

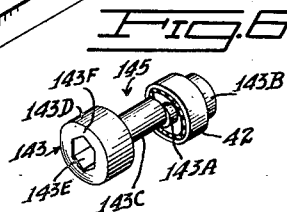
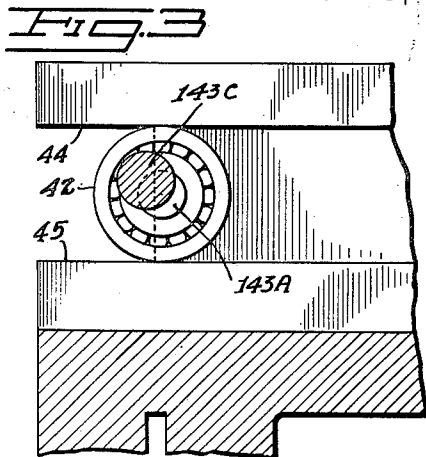
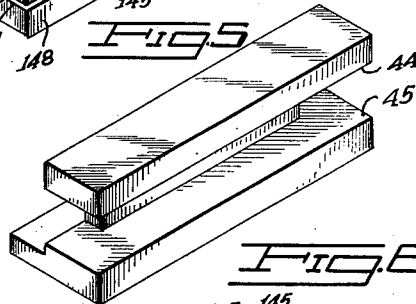
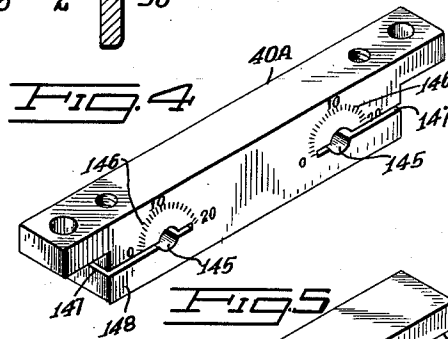
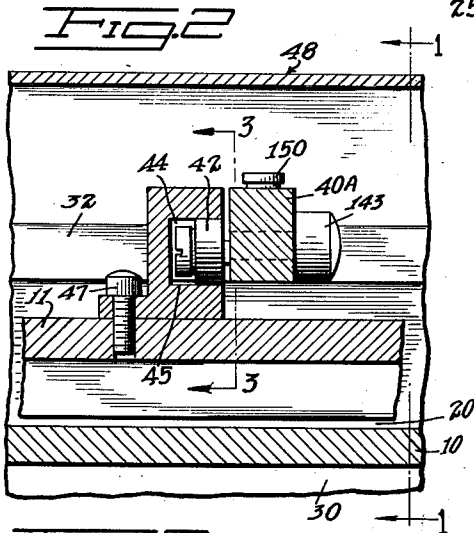
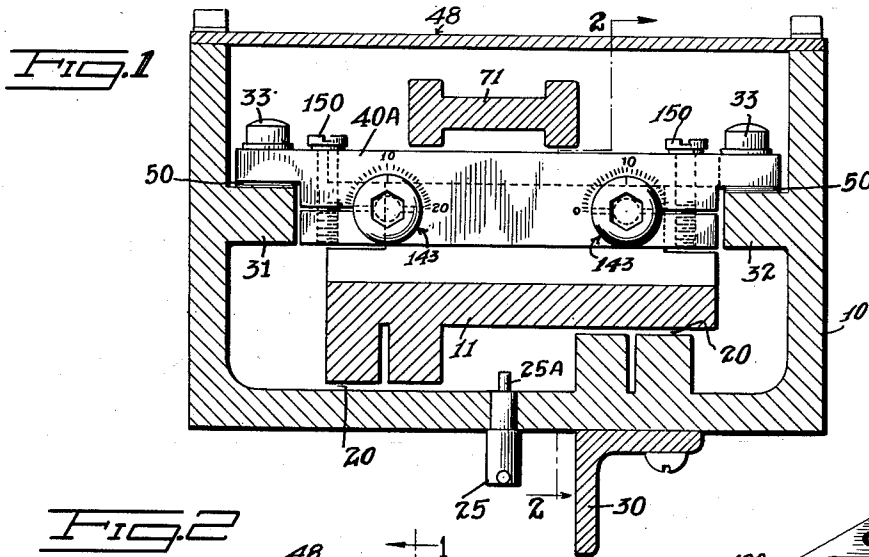
May 13, 1952

