May 13, 1952 K. A. ALLEBACH 2,596,113

BRIDGE-TYPE PRECISION ANTENNA STRUCTURE

Filed Sept. 18, 1948 5 Sheets-Sheet 1

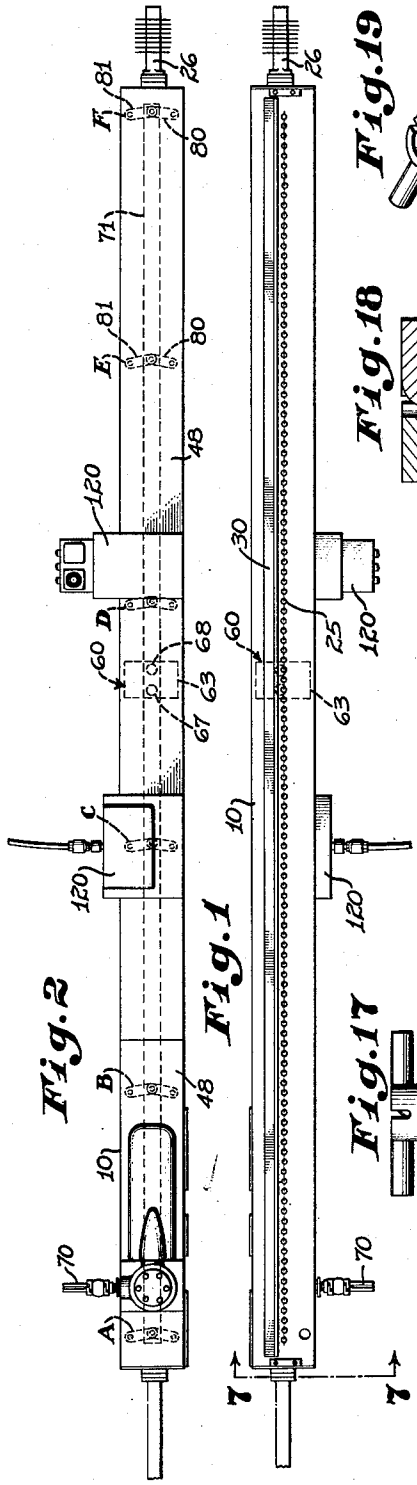


Fig. 1

Fig. 2

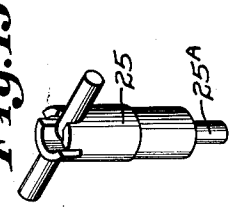


Fig. 19

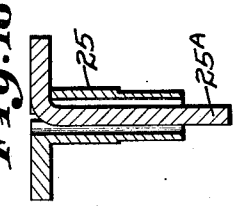


Fig. 18

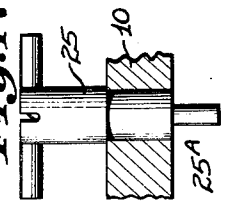


Fig. 17

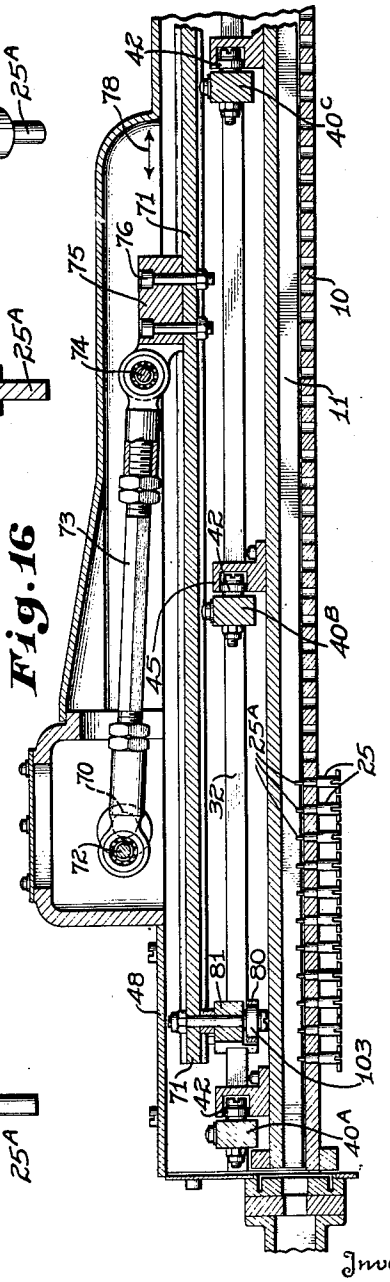


Fig. 16

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BRIDGE-TYPE PRECISION ANTENNA STRUCTURE

