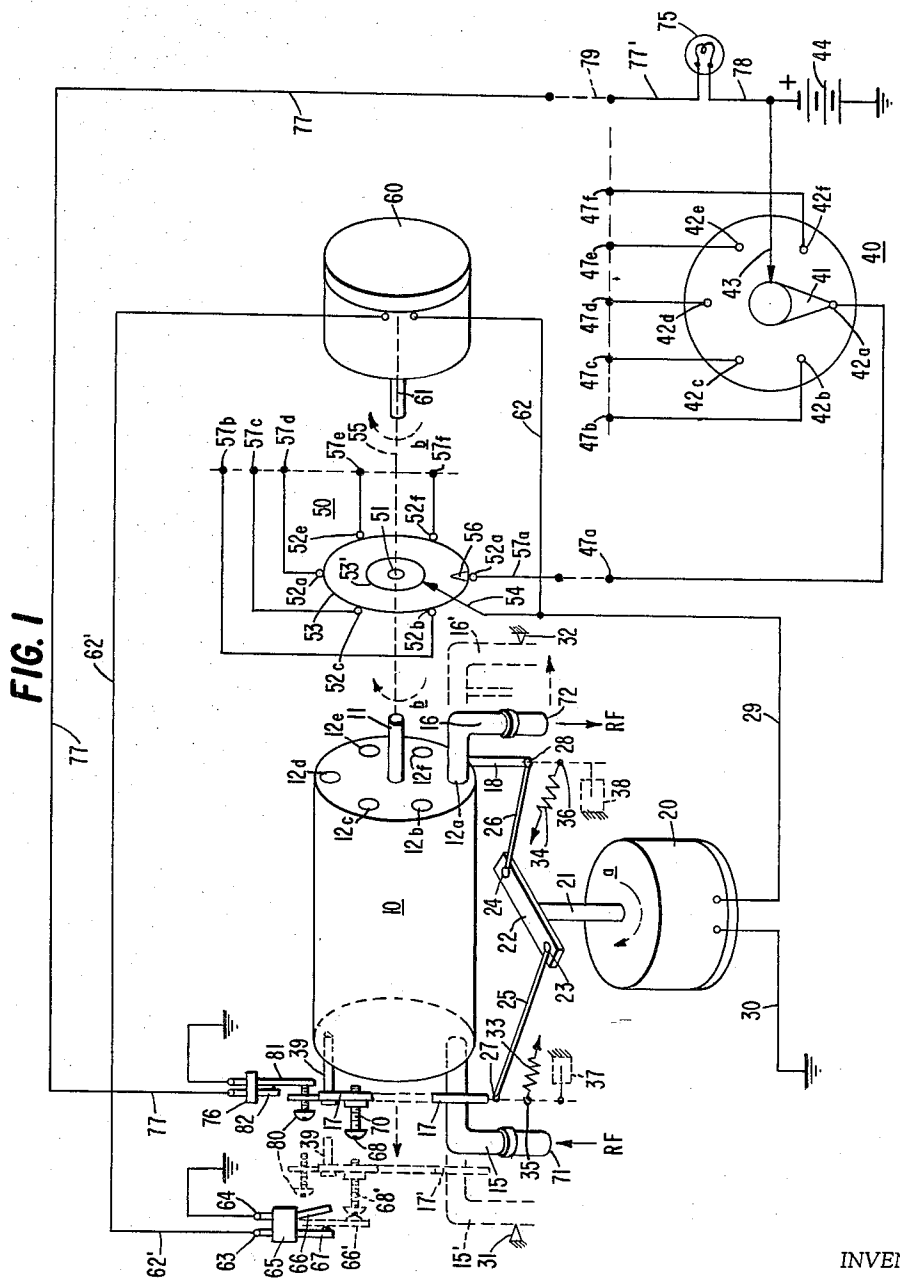
Oct. 15, 1963 M. T. HARGES 3,107,334

REMOTELY OPERATED MICROWAVE ATTENUATOR HAVING AUTOMATIC PLUG-IN CONNECTORS FOR COUPLING TO STEP ATTENUATORS ON MULTIPOSITION TURRET