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RADAR ANTENNA STRUCTURE

2,596,966

Filed Nov. 16, 1948

3 Sheets-Sheet 1



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FIG 10

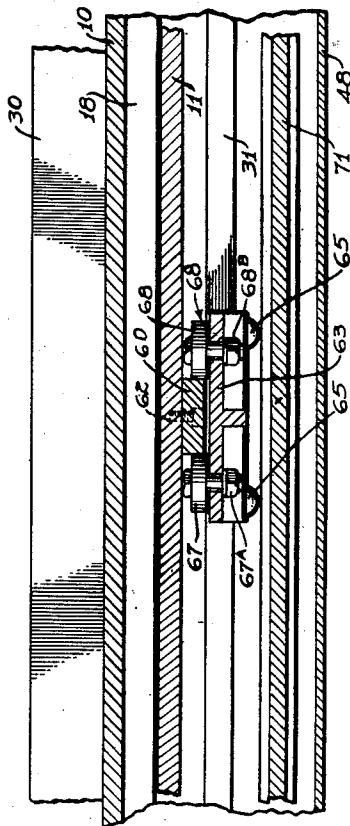


FIG 9

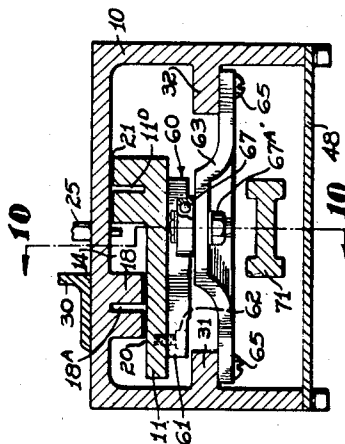
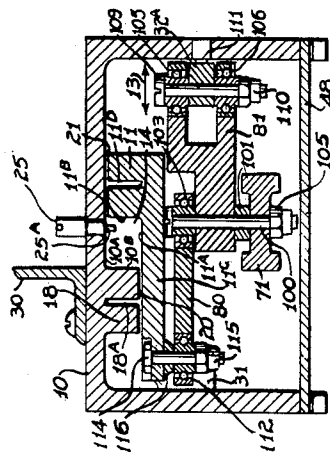


FIG 7



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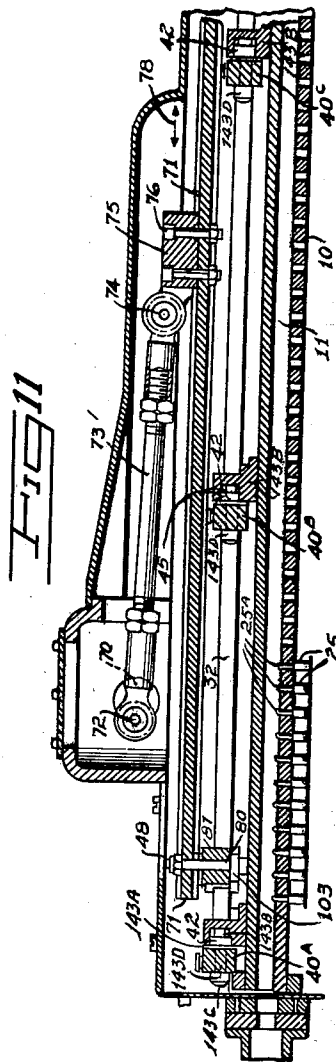
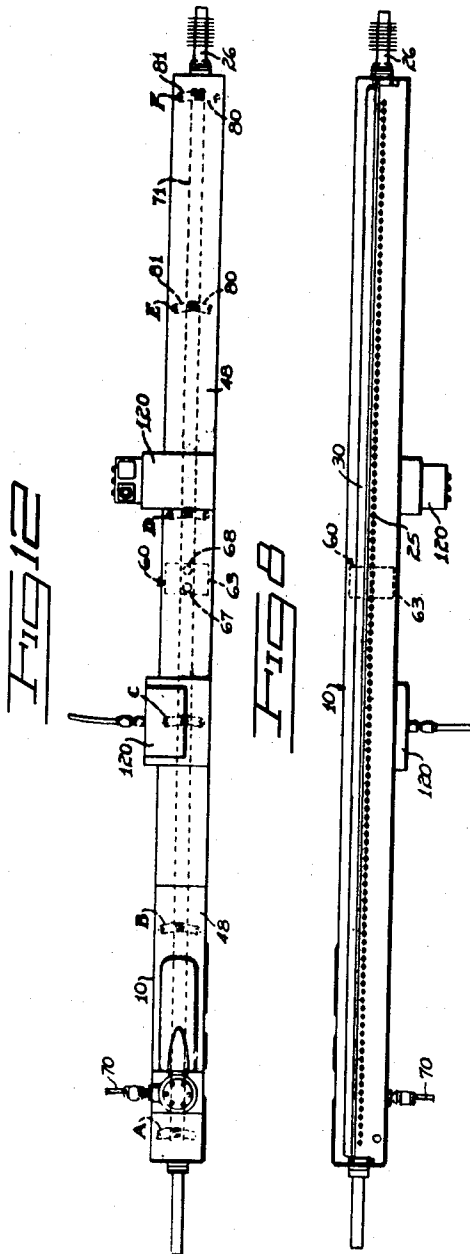
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UNITED STATES PATENT OFFICE

2,596,966

RADAR ANTENNA STRUCTURE

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Application November 16, 1948, Serial No. 60,325

15 Claims. (Cl. 250—33.63)

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The present invention relates to an improved variable cross-section wave guide arranged to feed a plurality of dipoles in, for example and not as a limitation, ground control approach systems (GCA); and more specifically the present invention relates to an improvement in the bridge-type precision antenna structure described and claimed in the co-pending patent application of Karl A. Allebach, filed September 18, 1948, Serial No. 49,910, and assigned to the same assignee.