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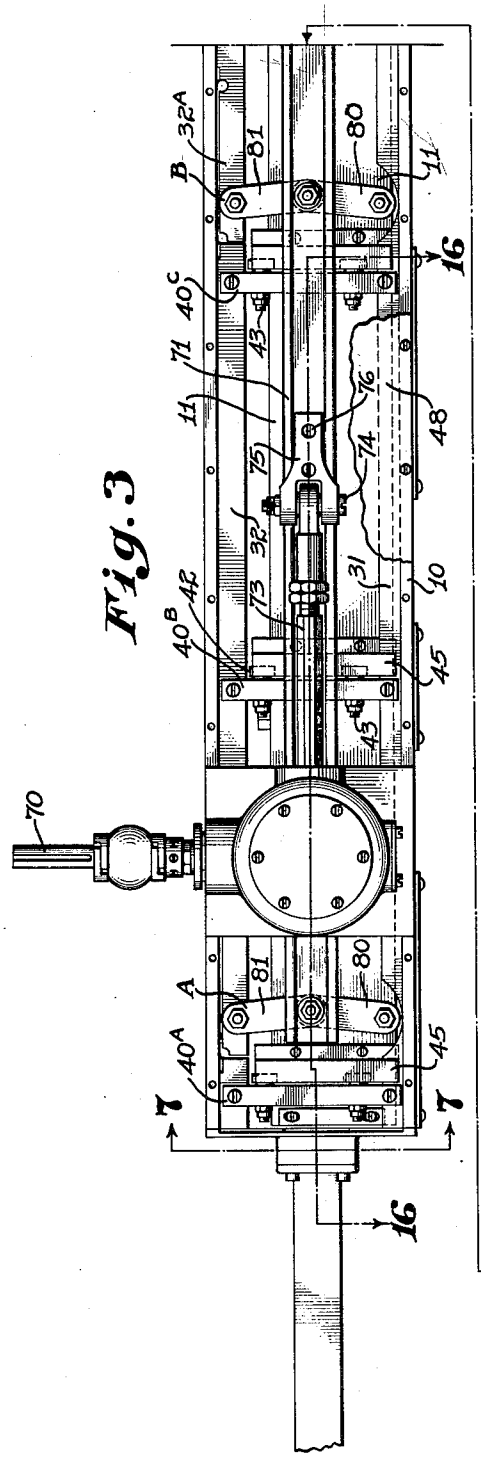


Fig. 3

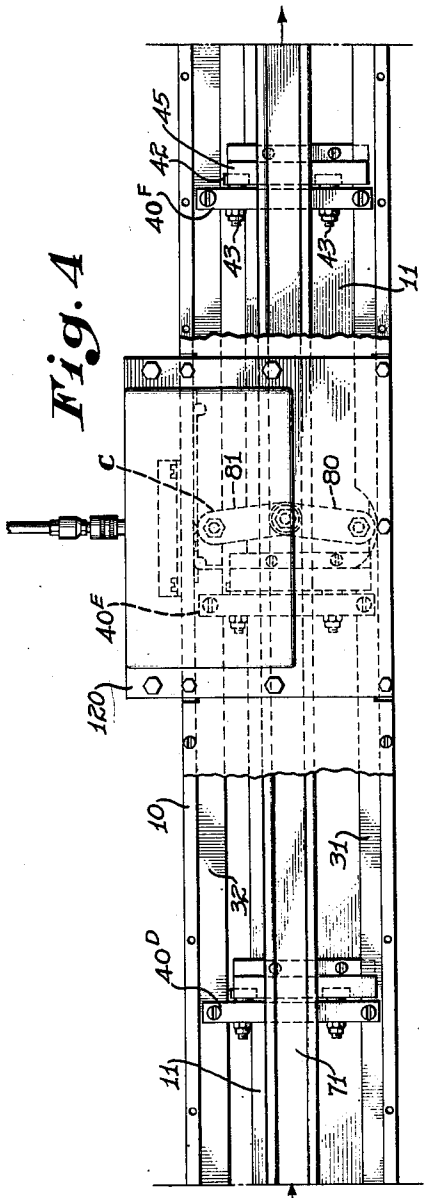


Fig. 4

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BRIDGE-TYPE PRECISION ANTENNA STRUCTURE