Filed March 25, 1960 4 Sheets-Sheet 1

FIG. 1



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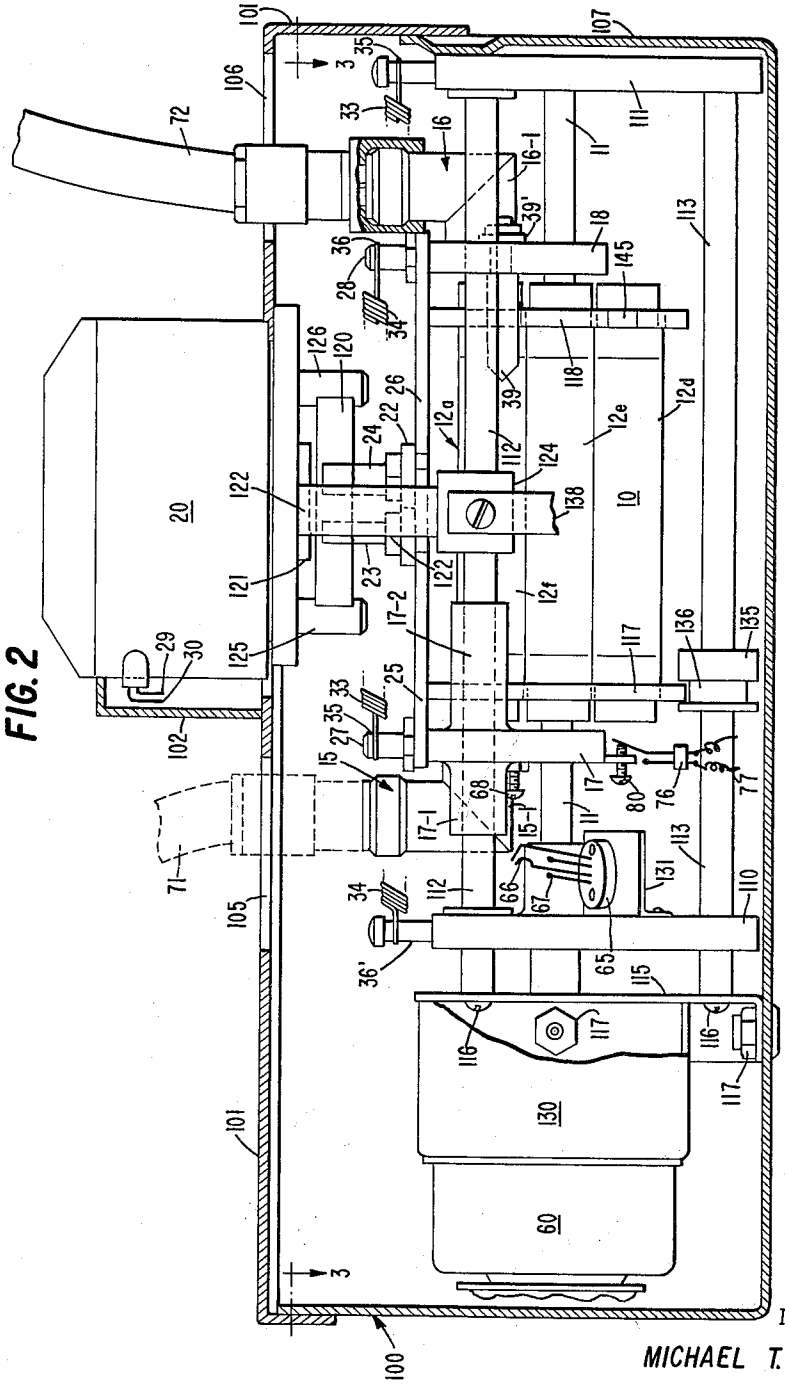
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Filed March 25, 1960 4 Sheets-Sheet 2

FIG. 2



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Filed March 25, 1960 4 Sheets-Sheet 3

FIG. 3

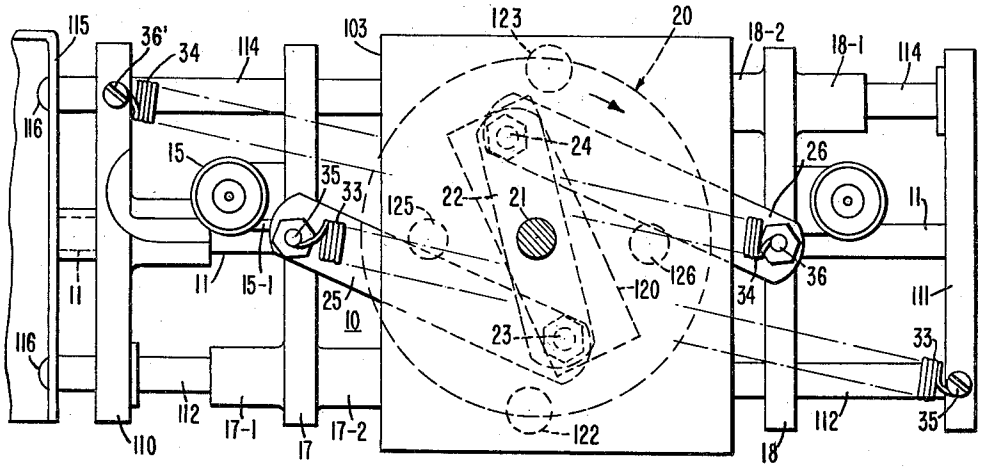
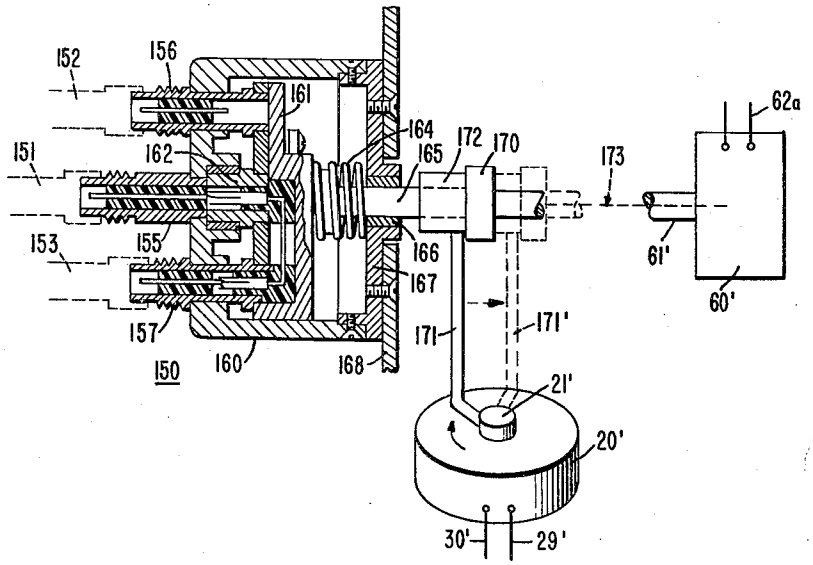