In setting up the variable wave guide antenna structure of the type described in the above-mentioned patent application, it is of importance that the cross-sectional dimensions of the wave guide at various sections along the wave guide may be adjusted independently and easily in order to effect a sharply directed electro magnetic radiated beam. Such adjustment consists in adjusting what is termed in the art as the "a" dimension and "b" clearance. It has been observed that not only must the "a" dimension be adjusted precisely but also the "b" clearance must also be adjusted precisely to produce the intended sharply directed beam. It is, therefore, desirable that substantially independently operated means be provided and spaced along the wave guide to adjust independently and continuously the corresponding "a" dimension and "b" clearance to thereby adjust the cross-sectional dimensions and resulting sharpness and freedom from side lobes of the radiated beam.

In accordance with the present invention, not only is the adjustment of such "a" dimension continuous over a range but also the adjusting means for the "b" clearance is likewise adjusted continuously over a range.

One of the objects of the present invention is to provide improved adjusting means whereby both the "a" dimension and "b" clearance may be continuously varied over a range to facilitate adjustment of the antenna structure proper.

A specific object of the present invention is to provide an improved adjustable mounting for a wave guide member such that the "b" clearance may be adjusted continuously over a range.

Another object of the present invention is to provide an improved wave guide which is relatively easy to manufacture, assemble and to maintain in working condition and characterized by the ease with which the "a" dimension and "b" clearance may be varied continuously over a range.

Yet another object of the present invention is

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to provide an improved antenna wave guide structure characterized by the fact that various portions of the guide may be adjusted independently of other portions and continuously in two mutually perpendicular directions whereby the wave guide may be adjusted for uniform or non-uniform dimensions, as the case may be, throughout its length for achievement of the desired radiation characteristics.

A further object of the present invention is to provide an improved cross-sectional wave guide characterized by the ease with which the "a" dimension and "b" clearance thereof may be conveniently adjusted continuously over a range at various sections along the wave guide, a subsidiary feature being that the wearing surfaces are readily accessible and interchangeable whereby the wave guide may be conveniently serviced while in use in the field.

Yet another object of the present invention is to provide an improved variable cross-section wave guide having one movable element thereof continuously adjustable in two mutually perpendicular directions at different regions along its length whereby the cross-section may be adjusted to produce the desired radiation characteristics.

Yet another object of the present invention is to provide an improved variable cross-section wave guide characterized by the comparative ease with which the "a" dimension and/or "b" clearance may both be adjusted continuously over a range.

Still another object of the present invention is to provide an improved variable cross-section wave guide comprising a movable wave guide member and a relatively stationary wave guide member characterized by the fact that by removing conveniently accessible bridge supporting members, the interior of the wave guide may be conveniently inspected and cleaned, and thereafter such supporting bridge members mounted in place again without disturbing appreciably the initial "a" dimension and/or "b" clearance adjustment of the wave guide, and also by the fact that such "a" dimension and "b" clearance may both be adjusted continuously over a range of values.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. This invention itself, both as to its organization and manner of operation, together with further objects and advantages thereof, may be best understood by reference to the following description taken in con-

section with the accompanying drawings in which:

Figure 1 is a cross-sectional view through a variable cross-section wave guide antenna structure taken substantially on the line 1—1 of Figure 2.

Figure 2 is a sectional view taken substantially on the line 2—2 of Figure 1.

Figure 3 is a sectional view taken substantially on the line 3—3 of Figure 2.

Figures 4, 5 and 6 are perspective views of the various elements incorporated in the structures shown in the previous three figures.

Figure 7 is a cross-sectional view, similar to the cross-sectional view shown in Figure 1 but taken through different spaced sections of the wave guide antenna structure to illustrate the manner in which the "a" dimension is continuously adjustable over a range of values.

Figure 8 is a plan view of the variable cross-sectional wave guide within which the present invention is incorporated.

Figure 9 is a sectional view through a portion of the wave guide structure.

Figure 10 is a sectional view taken substantially on the line 10—10 of Figure 9.

Figure 11 is another sectional view taken through the antenna structure.

Figure 12 is a view in elevation showing the other side of the wave guide shown in Figure 8.

As mentioned hereinabove, the present invention relates to improvements in the bridge-type precision antenna structure described and claimed in the co-pending patent application of Karl A. Allebach, Serial No. 49,910.

For a more complete description of the antenna structure, reference may be had to such co-pending application, and the structure shown and described therein is incorporated herein by reference and is deemed to be included herein as if set forth herein at length. For this purpose, and for convenience of reference, the same elements in the present application and in the aforementioned co-pending application have identical reference numerals.

The variable cross-section wave guide comprises essentially two parts, namely, a relatively stationary member 10 and a relatively movable member 11, the member 11 being reciprocable in the so-called "a" dimension or in the direction indicated by the arrows 13 in Figure 7 to maintain the internal variable cross-sectional area 14 of the wave guide rectangular at all times. This so-called "a" dimension is the distance, in Figure 7, between the walls 10B, 11B of the cooperating wave guide members 10, 11. This "a" dimension, of course, varies with variation in position of the movable wave guide member 11.

