United States Patent [19]

Mörz

[11] **3,864,683**

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[54] **ARRANGEMENT FOR AN AUTOMATIC RESETTING SYSTEM FOR MICROWAVE ANTENNAS**

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[30] **Foreign Application Priority Data**

Mar. 17, 1972 Germany 2212996

[52] **U.S. Cl.** ...... **343/113 R,** 343/16 M, 343/117 R, 343/786

[51] **Int. Cl.** **G01s 3/14**

[58] **Field of Search** .... 343/786, 113 R, 117 R, 343/100 PE, 16 M

[56] **References Cited**

UNITED STATES PATENTS

2,931,033 3/1960 Miller .... 343/16 M

Primary Examiner—Maynard R. Wilbur
Assistant Examiner—Richard E. Berger
Attorney, Agent, or Firm—Spencer & Kaye

[57] **ABSTRACT**

An improved arrangement for an automatic direction finding system for resetting microwave antennas when signals are received from a moving transmitter wherein the higher waveguide wave modes produced in the azimuth plane and in the elevational plane are utilized as deviation information, whereby the advantages of mode couplers for square waveguides may be used with antenna exciter having a circular, octogonal or cross-shaped cross section. The arrangement includes a junction or transition section between an antenna exciter having one of the above mentioned cross section and a waveguide with a square cross section. A mode coupler, which is provided with a microwave network, is connected to the waveguide with a square cross section to separate the deviation information of the received signal from the useful signal and the H_{20}-H_{02} signal containing the deviation information is fed to a comparator network for further processing to provide resetting signals for the antenna.