FIG. 5



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REMOTELY OPERATED MICROWAVE ATTENUATOR HAVING AUTOMATIC PLUG-IN CONNECTORS FOR COUPLING TO STEP ATTENUATORS ON MULTIPOSITION TURRET

Filed March 25, 1960 4 Sheets-Sheet 4

FIG. 4

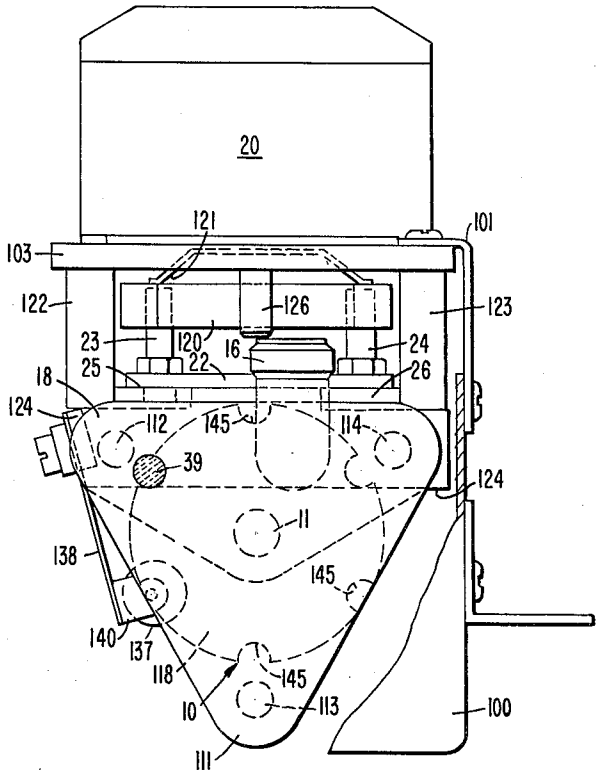
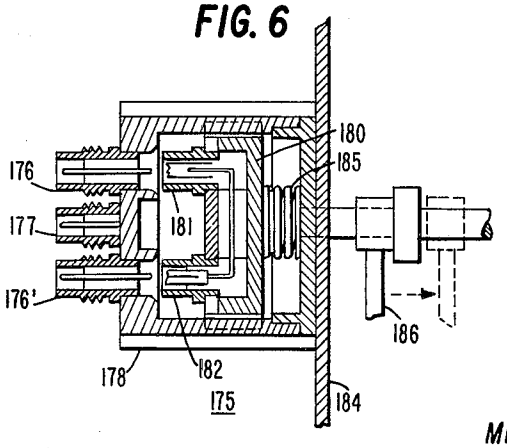


FIG. 6



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United States Patent Office

3,107,334
Patented Oct. 15, 1963

3,107,334

REMOTELY OPERATED MICROWAVE ATTENUATOR HAVING AUTOMATIC PLUG-IN CONNECTORS FOR COUPLING TO STEP ATTENUATORS ON MULTIPOSITION TURRET

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Filed Mar. 25, 1960, Ser. No. 17,686
4 Claims. (Cl. 333—81)

This invention relates to remotely operated multiposition microwave devices of the step displacement type, such as step attenuators, coaxial switches and selectors, and similar pull-turn-push operated assemblies including couplers, filters, etc.

The type of microwave device assemblies for which the present invention is particularly applicable embodies a number of coaxially constructed electrical elements arranged for individual coaction and/or insertion into one or more coaxial lines of a microwave system. Such coaxial elements are generally arranged in a cylindrical array about an axis of rotation. The connectors of the coaxial cables are longitudinally engageable with the components, selectively through predetermined angular displacement of their carrier.