The movable wave guide member 11 is so supported that it is adjustable at different positions along its length in two mutually perpendicular directions corresponding to the axes of the rectangular area 14 to assure substantially the same or different cross-sectional area along the length of the guide. The manner in which such member 11 is adjustably supported to produce this result is of importance in the action described in detail hereinafter. Also, since the movable element 11 is relatively long and heavy, it must have suitable bearing surfaces which, in accordance with one of the features of the present invention, are easily accessible and easily replaceable in the field.

As shown in Figure 7, the wave guide area is defined on the one hand by perpendicular faces

10A, 10B on the stationary member 10 and on the other hand by the perpendicular faces 11A, 11B on the movable member 11.

Face 10B comprises one of the surfaces of an integrally formed flange 18 on the channel shaped member 10, the flange 18 having a slotted portion 18A one quarter guide wave length deep which extends the full length of the flange 18 and cooperates with the adjacently positioned leg 11C to form a choke to prevent the leakage of radio frequency energy which would otherwise flow through the so-called "b" clearance or clearance space 20 between flange 18 and leg 11C. The clearances 20, 21 (Figure 7) are referred to herein as the "b" clearances, and are the spacing between cooperating L-shaped portions of the guide members 10, 11, as shown in Figure 7, such cooperating L-shaped portions of the guide members 10, 11 having an end of a leg of one L-shaped portion spaced from the adjacent leg of the other cooperating portion by a distance termed herein as the "b" clearance and represented by the spacing or clearances 20, 21.

In similar manner, face 11B comprises one of the surfaces of the L-shaped movable wave guide member 11, member 11 having a slotted portion 11D one quarter guide wave length deep which extends the full length of the member 11 and cooperates with the adjacently positioned face 10A to form a choke to prevent the leakage of radio frequency energy which would otherwise flow through the other so-called "b" clearance or clearance space 21 between member 11 and face 10A.

The purpose of moving the wave guide member 11 with respect to the other wave guide member 10 is to alter the phase velocity and hence the wave length in the guide to thereby change the relative phase at which the dipoles 25 are fed. This change in phase alters the effective direction of the combined radiated wave front or beam with the result that such beam scans through space when the wave guide member 11 is moved. A reflector 30, having an L-shaped cross-section is mounted on the guide member 10 with its axis parallel to the axis parallel to the array of dipoles 25.

The wave guide members 10, 11 may be approximately fourteen feet long or any other suitable length to produce a radiation beam of desired width and is intended for use as a so-called precision type of antenna in ground controlled approach (GCA) systems. The wave guide member 10 supports a linear broad side array of a continuous line of approximately 180 or any other suitable number of dipoles 25. These dipoles may be suitably spaced over a sufficient length to produce a beam approximately 0.4° wide in elevation. These dipoles 25 are mounted along the wide side of the supporting wave guide member 10 with their center conductors 25A extending into the guide as pickup probes. The insertion depth of the individual dipole probes 25A may be varied along the length of the array to produce a "gable" or other suitable distribution of power.

The dipole spacing is approximately one-half of the guide wave length and alternate dipoles are reversed, thus suppressing strong lobes which would otherwise exist at approximately 45° either side of the main lobe.

The small percentage of power not picked up by the series of probes 25A is dissipated by an attached load or conventional absorber unit 26 to prevent the formation of high standing waves

due to reflection which would result in producing side lobes. This absorber unit may contain a mixture of graphite and sand and may be equipped with external heat radiating fins and may be disposed at the end of the wave guide 10, 11 opposite to that end to which the high frequency energy is fed.

The movable wave guide member 11 is supported largely by an adjustably and releasably positioned series of bridge members 40A as required and at equal spaced positions along the wave guide. These bridge members 40A are each of the same construction and, as shown, are releasably mounted by bolts 33 on opposite inner flange members 31, 32. These bridge members each rotatably support a pair of ball bearing members 42 on corresponding axles 143A forming a part of the adjustably positioned crank members 143. The outer surfaces, if desired, of these ball bearing members 42 are hardened and cooperate with the abutting hardened surfaces on the bearing plates or tracks 44, 45 mounted by means of bolts 47 on the underside of the movable wave guide member 11. Of importance is the fact that these bearing members comprising the plates 44, 45 and the roller bearing members 42 are conveniently accessible from the bottom of the wave guide after the cover member 43 is removed so that as these bearing members or tracks become worn in use, they may be replaced in the field allowing the continued use of the same wave guide members 10, 11. In other words, the wave guide members 10, 11 are not susceptible of wear as are prior art wave guides. This is a very desirable feature since the manufacture of such wave guide members requires much skill and great care in observing dimensions.

In accordance with the present invention, the adjustably positioned crank members 143 are useful in continuously adjusting the "b" clearance of the wave guide.