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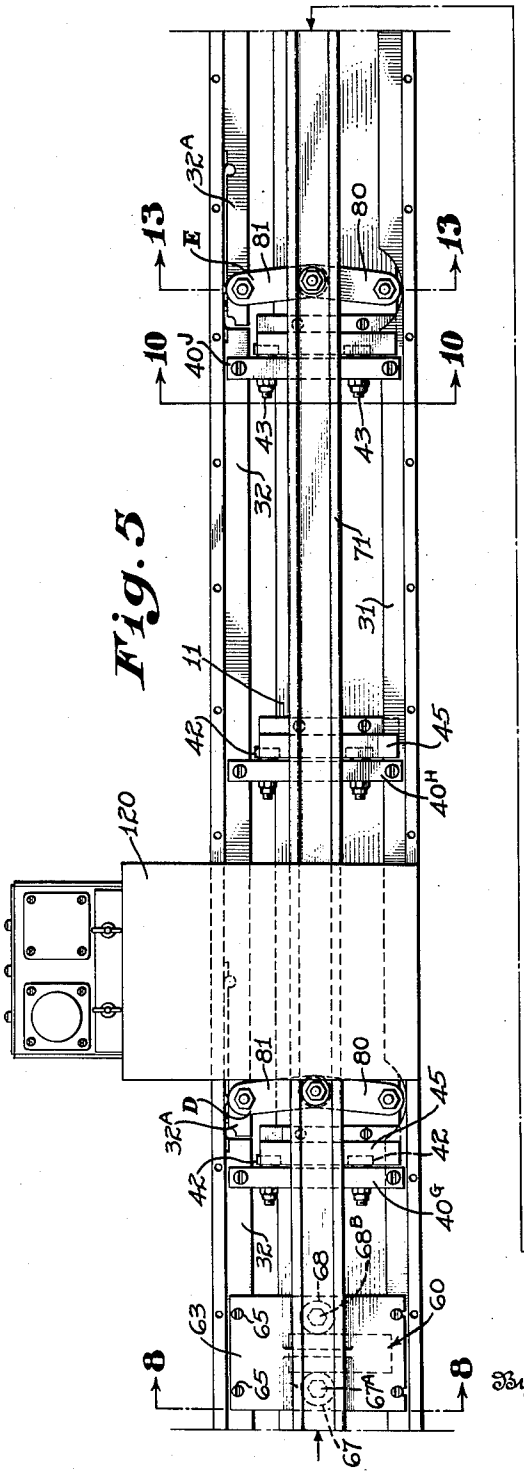


Fig. 5

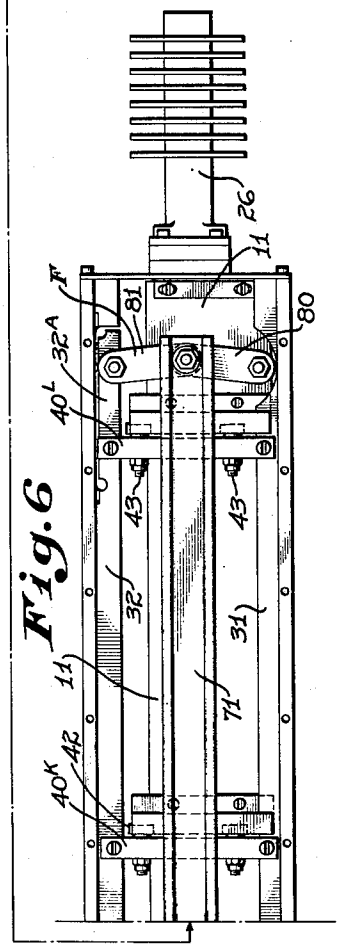


Fig. 6

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BRIDGE-TYPE PRECISION ANTENNA STRUCTURE