The motion for such selective engagement is generally a pull-turn-push action on the control knob in manual operation, and is also termed step operation. A microwave step attenuator in this class of device is one with a number of different coaxial insertion loss elements, each of the same line characteristic impedance. A typical array, for example, is with six attenuator units in a cylindrical pattern, with loss or attenuation values of zero, 10 db, 20 db, 30 db, 40 db and 50 db. Other arrangements are of course used. My Patent No. 2,848,693 for "Step Attenuators" is illustrative of such construction. Patent No. 2,432,476 shows typical microwave switch devices in this category.

The present invention is directed to novel automatically operated remotely positionable step-operated selectors of the type set forth hereinabove. The invention system effects the resultant motion in microwave multi-component assemblies to produce selective action of the coaxial elements without manual pull-turn-push requirement. A simple dial is turned to the setting desired for the remotely located microwave device, and positive rapid switchover of its setting is directly effected. One motive unit initially operates to disengage the connected microwave element and the cable connectors. Upon complete disengagement a second motive unit rotates the assembly or component array to its new required position while the cable connectors are maintained apart. When the new position is attained the drive circuit is rendered quiescent, and the first motive unit is thereupon deenergized. The microwave circuit is thereupon reestablished in the new dialed selection mode.

The remote step-operated microwave selector of the present invention is useful for apparatus located where manual operation is not practical. Such problem for example exists where the step-operated microwave device is in an inaccessible section of the equipment; or where panel space is at a premium. Also, the remote controlled invention device is ideal for operation of circuitry mounted on a tower, or in dangerous areas as ones contaminated by radioactivity or at missile operations. Further, the invention is applicable where rapid component or line switching is required, and in programmed or automatic systems.

The positions of the microwave devices hereof may be remotely selected by switch, dial or push buttons; or by electrical selection in general. The principles and features of the present invention are set forth in their application to a step attenuator of the type and construction

shown in my Patent No. 2,848,693, aforesaid. It is to be understood that the invention is equally applicable to microwave devices with other electrical components as filters, coaxial switches, etc. The control assembly is a compact, rugged construction, reliable under military and extreme environmental conditions. Its quiescent state uses no holding current or standby power. A switching cycle indicator affords positive indication of the switchovers established.

It is accordingly a primary object of the present invention to provide a novel remotely operated multi-position step-operated microwave device.

Another object of the present invention is to provide a novel remote step-operated pull-turn-push microwave device with dual motive units.

A further object of the present invention is to provide a novel multi-component microwave step device that is remotely controlled into precise rapid switchovers.

Still another object of the present invention is to provide a novel remotely operated microwave step device with a coaxial component array incorporating rotary and linear drive units that are in circuitry requiring no standby power.

Still a further object of the present invention is to provide a novel remotely operated pull-turn-push step attenuator assembly of compact, rugged, reliable construction.

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

FIG. 1 is a schematic diagram of the exemplary remote controlled step attenuator system.

FIG. 2 is a side-elevational view of the step attenuator device of FIG. 1, within its housing in cross-section.

FIG. 3 is a plan view of the step attenuator taken along the line 3—3 of FIG. 2, in the direction of the arrows.

FIG. 4 is an end view of the step attenuator of FIG. 2, with the housing partially cut away.

FIGS. 5 and 6 illustrate, in cross-section, other microwave devices utilizing the invention control system.

Referring to FIG. 1, the microwave unit **10** is a cylindrical carrier of individual coaxial attenuators **12***a* to **12***f* in an axial array about the central shaft **11**. Each attenuator **12***a* to **12***f* is generally of a different insertion loss amount, expressed in db, and progressively arranged in the array. A pair of coaxial end connectors **15**, **16** are engageable, along a given linear position, with the attenuator **12** positioned therebetween. The end connectors **15**, **16** are disengaged by each being linearly moved to a position away from unit **10**, shown in dotted lines at **15'** and **16'**. The attenuator array **10** is thereupon free to be rotated upon its axis **11** until the next desired attenuator **12***a* to **12***f* is in line with connectors **15**, **16**. Returning the connectors **15**, **16** into engagement completes the selection cycle. An exemplary embodiment of step attenuator **10** is detailed in FIGS. 2, 3 and 4; other forms are usable as well.

The linear disengagement and reengagement of end connectors **15**, **16** with the attenuator array **10** is accomplished by means of motive drive **20** and a compound linkage system therebetween. The shaft **21** of drive **20** is connected with a transverse lever **22** serving as a dual lever. An end plate **17** carrying connector **15** is coupled to pivot **23** on lever **22** by link **25**. End plate **18** of connector **16** is coupled to pivot **24** of lever **22** by link **26**. Link **25** is pivotally connected to plate **17** at **27**; link **26**, to plate **18** at **28**. Rotation or angular displacement of drive shaft **21** in the direction of arrow *a* shown in dotted causes the linear displacement of end connectors **15** and **16** outwardly of unit **10**, to their positions **15'**, **16'** of disengagement.