The crank member 143 comprises the shaft 143A upon which the bearing member 42 is maintained by a set screw 143E, and includes also a circular shaft 143C which is clampable in the circular apertures 145 in the bridge member 40A; also, the crank member 143 has an enlarged head 143D with a wrench socket 143E in its end for convenience in turning. The head 143D may also include an indicia marked 143F for cooperation with the dial scales 146 on the bridge member 40A.

The crank member 143 or off-set shaft is held in adjustable positions within the apertures 145 by clamping screws 150 threaded in the bridge member 40A and passing through the clamping slots 147 therein to urge the metal forming the bottom portion of the holes 145 against the circular shaft 143 to thereby clamp it in adjusted position.

In assembling the wave guide, the clamping screws 150 are screwed down into clamping engagement with the indicia 143F upon the crank member 143 adjacent the "0" mark along the scales 146. Thereafter, shims 50 are interposed between the individual bridge members 40A and their supporting bridge flanges 31, 32, the shims 50 being of such thickness that the movable wave guide 11 just touches the stationary wave guide member 10, in which case, the wave guide has a zero "b" clearance and, thereafter, the "b" clearance may be adjusted continuously to different calibrated magnitudes, as determined by the position of the indicia 143F with respect to the scales 146 on the bridge members. Such

scales may be marked off, for example, in thousandths of an inch. To effect an adjustment in "b" clearance, the clamping screw 150 is loosened and the crank member 143 is rotated the desired amount, using for that purpose a hexagonal head wrench engaged with the cooperating hexagonal socket 143E. The adjustment is thus made and the clamping screws 150 are tightened.

Thus, the "b" clearance of the wave guide may be varied not only continuously but also in predetermined calibrated amounts.

In order to assure movement of the wave guide 11 only in the direction indicated by the arrows 13 (Figure 7), a centrally disposed guide block 60, strap 63, and bearings 67, 68 (Figures 9 and 10) are provided.

The constructional features of this guide bearing 60 are more clearly shown in Figures 8, 9, 10 and 12. Such guide block 60 comprises a rectangular guide block 60 releasably attached to the guide member 11 by bolt 62 and a strap member 63 attached by bolts 65 to the flanges 31, 32, there being provided a pair of roller bearings 67, 68 rotatably and releasably mounted on a strap 63 for cooperation with the guide block 60. This guide block 60 may be hardened to resist wear as well as the outer cooperating surfaces on the guide rollers 67, 68. It is apparent that this guide block 60, comprising essentially the elements 60, 67, 68 and 63 may be conveniently replaced since all the elements are screw or bolt-fastened. The guide roller 67, 68 may be removed after removing their fastening nuts 67A, 68B, respectively.

The wave guide member 11 is reciprocated in the direction indicated by arrows 13 in Figure 7 upon rotation of the motor driven shaft 70 in Figures 11 and 12, the rotary movement of shaft 70 being converted into movement of the bar 71. The assembly shown in Figure 11 comprises a crank member 72 coupled to the shaft 70, an arm 73 adjustable in length and having one of its ends rotatably supported on the crank shaft 72 and the other of its ends journaled for rotation on the shaft 74 on the block 75 which is attached to the bar 71 by bolts 76, thus rotary movement of shaft 70 results in movement of the bar 71 in the direction indicated by the arrows 78 in Figure 11. Such movement of bar 71 along the longitudinal axis of the wave guide is converted into motion of the movable wave guide member 11 in a direction transverse to the axis of the wave guide by pivotally connected pairs of link members 80, 81 located at stations A, B, C, D, E, and F or at as many stations as are required by the length of the array.

The pairs of link members 80, 81 are connected to the longitudinal movable actuating bar 71 as shown in Figure 7. For this purpose, a locking bolt 100 passes through aligned apertures in the bar 71, spacer 101, and the central core of the ball bearing member 103 in one end of link pin 80 to lock these elements together by the releasable nut 105. The other end of link member 81 is bifurcated to receive the adjustably positioned extension 32A of flange 32. The bifurcated ends of link member 81 each receive a roller bearing member 105, 106, the central cores of which are locked together and to the flange extension 32A by the bolt 109 having the fastened nut 110 thereon. Thus, the link member 81 may rotate about the axis of the bolt 109. This axis of rotation which corresponds to the action of bolt 109 may be conveniently adjusted

as explained in greater detail hereinafter by adjustment of the set screw 114 for purposes of adjusting the internal "a" dimension of the wave guide 10, 11.

The outer end of link member 80 is provided with a bearing insert 112, the central core of which is locked to the wave guide member 11 by the bolt 114 having the fastening nut 115 thereon to clamp such central core to the guide member 11 with the spacer 116 clamped therebetween. It is thus apparent that the movable bar 71 and link assemblies 80, 81 are supported as a cantilever, the base or abutment for such cantilever being the adjustable extension 32A of flange 32. Incidentally, through the intermediary of the link members 80, 81, the extension 32A supports a portion of the load of the movable wave guide member 11. However, the larger portion of the weight of wave guide member 11 and the link assembly including links 80, 81 and bar 71 is supported on the bridge supported bearing structures 42, 44, 45 described in detail hereinabove. In other words, the main function of the adjustably positioned extension 32A of flange 32 is not to carry a load but to provide an adjustment whereby the distance between faces 10B and 11B of the wave guide may be altered at the different sections A through F along the wave guide in such a manner that the cross section may be made uniform or otherwise as required throughout the length of the wave guide. Such adjustments of the extension 32A, accomplished by adjustment of the set screws 114 and locking screw 320, is in a direction perpendicular to the direction in which the clearances 20, 21 are adjusted by the offset shafts or cranks 143.