10 Claims, 20 Drawing Figures

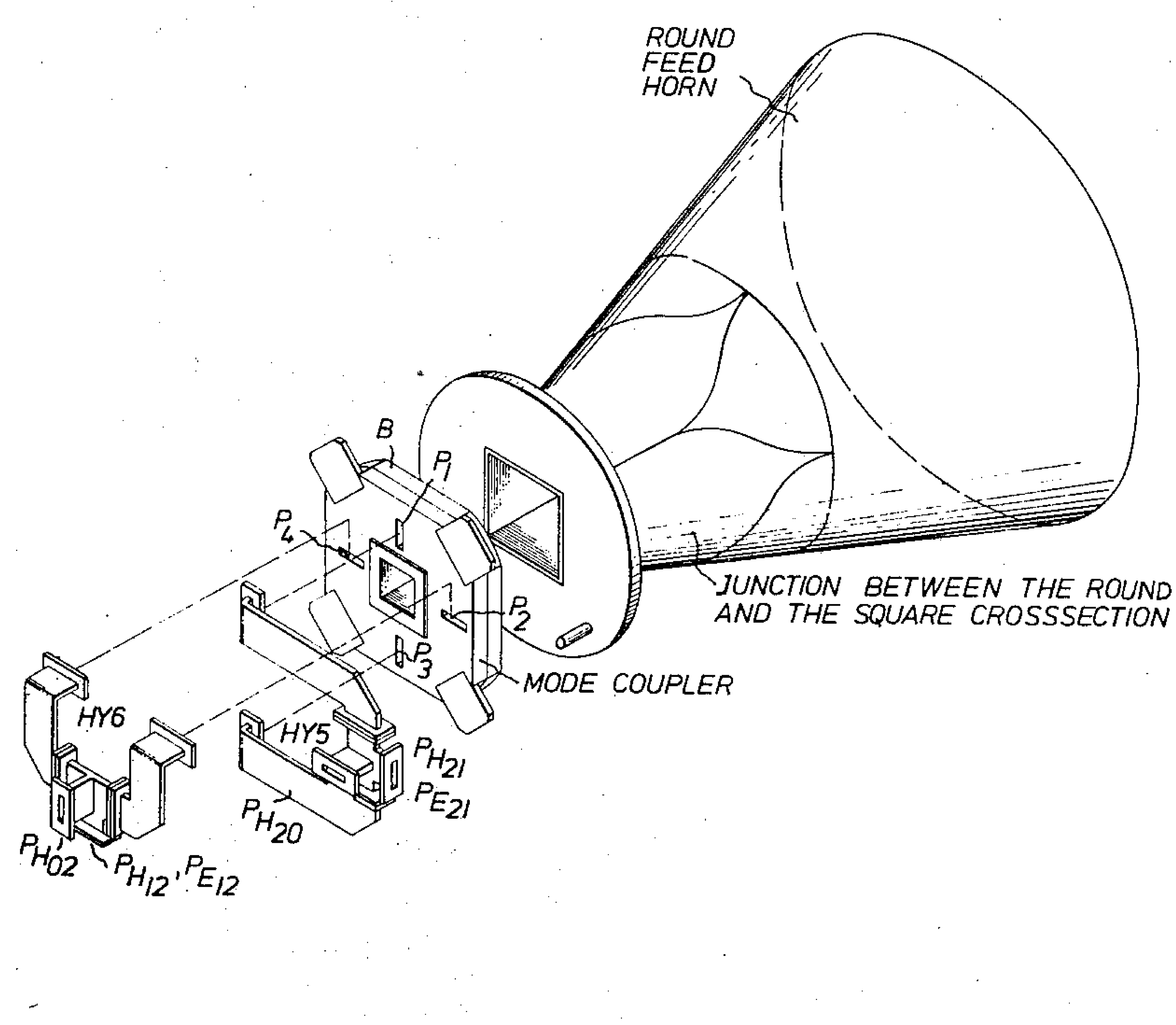


FIG.1a