The exemplary drive unit **20** is a rotary solenoid that effects rotary angular displacement of shaft **21** against a

predetermined torque upon electrical energization through leads 29, 30. Alternatively, unit 20 may be any equivalent electric motor drive, though only a fraction of a turn is needed when suitable linkage (as 22, 25, 26) is utilized. Other forms of mechanical arrangements, including gearing may be substituted. The resultant operation is to displace end plates 17, 18 with connectors 15, 16 for full disengagement (at 15', 16') from microwave unit 10 upon signal energization to the drive unit 20. Stops as at 31, 32 may be used to define their displacement limit.

The RF connectors 15, 16 are returned into engagement with the repositioned microwave array 10 in a positive manner. Towards this end springs 33 and 34 are respectively fastened to the movable connector plates 17, 18 at posts 35, 36 thereof. Springs 33, 34 are extended while drive 20 is energized and keeps the connectors at positions 15', 16'. Upon deenergization of drive 20 the biasing action of springs 33, 34 returns the plates 17, 18 and the connectors 15, 16 into the normal engaged position with array 10. This also resets the drive 20 and associated linkage 22, 25, 26.

Accurate angular positioning of drum 10 insures firm and undamaged reconnection of the coaxial connectors 15, 16 with the connection ends of the selected attenuator 12*a* to 12*f*. Air dash pots 37 and 38 secured to the end plates 17, 18 respectively may be used to produce slow reengagement of the connectors 15, 16 should strong springs 33, 34 be used. Also, a detent pin 39 extends from an end plate 17 to engage an indexing slot in drum 10. Pin 40 insures the accurate angular positioning of drum 10 before the connector assembly 15, 16 can close into engagement, as set forth in more detail hereinafter.

The selector switch 40 comprises selector arm 41 connectable individually with contacts 42*a* to 42*f* peripherally arranged about a non-conducting plate. The central selector 41 is in continuous contact through brush 43 with the positive terminal of battery 44, the negative terminal of which is grounded. A corresponding sensing switch 50 is mechanically connected at its hub 51 to rotate with drum 10, as indicated by the dotted axial line 55 extending from drum shaft 11. Hub 51 is insulatedly supported. A number of peripheral contacts 52*a* to 52*f* coact with conductive disc 53 of switch 50. A brush 54 is in continuous electrical contact with disc 53 through an integral ring 53'. A radial slot 56 in the disc 53 periphery is proportioned to break connection with the contacts 52 when the drum 10 is properly angularly positioned at its corresponding selection position.

In FIG. 1 sensing switch 50 is shown positioned with its notch 56 opposite contact 52*a* when drum 10 has its attenuator element 12*a* in the linear position for engagement with the RF connectors 15, 16. Selector arm 41 is correspondingly in connection with contact 42*a* of switch 40. This overall condition is the result of a previous movement of arm 41 to select attenuator element 12*a*, and its selection is thereupon represented as completed. Notch 56 shut off the complete circuit after the positioning was effected. The corresponding contact sets 42 and 52 are interconnected through leads 47*a* to 47*f* respectively joined to leads 57*a* to 57*f*. Contacts 42*a* and 52*a* are shown connected through dotted lead 45, indicating a remote cable connection, with the use of a multiple plug and jack (not shown) for convenience. The other contact leads are similarly connected.

The rotary motive drive 60 has its output shaft 61 connected to rotate drum shaft 11 through the indicated connection 55. Such connection may include a clutch and/or gearing. The exemplary system incorporates a stepping relay at drive 60, preferably in the form of a rotary solenoid, including a ratchet. Such angular drive units (as 20 and 60) are well known in the art, and are manufactured, for example, by G. H. Leland, Inc. under their trademark "Ledex." The drive output shaft 61

rotates shaft 11 in the direction of the arrows *b*. The rotary solenoids 20 and 60 are usually used with a spark suppressor, as a shunt capacitor or shunt solid state rectifier (not shown). Other equivalent drives and auxiliary circuitry may be employed.

The rotary drive 60 is connected to brush 54 of sensing switch 50, through connection 62. The low side of drive 60 is connected to terminal 63 of switch 65 by lead 62'. Terminal 64 of switch 65 is grounded. Switch 65 is normally open. One of its contact arms 66 is abutted by the head 68 of set-screw 70 extending from one of the connector plates 17, when in its fully disengaged cycle phase. When thus abutted, contact 66 is moved to 66' to close on contact 67. During such phase, the circuit of drive 60 from its high lead 62 is completed to ground, and the drive 60 is energized when brush 54 is in connection to battery 44 through switches 40 and 50. Set screw 70 is adjusted to establish closure of rotary drive switch 65 when the linear drive operation on connectors 15, 16 is substantially completed. This feature insures safe operation of the rotary drive 60 and rotation of microwave drum 10, without damage to their RF connections.