The adjustably positioned extensions 32A are formed by slitting flange 31, 32 to allow easy movement of the free end thus formed by the set screw 114. It is noted that there is such an adjustable flange 32A at each one of the stations A-F so that the adjustment may be made where needed.

It is thus apparent that when the actuating bar 71 is reciprocated, links 80, 81 are rotated about an adjustable axis corresponding to the axis of bolts 109, 114 (Figure 7) to impart a reciprocation to the movable wave guide member 11 in the direction indicated by the arrow 13, it being remembered that longitudinal movement of such guide member 11 in the direction of its axis is prevented by the centrally disposed guide block 69 (Figures 10 and 12).

In conventional manner, conventional angle data coupling capacitor and blanker switch units 120 (Figure 8) may be associated with the movable wave guide member 11 to provide synchronization of cathode ray beam sweeps and for other purposes.

While the particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

I claim:

1. In a variable wave guide structure adapted to propagate ultra-high frequency energy, and arranged to feed a plurality of spaced dipoles, an elongated member forming a relatively stationary portion of said wave guide through which portions of said spaced dipoles extend to serve as

spaced pickup probes for energy propagated as radiation within said wave guide structure, the internal cross-section of said wave guide being variable to alter the apparent wave length of such radiation to thereby change the relative phase at which the dipoles are fed to produce a change in direction of the total energy radiated from all of said dipoles, said elongated member having pairs of support surfaces spaced transversely thereof, a plurality of bridge structures releasably mounted on corresponding pairs of said support surfaces, a movable wave guide member cooperatively associated with said first wave guide member to form therewith the internal space of the wave guide within which said radiation is propagated, an adjustably positioned crank member on each of said bridge structures, and said movable wave guide member being mounted for movement on said crank member.

2. In a variable wave guide structure adapted to propagate ultra-high frequency energy and arranged to feed a plurality of spaced dipoles, said spaced dipoles each having a portion thereof extending within said wave guide to serve as spaced pickup probes for energy propagated as radiation within said wave guide structure, the internal cross-section of said wave guide structure being variable to alter the apparent wave length of such radiation to thereby change the relative phase at which the dipoles are fed to produce a change in direction of the total energy radiated from all of the dipoles, said wave guide structure including an elongated member having a pair of internally formed flanges on opposite walls thereof extending substantially parallel in the longitudinal direction of said elongated member, a movable wave guide section cooperatively associated with said elongated member to form a variable cross-section wave guide, a bridge structure having each of its ends releasably and adjustably mounted on said flanges, a crank member adjustably positioned on said bridge structure, said movable wave guide section being mounted for movement on said crank member, at least a portion of one of said flanges being supported as a cantilever on said elongated member, said movable wave guide section being supported on the free end of said cantilever, and means disposed between the free end of said cantilever and said elongated member to adjust the position of said cantilever with respect to said elongated member to thereby adjust the position of said movable wave guide section and cross-sectional area of said wave guide.

3. In a variable wave guide structure adapted to propagate ultra-high frequency energy and arranged to feed a plurality of spaced dipoles, said spaced dipoles having at least a portion thereof extending into said wave guide to serve as pickup probes for energy propagated as radiation within said wave guide structure, the internal cross-section of said wave guide structure being variable to alter the apparent wave length of said radiation to thereby change the relative phase at which the dipoles are fed to produce a change in direction of the total energy radiated from all of the dipoles, said variable wave guide structure comprising: a relatively stationary elongated wave guide member, said stationary wave guide member having cantilever supporting members at different sections along its length, the free ends of said cantilever supporting members being movable to adjusted positions with respect to said stationary wave guide member, a movable wave guide member cooperatively asso-

ciated with respect to the first mentioned stationary wave guide member to form said variable wave guide structure, said movable wave guide member being supported on said cantilever supporting members, and means for adjusting and maintaining in adjusted position said free ends of said cantilever supporting members to thereby adjustably position said movable wave guide member with respect to said stationary wave guide member to align said movable wave guide member with respect to the stationary wave guide member, a bridge member having opposite ends thereof releasably secured to said relatively stationary guide member, a crank member adjustably positioned on said bridge member, and said movable guide member being mounted for movement on said crank member.

