secured with movable connector plate **35'** which rides upon the bottom shaft **25'** (corresponding to shaft **25** in Fig. 4).

In other words each of the movable connector plates (as **35'**), corresponding to plates **35** and **36** of Fig. 4, is provided with three axial bearings instead of two, to minimize transverse resistance to movement of these plates. The remainder of the twelve attentuator pad assembly of Fig. 6, is constructed similarly to that of the six pad unit of Figs. 1 to 5, and corresponding elements of Fig. 6 are indicated with the numerals of Fig. 5, except primed.

It is noted that end plates **21**, **22** of the exemplary step attenuator, as well as movable connector plates **35**, **36**, are made triangular in shape. This shape reduces the cost, weight and size of the step attenuator, as it has been found that a three rod unit (corresponding to the rods **23**, **24**, **25**), are sufficient to provide ruggedness and practical operability. It is to be understood that other shapes for these plates are feasible, as is the use of a different member of transverse supporting rods.

Fig. 9 is an "exploded" illustration of the exemplary bearing **42** which secures movable connector plate **35** with control shaft **16** for axial displacements, and serves as a bearing for the support and rotation of control shaft **16**. At suitable positions along shaft **16**, near its control end, are provided grooves **71**, **72** for engagement with "E" rings **73**, **74**. "E" rings **73**, **74** prevent axial displacement of bearing **42** when it is thusly mounted on shaft **16**. The bearing **42** comprises brass bearing member **75** having internal opening **76** which rides upon shaft **16** between grooves **71**, **72**. Bearing member **75** is threaded at **77** for engagement with nut **78**. Washer **79** is at one end of bearing **42**. A cylindrical sleeve or bushing **80** fits over bearing **75**. The assembled bearing **42** is locked on shaft **16** by the "E" rings **73**, **74** as aforesaid, to prevent axial displacement between the shaft **16** and the bearing **42**. As described in connection with Figs. 1 and 2, the outer surface (**80**) of bearing **42** is secured with movable connector plate **35** for axial movement of the plate together with shaft **16**.

While the present invention has been described with application to specific embodiments thereof, it is to be understood that its principles and features may take other forms, as are expressed by the following claims.

We claim:

1. A step attenuator of the character described comprising a pair of movable plate members spaced apart, an assembly of attenuator pads mounted between said plate members, a pair of terminal connectors individually mounted on said plate members for selective engagement with said attenuator pads across the terminal ends thereof, and means interlinking said pair of plate members to establish engagement and disengagement of said pair of terminal connectors with a selected attenuator pad through the displacement of said plate members in opposing directions.

2. A step attenuator of the character described comprising a pair of plate members spaced apart and movable along a longitudinal axis, an assembly of attenuator pads longitudinally oriented in a circular array, a pair of terminal connectors individually mounted on said plate members for selective engagement with said attenuator pads across the terminal ends thereof, and means interlinking said pair of plate members to establish engagement and disengagement of said pair of terminal connectors with a selected attenuator pad.

3. A step attenuator comprising a first and second movable plate spaced longitudinally apart, an assembly of attenuator units longitudinally oriented in a circular array and positioned between said first and second plates, a first and second terminal connector individually mounted on said plates in longitudinal arrangement for selective engagement with said attenuator units across the terminal ends thereof, and means interlinking said first and second plates to establish engagement and disengagement of said first and second terminal connectors with a selected attenuator unit with said plates being displaced by a substantially equal extent in opposing directions.

4. A step attenuator as claimed in claim 1, further including a shaft for rotating the assembly and establish the attenuator pad selection for the said engagement, said shaft being coupled to one of said plates to effect the said mutual displacements of said plate members.

5. A step attenuator as claimed in claim 2, further including a shaft concentric through said assembly and coupled thereto for rotating the assembly and establish the attenuator pad selection for the said engagement.

6. A step attenuator as claimed in claim 3, further including a shaft coupled with one of said movable plates for longitudinally displacing said one plate and through said interlinking means effect the engagement and disengagement of said terminal connectors with the selected attenuator unit.

7. A step attenuator as claimed in claim 2, further including a shaft concentric through said assembly and coupled thereto for rotating the assembly and establish the attenuator pad selection for the engagement, said shaft being coupled with one of said plate members for longitudinally displacing said one plate member and through said interlinking means effect the engagement and disengagement of said pair of terminal connectors with the selected attenuator pad.

8. A step attenuator as claimed in claim 1, further including a frame having a plurality of longitudinal rods slidably carrying said plate members, and an element extending from at least one of said rods for pivotally supporting said interlinking means.

9. A step attenuator as claimed in claim 2, further including a frame having a plurality of longitudinal rods slidably carrying said plate members, and axial bearings on said plate members slidably coupled with said rods.

10. A step attenuator as claimed in claim 3, further including a frame having a plurality of longitudinal rods slidably carrying said movable plates, and axial bearings on said movable plates slidably coupled with said rods, and means for holding said assembly against longitudinal displacement with respect to said frame.

11. A step attenuator as claimed in claim 5, wherein said shaft is flattened to slidably engage said assembly and effect rotation thereof.

12. A step attenuator as claimed in claim 6, further including a bearing about said shaft with its outer portion secured with said one movable plate.

13. A step attenuator as claimed in claim 8, wherein said interlinking means comprises a central arm pivoted on said element and an individual arm linking each of said plate members with said central arm.

14. A step attenuator as claimed in claim 2, wherein said interlinking means comprises a central pivoted arm and an individual arm linking each of said plate members with said central arm.

15. A step attenuator as claimed in claim 10, wherein said interlinking means comprises a central pivoted arm and an individual arm linking each of said movable plates with said central arm, said central arm being pivotally supported in said frame.

16. A step attenuator as claimed in claim 5, further including a frame slidably carrying said movable plates, and means for holding said assembly against longitudinal displacement with respect to said frame.

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