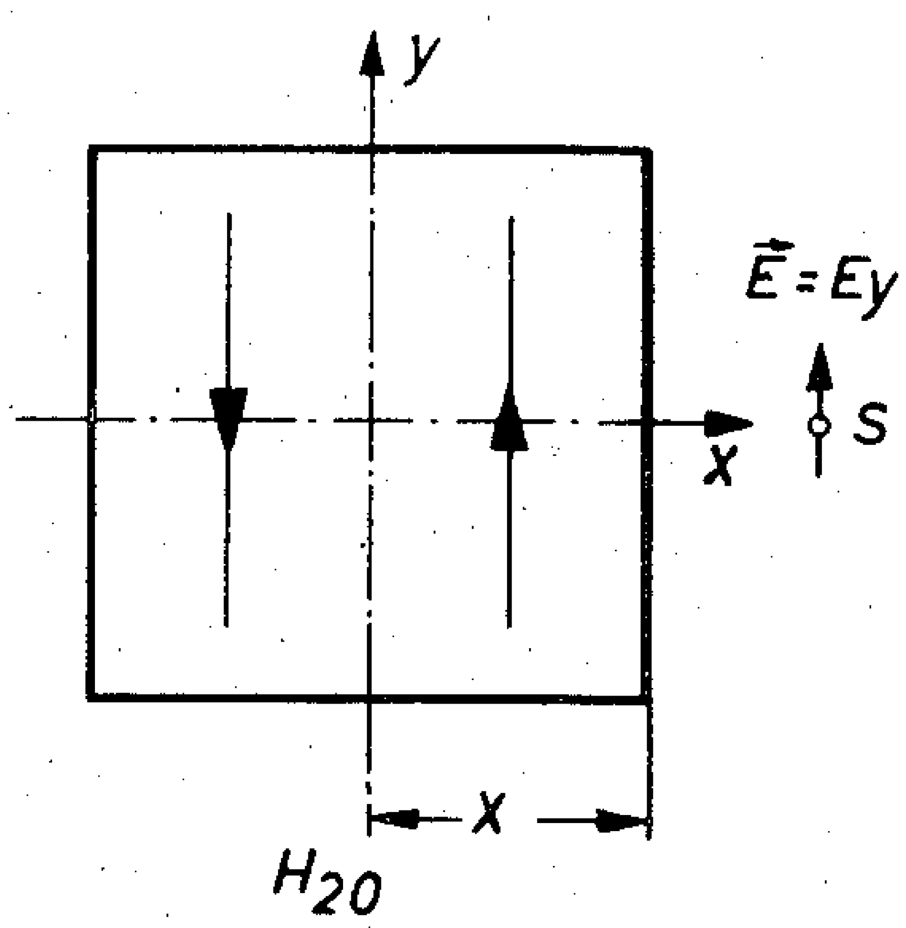


FIG.1b

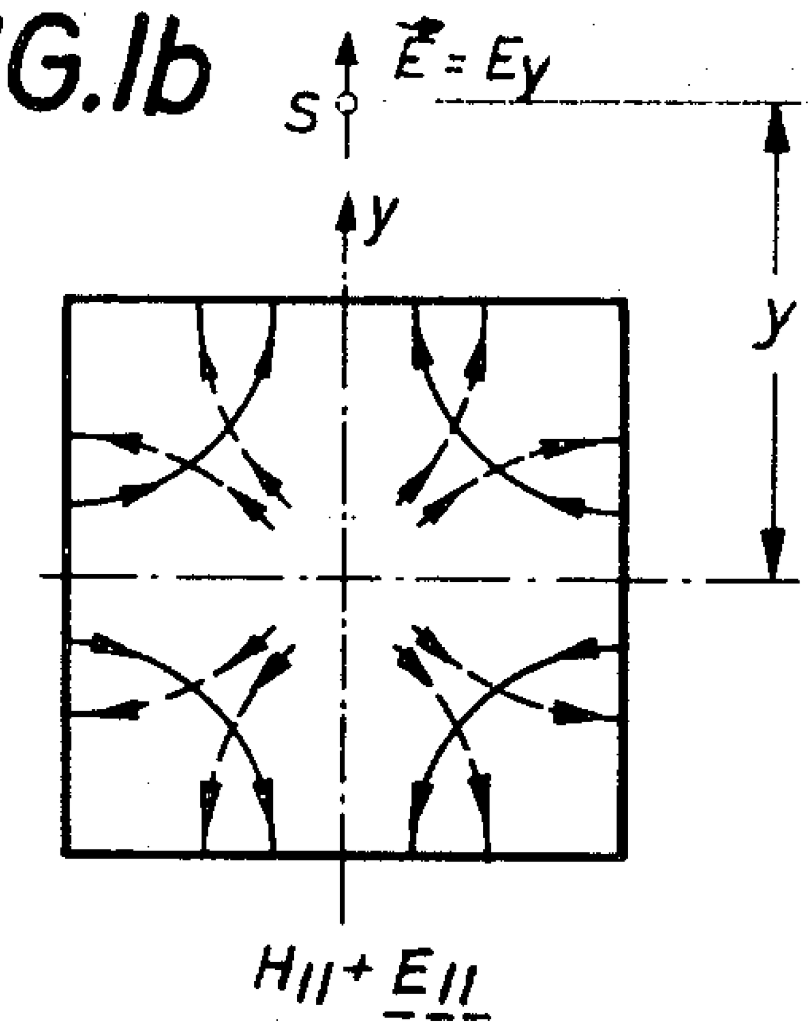


FIG.2a