4. In a variable wave guide structure adapted to propagate ultra-high frequency energy and arranged to feed a plurality of spaced dipoles, said spaced dipoles having at least a portion thereof extending into said wave guide to serve as pickup probes for energy propagated as radiation within said wave guide structure, the internal cross-section of said guide structure being variable to alter the apparent wave length of said radiation to thereby change the relative phase at which the dipoles are fed to produce a change in direction of the total energy radiated from all of the dipoles, said wave guide structure comprising: a relatively stationary wave guide member and a movable guide member cooperating therewith, a plurality of supporting elements releasably mounted on said stationary guide member at points therealong, crank members adjustably positioned on said supporting elements, said movable guide member being movable on said crank members, and cooperating wear-resistant surfaces disposed between said crank members and said movable guide member.

5. In a variable wave guide structure adapted to propagate ultra-high frequency energy and arranged to feed a plurality of spaced dipoles, said spaced dipoles having at least a portion thereof extending into said wave guide to serve as pickup probes for energy propagated as radiation within said wave guide structure, the internal cross-section of said guide structure being variable to alter the apparent wave length of said radiation to thereby change the relative phase at which the dipoles are fed to produce a change in direction of the total energy radiated from all of the dipoles, said wave guide structure comprising: a relatively stationary wave guide member having at least a pair of spaced supporting members thereon, a relatively movable wave guide section cooperatively associated with said stationary guide member to provide a wave guide of varying cross-sectional area, a bridge structure releasably supported on said supporting members, spacers of predetermined thickness between said bridge structure and said supporting members to adjust the position of said bridge structure with respect to said stationary guide member, a crank member adjustably positioned on said bridge structure, and means supporting said movable guide member on said crank member for movement thereon.

6. In a variable wave guide structure adapted to propagate ultra-high frequency energy and arranged to feed a plurality of spaced dipoles, said spaced dipoles having at least a portion thereof extending into said wave guide to serve as pickup probes for energy propagated as radiation within said wave guide structure, the internal cross-section of said guide structure being var-

iable to alter the apparent wave length of said radiation to thereby change the relative phase at which the dipoles are fed to produce a change in direction of the total energy radiated from all of the dipoles, said wave guide structure comprising: a relatively stationary wave guide member having mounted thereon at least two spaced supporting members, one of said members being adjustably positioned with respect to said wave guide, means for adjusting said one supporting member and maintaining said one supporting member in adjusted position, a relatively movable guide member cooperatively associated with said stationary guide member to form a variable cross-sectional wave guide therewith, a bridge structure mounted on said supporting members, a crank member adjustably positioned on said bridge structure, and means mounting said movable wave guide on said crank member for movement thereon.

7. In a variable wave guide structure adapted to propagate ultra-high frequency energy and arranged to feed a plurality of spaced dipoles, said spaced dipoles having at least a portion thereof extending into said wave guide to serve as pickup probes for energy propagated as radiation within said wave guide structure, the internal cross-section of said guide structure being variable to alter the apparent wave length of said radiation to thereby change the relative phase at which the dipoles are fed to produce a change in direction of the total energy radiated from all of the dipoles, said wave guide structure comprising: a relatively stationary wave guide member, a relatively movable cooperating wave guide member to provide said guide structure of varying cross-sectional area, a longitudinally movable bar extending substantially the length of said wave guide and parallel to the longitudinal axis of the wave guide, said relatively movable guide member being mounted for movement on said stationary guide member in a direction perpendicular to the longitudinal axis of the guide, said bar member being pivotally attached to said relatively movable guide member, an adjustable supporting member on said stationary guide member, a pivotal connection between said bar and said adjustable supporting member, a bridge member releasably secured to said stationary guide member, crank means adjustably positioned on said bridge member, and means mounting said movable guide member on said crank means for movement thereon.

8. In a variable wave guide structure adapted to propagate ultra-high frequency energy and arranged to feed a plurality of spaced dipoles, said spaced dipoles having at least a portion thereof extending into said wave guide to serve as pickup probes for energy propagated as radiation within said wave guide structure, the internal cross-section of said guide structure being variable to alter the apparent wave length of said radiation to thereby change the relative phase at which the dipoles are fed to produce a change in direction of the total energy radiated from all of the dipoles, a relatively stationary wave guide member, at least a pair of spaced supporting members on said stationary guide member, a bridge structure releasably mounted on said spaced supporting members, an adjustably positioned element mounted on said bridge structure, a relatively movable cooperating wave guide section movably mounted on said adjustably positioned element to provide said variable wave guide, a relatively movable cooperating wave guide sec-

tion; movably mounted on said bridge structure, said bridge structure being adjustable in a first direction, a longitudinal movable bar member extending substantially parallel to the direction of said wave guide, means arranged to guide said movable wave guide section in a direction perpendicular to the direction of said wave guide, a pivoted link-connected bar to said movable wave guide section, a support on said stationary wave guide section adjustable in a direction perpendicular to said first direction, and said bar member being pivotally mounted on said adjustable support.