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Fig. 7

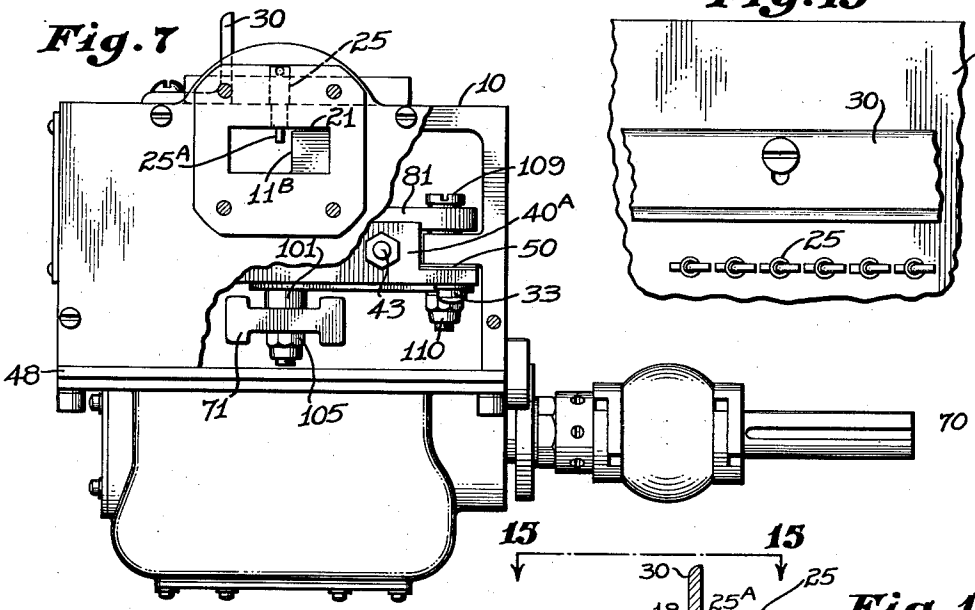


Fig. 15

Fig. 10

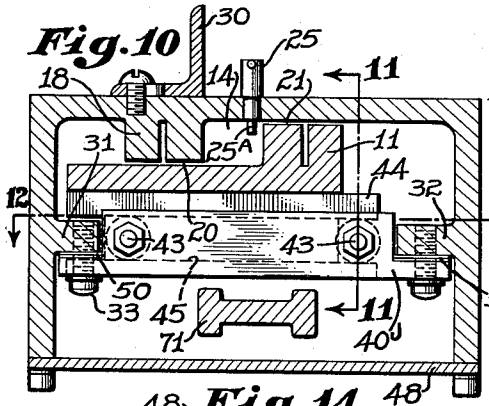


Fig. 13

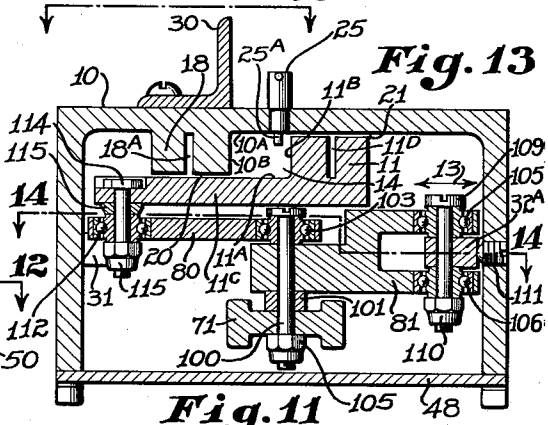


Fig. 14

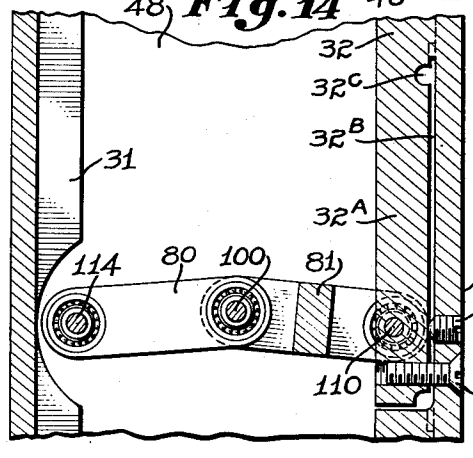
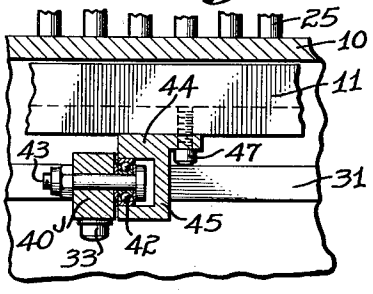


Fig. 11



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May 13, 1952 K. A. ALLEBACH 2,596,113