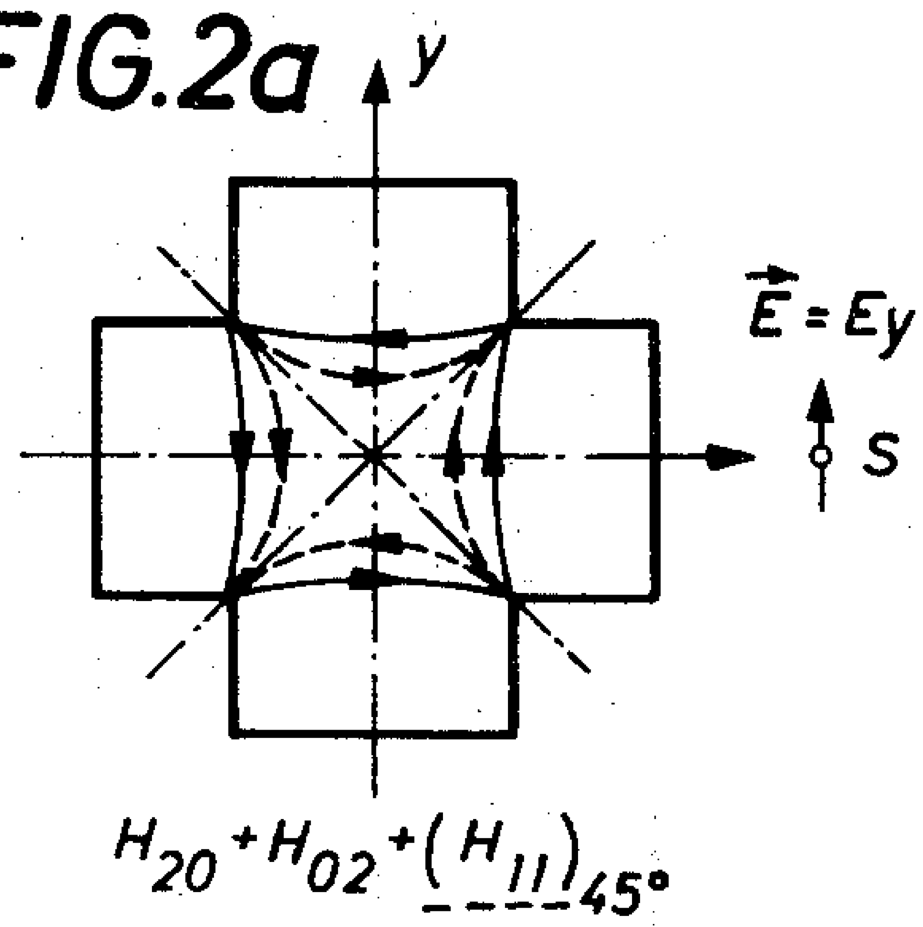


FIG.2b

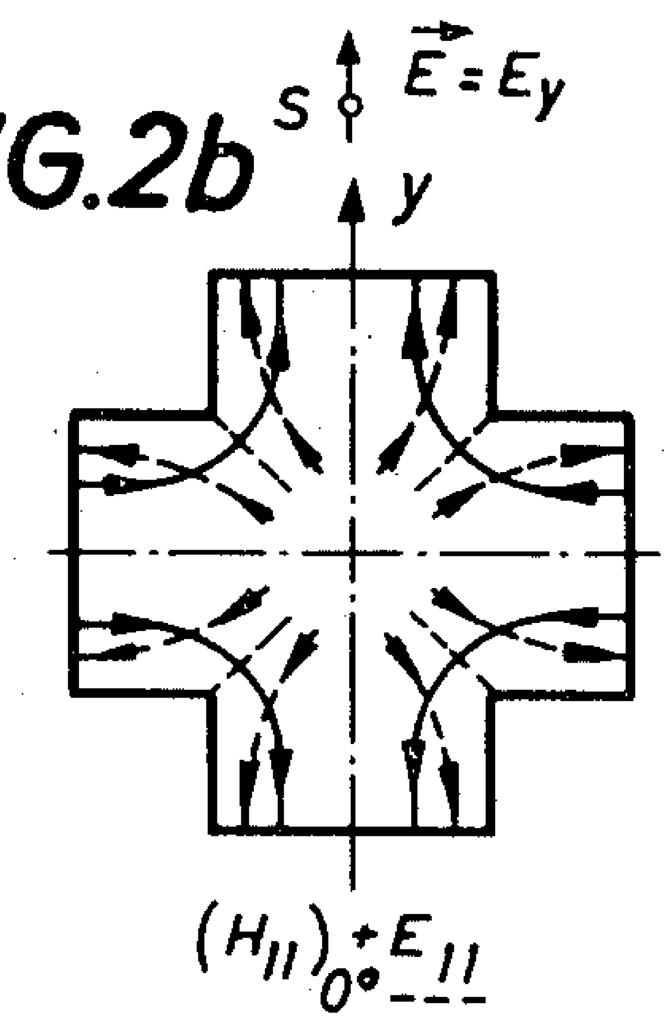