9. In a variable wave guide structure adapted to propagate ultra-high frequency energy and arranged to feed a plurality of spaced dipoles, said spaced dipoles having at least a portion thereof extending into said wave guide to serve as pickup probes for energy propagated as radiation within said wave guide structure, the internal cross-section of said guide structure being variable to alter the apparent wave length of said radiation to thereby change the relative phase at which the dipoles are fed to produce a change in direction of the total energy radiated from all of the dipoles, said wave guide structure comprising: a relatively stationary wave guide section, and a cooperating relatively movable wave guide section, means arranged to guide the movement of said movable section in a direction substantially perpendicular to the longitudinal axis of said wave guide, a plurality of independently adjustable supporting members mounted on said relatively stationary wave guide member and along its length, a longitudinally movable bar member movably substantially parallel to the longitudinal axis of said wave guide, link means connecting said bar to said movable wave guide section and to said adjustable supporting members, a plurality of bridge members releasably supported at their ends with respect to said stationary wave guide section, adjustably positioned elements mounted on each of said bridge members and adapted to at least partially support said movable wave guide section for movement thereon.

10. The invention defined in claim 9, characterized by the fact that said plurality of bridge members are releasably mounted and are adjustable in position.

11. In a variable wave guide structure adapted to propagate ultra-high frequency energy and arranged to feed a plurality of spaced dipoles, said spaced dipoles having at least a portion thereof extending into said wave guide to serve as pickup probes for energy propagated as radiation within said wave guide structure, the internal cross-section of said guide structure being variable to alter the apparent wave length of said radiation to thereby change the relative phase at which the dipoles are fed to produce a change in direction of the total energy radiated from all of the dipoles, said wave guide structure comprising: a relatively stationary guide member, a relatively movable wave guide member cooperatively associated with said stationary guide member to provide a wave guide with a variable rectangular cross-sectional area, each of said wave guide members having cooperating L-shaped portions with an end of a leg of one portion spaced from the adjacent leg of the other cooperating portion by a distance termed the "b" clearance, a supporting member releasably secured to said stationary wave guide member, an adjustably positioned element mounted on said supporting member, means mounting said mov-

able wave guide member for movement on said adjustably positioned element whereby said "b" clearance is adjusted in accordance with the position of said adjustably positioned element.

12. In a variable wave guide structure adapted to propagate ultra-high frequency energy, an elongated member forming a relatively stationary portion of said wave guide structure, the internal cross-section of said wave guide being variable to alter the apparent wave length of radiation propagated therein, said elongated member having pairs of support surfaces spaced transversely thereof, a plurality of bridge structures releasably mounted on corresponding pairs of said support surfaces, a movable wave guide member cooperatively associated with said first wave guide member to form therewith the internal space of the wave guide within which said radiation is propagated, an adjustably positioned crank member on said bridge member, and said movable wave guide member being mounted for movement on said crank member.

13. In a variable wave guide structure adapted to propagate ultra-high frequency energy, the internal cross-section of said wave guide structure being variable to alter the apparent wave length of the ultra-high frequency energy propagated therein, said wave guide structure including an elongated member having a pair of internally formed flanges on opposite walls thereof extending substantially parallel in the longitudinal direction of said elongated member, a movable wave guide section cooperatively associated with said elongated member to form a variable cross-section wave guide, a bridge structure releasably and adjustably mounted on said flanges, a crank member adjustably positioned on said bridge structure, said movable wave guide section being mounted for movement on said crank member, at least a portion of one of said flanges being supported as a cantilever on said elongated member, said movable wave guide section being supported on the free end of said cantilever, and means disposed between the free end of said cantilever and said elongated member to adjust the position of said cantilever with respect to said elongated member to thereby adjust the position of said movable wave guide section and the cross-sectional area of said wave guide.

14. In a variable wave guide structure adapted to propagate ultra-high frequency energy as radiation, the internal cross-section of said guide structure being variable to alter the apparent wave length of said radiation, said variable wave guide structure comprising: a relatively stationary elongated wave guide member, said stationary wave guide member having cantilever supporting members at different sections along its length, the free ends of said cantilever supporting members being movable to adjusted positions with respect to said stationary wave guide member, a movable wave guide member associated with respect to the first-mentioned stationary wave guide member to form said variable wave guide structure, said movable wave guide member being supported on said cantilever supporting members, and means for adjusting and maintaining in adjusted position said free ends of said cantilever supporting members to thereby adjustably position said movable wave guide member with respect to said stationary wave guide member to align said movable guide member with respect to the stationary guide member, a bridge member having opposite ends

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thereof releasably secured to said relatively stationary guide member, a crank member adjustably positioned on said bridge member, and said movable guide member being mounted for movement on said crank member.

15. In a variable wave guide structure adapted to propagate high frequency energy as radiation, the internal cross-section of said guide structure being variable to alter the apparent wave length of said radiation, said wave guide structure comprising: a relatively stationary guide member, a relatively movable wave guide member cooperatively associated with said stationary guide member to provide a wave guide with a variable rectangular cross-sectional area, each of said wave guide members having cooperative L-shaped portions with an end of a leg of one portion spaced from the adjacent leg of the other cooperating portion by a distance termed the "b" clearance, a supporting member releasably secured to said stationary wave guide member, an adjustably positioned element mounted on said

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supporting member, means mounting said movable wave guide member for movement on said adjustably positioned element whereby said "b" clearance is adjusted in accordance with the position of said adjustably positioned element.

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