BRIDGE-TYPE PRECISION ANTENNA STRUCTURE

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Fig. 9

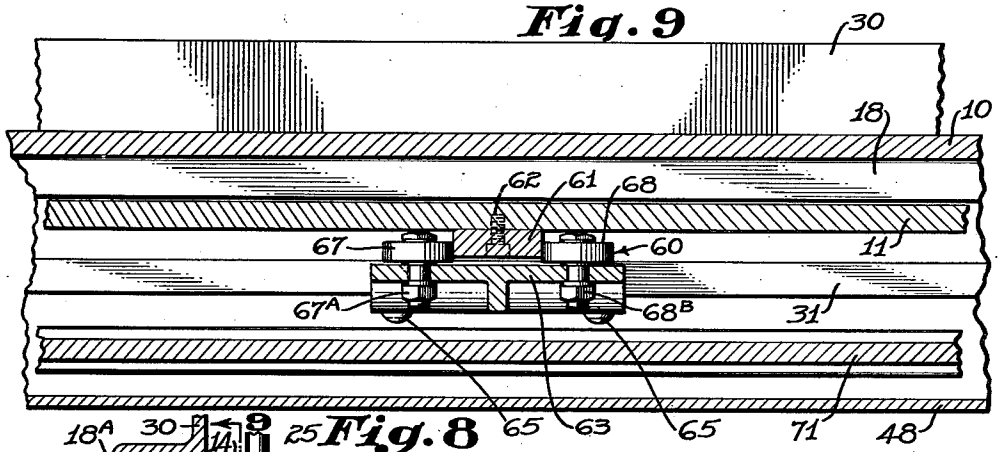


Fig. 8

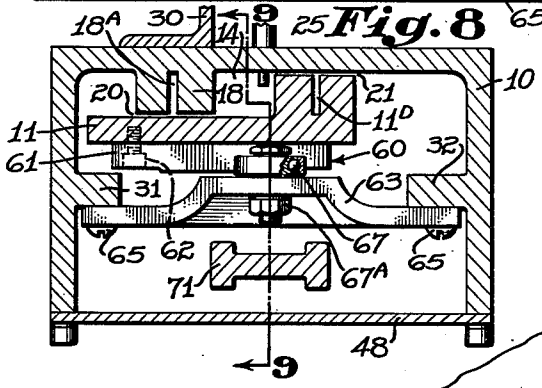


Fig. 21

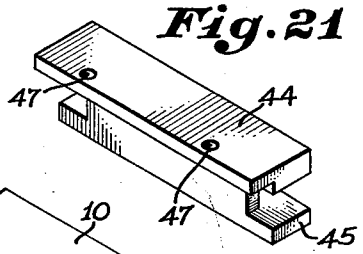


Fig. 20

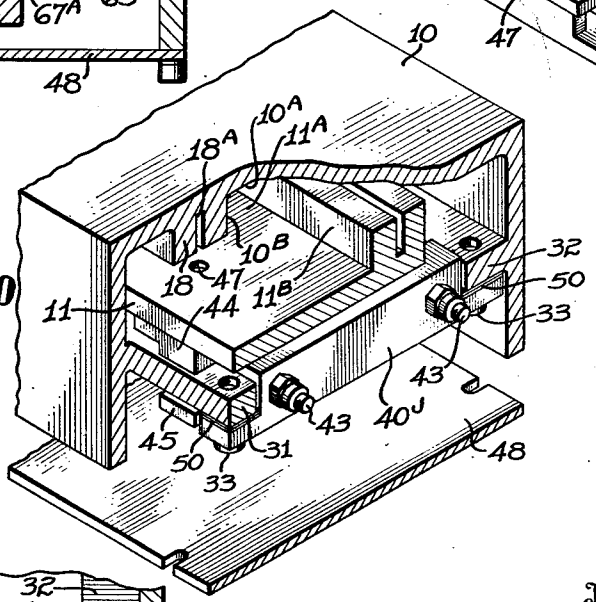
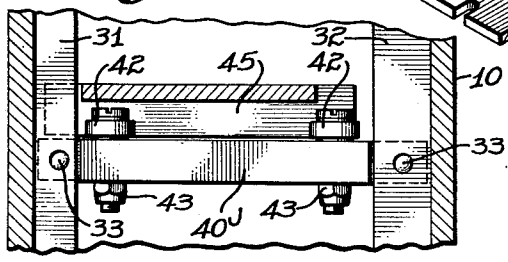


Fig. 12



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Patented May 13, 1952

2,596,113

UNITED STATES PATENT OFFICE

2,596,113

BRIDGE-TYPE PRECISION ANTENNA STRUCTURE

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Application September 18, 1948, Serial No. 49,910

19 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).

Variable cross section wave guides have previously been used to feed a plurality of dipoles in an array. Such prior art wave guides were relatively difficult and expensive to manufacture and to assemble and to maintain in use.

It is, therefore, an object of the present invention to provide an improved wave guide which is relatively easy to manufacture and assemble and to maintain in working condition.

Another object of the present invention is to provide an improved wave guide characterized by the fact that various portions of the guide may be adjusted independently of other portions whereby the wave guide may be adjusted for uniform dimensions throughout its length or for achievement of desired radiation characteristics.

Another object of the present invention is to provide an improved variable cross section wave guide in which the wearing surfaces are readily accessible and interchangeable whereby the wave guide may be conveniently serviced while in use in the field.

Still another object of the present invention is to provide an improved variable cross section wave guide having one movable element thereof adjustable in two directions at different regions along its length whereby the cross section may be adjusted to be uniform throughout its entire length.

Yet another object of the present invention is to provide an improved variable cross section wave guide characterized by the fact that the movable element thereof is movably mounted on a conveniently accessible bridge element.

Still another important 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 be adjusted.