In normal operation of the invention remote control system, the selector switch 40 is located at the manual control site. The microwave array 10 and RF connectors 15, 16, together with drives 20, 60 and sensing switch 50 form a unitary assembly at the site of the microwave apparatus. The exemplary RF cables 71, 72 extend respectively from end connectors 15, 16, and include the selected microwave component therebetween, in the example an attenuation insertion loss of specific db level. Other applications may involve a specified filter; impedance change; the use of additional cables in conjunction with predetermined switchovers; etc. All that is needed to interconnect the invention system for remote control operation is the set of cables 45, 47*b* to 47*f*, and a lead to battery 44 if the latter is located with the other apparatus.

In operation, the manual selector arm 41 of selector switch 40 is moved to the next selection position along an indexed panel (not shown) to engage the corresponding contacts 42*a* to 42*f*. This translates the positive terminal of battery 44, through arm 43 and the selected contact 42 to the corresponding contact 52 on sensing switch 50. In FIG. 1 contacts 42*a*, 52*a* represent the previously selected condition, being in the quiescent stage. The energized sensing contact 52 conducts through plate 53 to brush 54. The linear displacement drive 20 is thereupon directly energized by power source 44 through lead 29, causing disengagement of RF end connectors to their positions 15', 16' in the manner hereinabove described.

When the head of set-screw 70 abuts switch arm 66, switch 65 is closed to cause the direct energization of rotary displacement drive 60. Such rotary displacement may be in successive steps through a ratcheted rotary solenoid until the necessary angular displacement of microwave unit 10 is effected; or in a geared down output of a motor-clutch arrangement. The rotation is continued in the direction of arrow *b* until the notch 56 in sensing relay 50 reposes opposite the selected contact 52 position, whereupon the drive circuitry is opened. Rotary drive 60 promptly ceases, and the torque exerted by shaft 21 of drive 20 during the operation of drive 60 is directly relieved. End connectors 15, 16 reengage microwave unit 10 in its new angular position, through the described action of springs 33, 34 and dash pots 37, 38.

The power source 44 is fully disconnected once the new selection is completed. Thus no standby power is consumed. A switching cycle indicator lamp 75 is illuminated during the switching cycle. Switch 76 is connected in series with lamp 75 and the positive battery terminal through leads 77, 77', 78 with remote cable lead 79 inbetween. A set-screw 80 is mounted on one of the con-

nector plates 17 to abut a contact arm 81 of switch 76 and maintain it in open circuit condition when the connectors are engaged.

When the connectors 15, 16 are started in their disengagement cycle contact arm 81 is relieved and closes with contact 82 to light up the pilot lamp 75 during the switching cycle. When the cycle is completed, set-screw 80 reopens switch 76 to put out the indicator 75. However, should there for some reason be a failure of connectors 15, 16 to fully engage, pilot indicator 75 remains lit. Such failure to connect may result as from a speck of foreign matter. Usually by a retracking operation, the unit may be thereupon properly positioned. The switching cycle lamp 75 thus serves as an important indicator in the remote control operation. It is generally located with selector switch 40.

FIGS. 2, 3 and 4 illustrate one form that the remote controlled microwave step assembly may assume in practice. The microwave element carrier 10, its rotary displacement drive unit 60 and the mechanism 50 associated therewith, are mounted in metallic housing 100. The linear displacement drive unit 20 is supported above top plate 101 of housing 100 by exterior bracket 102, and on plate 103. RF coaxial cables 71, 72 extend from their right angle end connectors 15, 16 through respective longitudinal slots 105, 106 in top plate 101. Cables 71, 72 thus clear the housing during their reengagement excursions.

The microwave device 10 contains two triangular end plates that are held stationary. Plate 111 is secured to side 107 of housing 100. Three corner rods 112, 113, 114 extend between the fixed end plates 110, 111 to unitize the step attenuator assembly 10. The rods 112, 113, 114 project beyond plate 110 and are fastened to the bracket 115 with machine screws 116. Bracket 115 is attached to housing 100 with bolts 117. The movable connector plates 17, 18 slide on the two top rods 112, 114 which they straddle. Plate 17 has an extended tubular section 17–1, 17–2 the interior of which has a suitable friction reducing surface such as "Oilite" that rides on rod 112, and provides stability of displacement to the plate 17. In a similar manner, connector plate 18 employes extended tubular section 18–1, 18–2.

RF connectors 15, 16 are of the right-angle or 90° type, with their respective lower sections 15–1, 16–1 projecting through plates 17, 18. The connector sections 15–1, 16–1 are in linear alignment with each other, and coaxially with the microwave element 12*a* namely the attenuator unit 12*a* in the illustrated example, in the selection position of array 10. The tubular attenuator elements 12*a* to 12*f* are arranged in a cylindrical pattern between end discs 117, 118 forming the carrier or drum 10. Central shaft 11 extends axially through drum 10 between discs 117, 118, and suitably journaled in end plates 110, 111. Movable connector plates 17, 18 subtend shaft 11.