FIG.3a

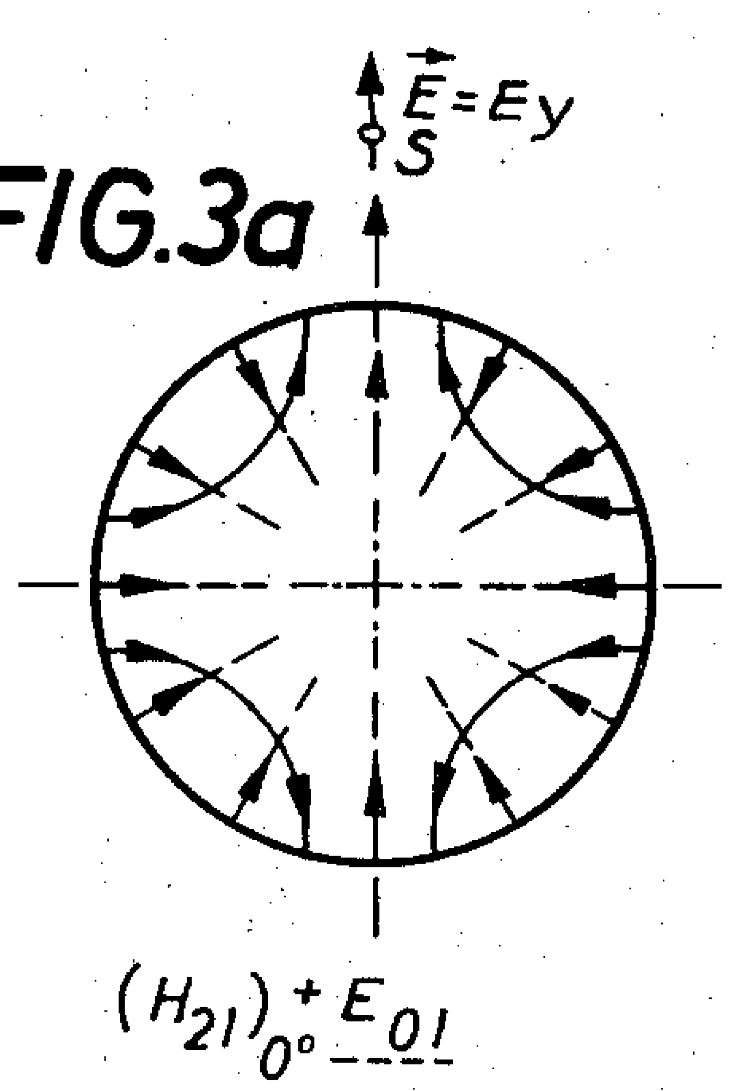
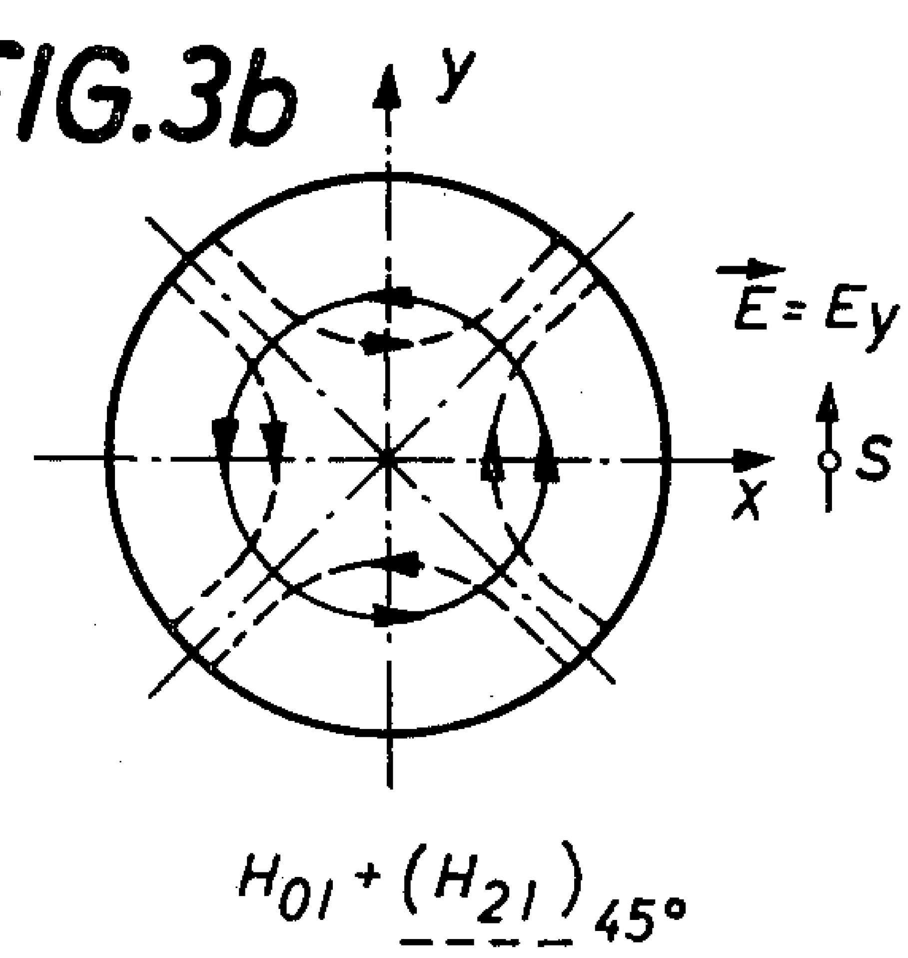