Yet another important object of the present invention is to provide an improved variable cross section wave guide with the movable wave guide member supported on a bridge structure and associated tracks and bearings characterized by the fact that the bridges may be easily removed and the bearings and/or tracks may be replaced or cleaned independently of one another.

Yet another important object of the present invention is to provide an improved variable cross section wave guide comprising a movable wave

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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.

Still a further object of the present invention is to provide an improved wave guide, the interior of which, by disassembling, may be conveniently inspected and cleaned, as the occasion arises, and then reassembled without disturbing the initial adjustment of the critical dimensions in the wave guide.

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 connection with the accompanying drawings in which:

Figure 1 is a plan view of a variable cross section wave guide arranged to feed a plurality of dipoles embodying the features of the present invention.

Figure 2 is a view in elevation showing the other side of the wave guide shown in Figure 1.

Figures 3, 4, 5 and 6 taken collectively show progressive sections of the wave guide of Figure 2 in enlarged form, the individual sections in Figures 3, 4, 5 and 6 being formed together in that order as indicated by the arrows.

Figure 7 is a view in side elevation taken in the direction indicated by the arrow 7—7 in Figures 1 and 3.

Figure 8 is a sectional view taken on the line 8—8 of Figure 5.

Figure 9 is a sectional view taken substantially on the line 9—9 of Figure 8.

Figure 10 is a sectional view taken substantially on the line 10—10 of Figure 5.

Figure 11 is a sectional view taken substantially on the line 11—11 of Figure 10.

Figure 12 is a sectional view taken substantially on the line 12—12 of Figure 10.

Figure 13 is a sectional view taken substantially on the line 13—13 of Figure 5.

Figure 14 is a sectional view taken substantially on the line 14—14 of Figure 13.

Figure 15 is a view taken in the direction indi-

cated by the arrows 15—15 in Figure 13 of a portion of the antenna structure.