Lever plate 22 is coupled to connector plate 17 by link 25 engaging corresponding posts 23, 27; and to connector plate 18 by link 26 across posts 24, 28 (see also FIG. 1). The drive shaft 21 from unit 20 connects to rectangular drive plate 120, which in turn is coupled to the respective posts 23, 24 extending from lever plate 22. A plate spring 121 holds drive plate 120 in engagement. Tubular posts 122, 123 extend from member 124 across rods 112, 114 to support horizontal plate 103 upon which drive unit 20 is mounted. Stop pins 125, 126 prevent overshoot of the linear displacement plate 120, and thus limit the extent of disengaging motion of end connectors 15, 16 and plates 17, 18 in assembly 10. The full arrangement of bias springs 33, 34 is shown in FIG. 3. The fixed end of spring 33 is secured to post 35′ on end plate 111; of spring 34, to post 36′ on end plate 110. Air dash-pots 37, 38, optional as stated, are not included in FIGS. 2, 3, 4.

The rotary step drive unit 60 extends at one end of

microwave assembly 10. The sensing switch 50, drive ratchet, interrupter, spark suppressor, and related parts and leads described in connection with FIG. 1, are contained within end bell 130 between drive 60 and bracket 115. The control switch 65 is mounted on a bracket plate 131 extending from end plate 110. The head 68 of set-screw 70 is adjustable with respect to connector plate 17 to impinge upon arm 66 of switch 65. Contact 66′ thereupon closes on contact 67 to initiate the rotary step drive 60 as set forth hereinabove. The switching cycle indicator switch 76 is suitably supported to coact with set-screw 80 depending from plate 17.

Microwave element carrier or drum 10 is held against axial displacement by collar 135 fastened to shaft 113 (FIG. 2). Collar 135 contains a groove 136 in which one of the drum discs 117 rides. In this manner, mechanical engagement and disengagement of end connectors 15, 16 as well as rotary displacement of drum 10 is effected without disturbing its axial position on shaft 11. A roller 137 (see FIG. 4), is pressed against the side of drum array 10 by leaf spring 138 depending from member 124. Roller 137 is rotatably held in arms 140 extending from spring 138, and oriented to press between adjacent coaxial attenuator elements 12*a* to 12*f*. The roller-spring 137, 138 arrangement serves as a detent to stably hold drum 10 in its selection positions.

A series of peripheral notches 145 about drum disc 118 cooperates with detent pin 39 mounted at 39′ in connector plate 18. When the connectors 15, 16 start their return for reengagement the tip 39*a* of pin 39 rides into a notch 145 when the angular phasing is correct. This is due to tip 39*a* being made to extend further from connector plate 18 than the exterior portion of the connector 16 to engage an element 12. If a slight angular irregularity exists, the pin 39 corrects it so that no jamming or distorting occurs on the delicate connector ends, insuring smooth and proper coaxial engagement.

It is to be understood that the invention remote control system is applicable generally to pull-turn-push microwave devices, and that the step attenuator described hereinabove was by way of example. Other linkage arrangements can be incorporated to effect the pull-turn-push step operation of the microwave device per se. Also, as set forth hereinabove, other circuit functions may be effected by the device. FIGURES 5 and 6 illustrate other typical microwave devices to which the present invention is applicable.

FIG. 5 illustrates (in part) the application of the invention system to a push-turn-pull microwave cable switch or selector 150. A central or main microwave cable 151 is electrically connectible selectively to a series of other cables, as 152, 153, by means of the pull-turn-push cable switch 150. Central cable 151 is coupled to center coaxial terminal connector 155; and the other cables 152, 153 to radially disposed terminal connectors 156, 157 respectively of unit 150. Terminals 155, 156, 157 extend from the body 160 of unit 150, for the coaxial coupling described. Other radial cable terminals are generally disposed about body 160 for multi-positioned operation.

An indexing member 161 contains a coaxial U-coupler 162, 163 coactable with the inner end of central terminal 155 and a single one of the other radial terminals 156, 157 etc. Body 161 is normally spring biased into an engaged position, as illustrated, by helical spring 164 about control shaft 165. Shaft 165 is rotatably supported in bushing 166 within an aperture of cap 167 of body 160. Cap 167 is secured to a fixed panel 168 of the equipment. A cable switch per se of the type herein is described in more detail in U.S. Patent No. 2,432,476.

The control shaft 165 extends beyond panel 168 for coaction with the system control motors 20′ and 60′. The "pull" control motor 20′ corresponds with motor 20 of the control system hereinabove set forth; and the "turn" motor 60′, with motor 60 thereof. A boss or

collar 170 is secured on shaft 165, spaced from panel 168. A control arm 171 connects the output shaft 21' of motor 20' with shaft 165 through a slideable end section 172.

When "pull" motor 20' is energized by control circuitry corresponding to that described in connection with FIG. 1, arm 171 is motivated to the full-open (pull) position shown in dotted lines at 171'. The end section 172 abuts collar 170 and "pulls" shaft 165 and indexing member 161 "open" against the pressure of spring 164. U-connector 162, 163 is thus electrically disengaged. Motor 20' holds its torque and the said cable disengagement, for the next control operation to ensue.