Figure 16 is a sectional view taken substantially on the line 16—16 of Figure 3.

Figure 17 is a view in elevation of one of the dipoles showing the manner in which it is mounted on the wave guide.

Figures 18 and 19 are respectively a sectional view and a perspective view of the dipole shown in Figure 17.

Figure 20 is a perspective view of the end of the wave guide structure partly fragmented.

Figure 21 is a perspective view of one of the hardened surfaces supporting members attached to the movable guide section.

The 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 13 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 13, 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 to assure the same cross sectional area 14 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 13, 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 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.

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 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 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 radiated combined 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 member 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 .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 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 (Figure 6) to prevent the formation of high standing waves due to reflection which would result in producing side lobes. The absorber unit 26 may contain a mixture of graphite and sand and may be equipped with external heat radiating fins. This absorber unit 26 is, of course, 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, 40B, 40C, 40D, 40E, 40F, 40G, 40H, 40J, 40K, and 40L or any other number of such members as required and at equal spaced positions along the wave guide. These bridge members 40A–40L are each of the same construction and, as shown in Figures 10, 12, and 20, are releasably mounted by bolts 33 on opposite inner flange members 31, 32. These bridge members rotatably support a pair of ball bearing members 42 on corresponding axles 43. 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 48 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.

Shims 50' of different thicknesses may be interposed between such individual bridge mem-

bers 40A–40L and their supporting bridge flanges 31, 32 to adjust the wave guide clearances 20, 21 at the respective sections at which such bridge members are located.

In order to assure movement of the wave guide 11 only in the direction indicated by the arrows 13 (Figure 13) a centrally disposed guide bearing 60 (Figures 8 and 9) is provided.

The constructional features of this guide bearing 60 are more clearly shown in Figures 1, 8 and 9. Such guide bearing 60 comprises a rectangular guide block 61 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 61. This guide block 61 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 bearing 60 comprising essentially the elements 61, 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 13 upon rotation of the motor driven shaft 70 in Figures 2, 3 and 16, the rotary movement of shaft 70 being converted into movement of the bar 71. The assembly shown in Figure 16 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 crankshaft 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 16. 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 in Figures 3, 4, 5, 6 and 13, or at as many stations as 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 13. 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 111 for purposes of adjusting the internal dimensions 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 115 clamped therebetween. It is thus apparent that the movable wave 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 throughout the length of the wave guide. Such adjustments of the extension 32A, accomplished by adjustment of the set screws 111 and locking screw 32D, is in a direction perpendicular to the direction in which the clearances 20, 21 are adjusted by providing shims 50 (Figure 10). These clearances 20, 21 are referred to herein as the B-clearances and are the spacing between cooperating L-shaped portions of the guide members 10, 11, 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 clearance 20, 21.

The adjustably positioned extensions 32A, as perhaps best seen in Figure 14, is formed by slitting such flange at 32B and decreasing its cross section at 32C to allow easy movement of its free end and by the set screw 111. In order to avoid vibration of the extension 32A and to hold its adjustment a locking screw 32D is provided to urge such extension 32A against the set screw 111. 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 81 are rotated about an adjustable axis corresponding to the axis of bolts 109 (Figure 13) 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 60 (Figures 2, 5 and 9).

In conventional manner, conventional angle coupling and capacitor and blanker switch units 120 (Figures 1 and 2) may be associated with the movable wave guide member 11 to provide synchronization of cathode ray beam sweeps and 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, and said movable wave guide member being mounted for movement on said bridge structure.

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 releasably and adjustably mounted on said flanges, said movable wave guide section being mounted for movement on said bridge structure, at least a portion of one of said flanges being supported as a centilever 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 with said wave guide structure 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 said dipoles, said wave guide structure comprising: a relatively stationary wave guide member, a relatively movable wave guide member cooperating with said relatively stationary wave guide member to form a substantially rectangular internal cross-sectional area of said wave guide, means adjustably supporting said movable wave guide member for adjusted movement along one axis of said rectangular area, and means independent of the last mentioned means for adjustably supporting said movable wave guide member in adjusted positions along the other axis of said rectangular area.

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 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 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 wave guide member with respect to the stationary wave 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, a relatively movable wave guide member cooperatively associated with said stationary wave guide member to form therewith a variable cross-sectional wave guide, the cross-section of said wave guide being rectangular, said rectangular cross-sectional area being defined by cooperating L-shaped portions of said stationary and movable guide members with an end of a leg of one portion spaced from the adjacent leg of the other portion a distance termed the B-clearance between said guide members, said stationary wave guide member having mounted thereon, spaced along its length, a plurality of cantilever supporting members, the free ends of said cantilever members being adjustable in position and supporting said movable guide member, means for moving the free ends of said cantilevers in a first direction corresponding to one of the axes of said rectangular area, said first direction being perpendicular to the direction in which said B-clearance is measured, means for adjusting and maintaining in adjusted position the free ends of said cantilever supporting members to thereby adjust the position of said movable guide member

with respect to said stationary guide member along said first direction, and means supporting said movable guide member on said stationary guide member for adjustment in a direction perpendicular to said first direction and corresponding to the other longitudinal axis of said rectangular cross-sectional area to adjust said B-clearance.

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 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 adjustable supporting elements mounted on said stationary guide member at points therealong, means for adjusting the position of said supporting members with respect to said stationary guide member, said movable guide member being movable on said supporting members, and cooperating wear-resistant surfaces disposed between said supporting members and said movable guide member.

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 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, and means supporting said movable guide member on said bridge member 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, 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, and means mounting said movable wave guide on said bridge member for movement thereon.

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 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, and means mounting said movable guide member on said bridge member for movement thereon.

10. 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, a relatively movable cooperating wave guide section movably mounted on said bridge structure to provide said variable wave guide, a relatively movable cooperating wave guide section 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 guide section adjustable in a direction perpendicular to said first direc-

tion, and said bar member being pivotally mounted on said adjustable support.

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 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 movable 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 and adapted to at least partially support said movable wave guide section for movement thereon.

12. The invention defined in claim 11, characterized by the fact that said plurality of bridge members are releasably mounted and are adjustable in position.

13. 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, means mounting said movable wave guide member for movement on said supporting member, and means for adjusting the position of the supporting member to adjust said B-clearance.

14. 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, and said movable wave guide member being mounted for movement on said bridge structure.

15. 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, said movable wave guide section being mounted for movement on said bridge structure, 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 dispose 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.

16. In a variable wave guide structure adapted to propagate high frequency energy as radiation, the internal cross-section of said wave guide structure being variable to alter the apparent wave length of such radiation, said wave guide structure comprising: a relatively stationary wave guide member, a relatively movable wave guide member cooperating with said relatively stationary wave guide member to form a substantially rectangular internal cross-sectional area of said wave guide, means adjustably supporting said movable wave guide member for adjustable movement along one axis of said rectangular area, and means independent of the last mentioned means for adjustably supporting said movable wave guide member in adjusted positions along the other axis of said rectangular area.

17. 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.

18. 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 wave guide structure comprising: a relatively stationary wave guide member, a relatively movable wave guide member cooperatively associated with said stationary wave guide member to form therewith a variable cross-sectional wave guide, the cross-section of said wave guide being rectangular, said rectangular cross-sectional area being defined by cooperating L-shaped portions of said stationary and movable guide members with an end of a leg of one portion spaced from the adjacent leg of the other portion a distance termed the B-clearance between said guide members, said stationary wave guide member having mounted thereon, spaced along its length, a plurality of cantilever supporting members, the free ends of said cantilever members being adjustable in position and supporting said movable guide member, means for moving the free ends of said cantilevers in a first direction corresponding to one of the axes of said rectangular area, said first direction being perpendicular to the direction in which said B-clearance is measured, means for adjusting and maintaining in adjusted position the free ends of said cantilever supporting members to thereby adjust the position of said movable guide member with respect to said stationary guide member along said first direction, and means supporting said movable guide member on said stationary guide member for adjustment in a direction perpendicular to said first direction and corresponding to the

other longitudinal axis of said rectangular cross-sectional area to adjust said B-clearance.

19. 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, means mounting said movable wave guide member for movement on said supporting member, and means for adjusting the position of the supporting member to adjust said B-clearance.

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