With indexing member 161 fully disengaged the shaft 165 is axially displaced, as is collar 170 to position 170' shown in dotted. The thus "opened" position of the microwave terminals of unit 150 is electrically determined or signalled by an end switch 65' corresponding to switch 65 (FIG. 1). The "turn" motor 60' is thereupon energized to operate shaft 165 and rotate indexing member 161 to the indexing position newly selected (as by selection means 40, 50 of the FIG. 1 system).

The control shaft 165 is suitably coupled to drive shaft 61' of step relay or motive unit 60'. The indicated coupling 173 may for example be a splined connection between displaceable shaft 165 and the drive shaft 61', to maintain the drive relation. Equivalent mechanical coupling may instead be employed. The selector switch system corresponding to 50 of FIG. 1 is coupled thereto, as will now be understood by those skilled in the art.

Upon completion of this selective "turn" operation, the "pull" motor 20' is deenergized, whereupon spring 164 returns indexing member 161 into cable bridging engagement, for the new selected cable operation. Application of the principles and details of the overall system and invention as described for the device 10 hereinabove, to cable switch 150, will now be apparent to those skilled in the art.

FIG. 6 illustrates a further microwave pull-term-push device 175. The microwave switch 175 contains radial pairs of cable terminals 176, 176' and 177 (with 177' not shown) extending from its body 178. An indexing member 180 contains a U-connector with cable terminals 181, 182 at 180° separation for electrically connecting a selected cable pair as 176, 176' or 177, 177', etc. The cap 183 of body 178 secures the unit 175 to a panel 184.

A spring 185 between cap 183 and indexing member 180 is shown in its compressed extended or "pull" position with terminals 181, 182 disengaged from pair 176, 176'. This condition is effected by the "pull" motor (not shown) having motivated arm 186 in the selection control cycle when the selection cycle is completed; the displacement torque on arm 186 is released, and spring 185 closes indexing member 180. The U-connector thereupon engages its terminals 181, 182 with the selected cable pair, e.g. 176, 176', and thereby coaxially interconnects them. The remainder of the selection control system for device 175 is similar to that described for coaxial switch 150 of FIG. 5.

Although the present invention has been described in connection with exemplary embodiments, modifications and variations within the spirit and scope thereof will now become apparent to those skilled in the art, as will its application to other microwave step devices, and it is therefore not intended to be limited except as set forth in the following claims.

What is claimed is:

1. Remotely operated microwave apparatus comprising a step attenuator having two coaxial type terminals displaceable to effect individual end to end engagement and disengagement with attenuator pads of the step attenuator, said terminals being aligned in a predetermined axial position for selective coaction with the attenuator pads, a first electric drive unit having a shaft coupled to said terminals including linkage means to axially separate and disengage said terminals from the attenuator pads through operation of said first drive unit, a second electric drive unit arranged to rotate said step attenuator when said terminals are disengaged from the attenuator pads, and selection means including circuit connections to said first and second drive units for effecting the axial separation and disengagement of said terminals from an attenuator pad engaged therewith and thereupon selectively rotating the attenuator pads to a desired position, and spring means for axially engaging said terminals end to end with the selected attenuator pad.

2. Remotely operated microwave apparatus comprising a step attenuator having two coaxial type terminals displaceable to effect individual end to end engagement and disengagement with attenuator pads of the step attenuator, said terminals being aligned in a predetermined axial position for selective coaction with the attenuator pads, a first electric drive unit having a shaft coupled to said terminals including linkage means to axially separate and disengage said terminals from the attenuator pads through operation of said first drive unit, a second electric drive unit arranged to rotate said step attenuator when said terminals are disengaged from the attenuator pads, and selection means including circuit connections to said first and second drive units for effecting the axial separation and disengagement of said terminals from an attenuator pad engaged therewith through motivation of said first drive unit and thereupon selectively engaging said terminals with another attenuator pad through rotation of said step attenuator by said second drive unit and subsequent release of the first unit drive.

3. Remotely controlled microwave apparatus as claimed in claim 2, further including switch means positioned for actuation upon full axial separation and disengagement of said terminals by the motivation of said first drive unit and circuit connections between said switch means and said selection means to initiate motivation of said second drive unit upon the said full axial terminal disengagement.

4. Remotely controlled microwave apparatus as claimed in claim 3, further including spring means arranged to bias said terminals into said end to end attenuator pad engagement and to return said terminals into the axial engaged condition with the selected attenuator pad upon the release of said first unit.

References Cited in the file of this patent

UNITED STATES PATENTS

2,429,401	Davis	Oct. 21, 1947
2,516,606	Weaver	July 25, 1950
2,555,025	Cheek	May 29, 1951
2,709,725	Bieber	May 31, 1955
2,812,486	Foster	Nov. 5, 1957
2,848,693	Harges	Aug. 19, 1958