FIG.3b



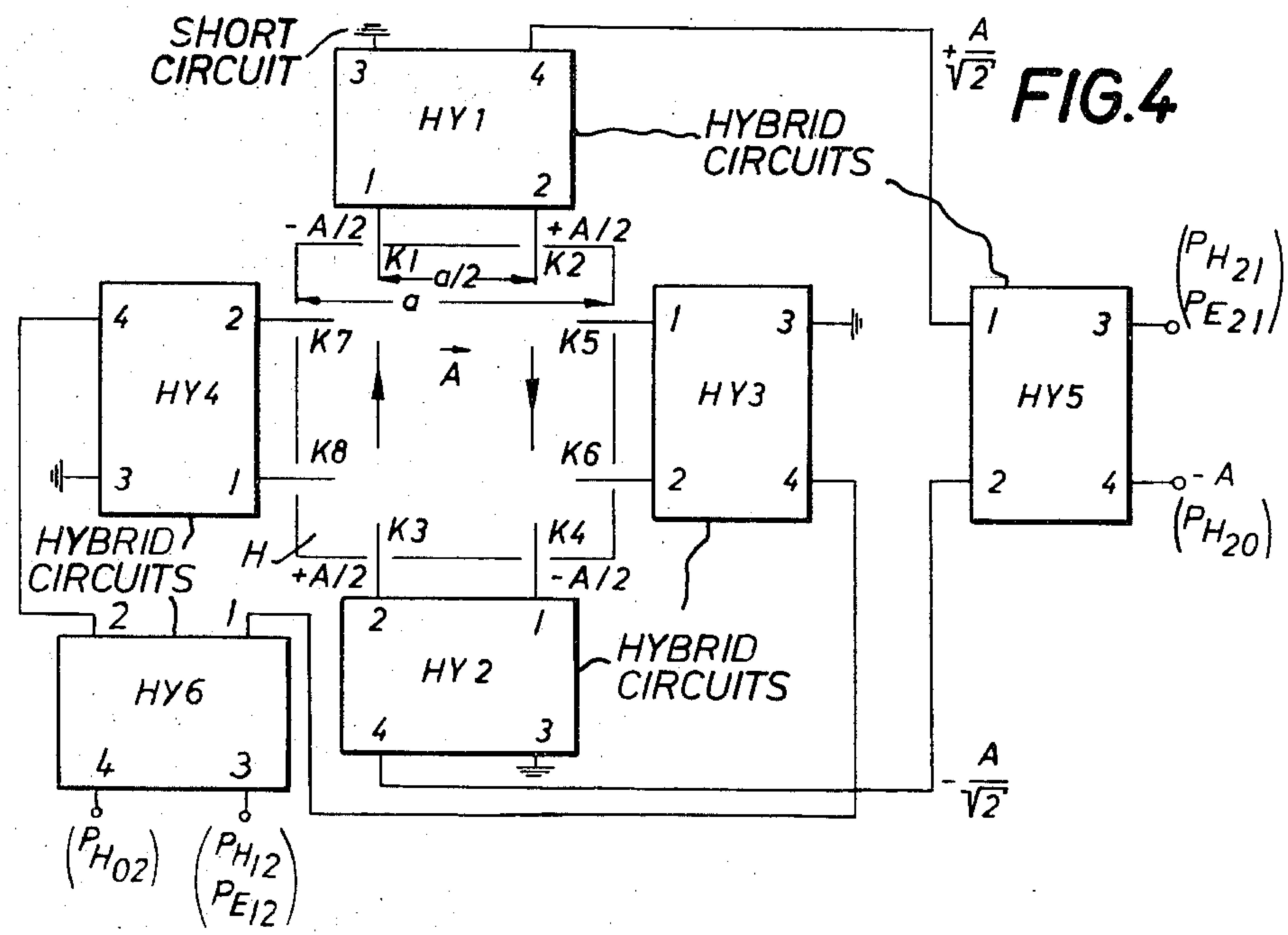

SHORT CIRCUIT
HY1
HY2
HY3
HY4
HY5
HY6
HYBRID CIRCUITS
HYBRID CIRCUITS
HYBRID CIRCUITS
HYBRID CIRCUITS
K1
K2
K3
K4
K5
K6
K7
K8
-A/2
+A/2
+A/2
-A/2
a/2
a
A
H
+A/√2
-A/√2
-A
(PH21 PE21)
(PH20)
(PH02)
(PH12 PE12)

FIG.4

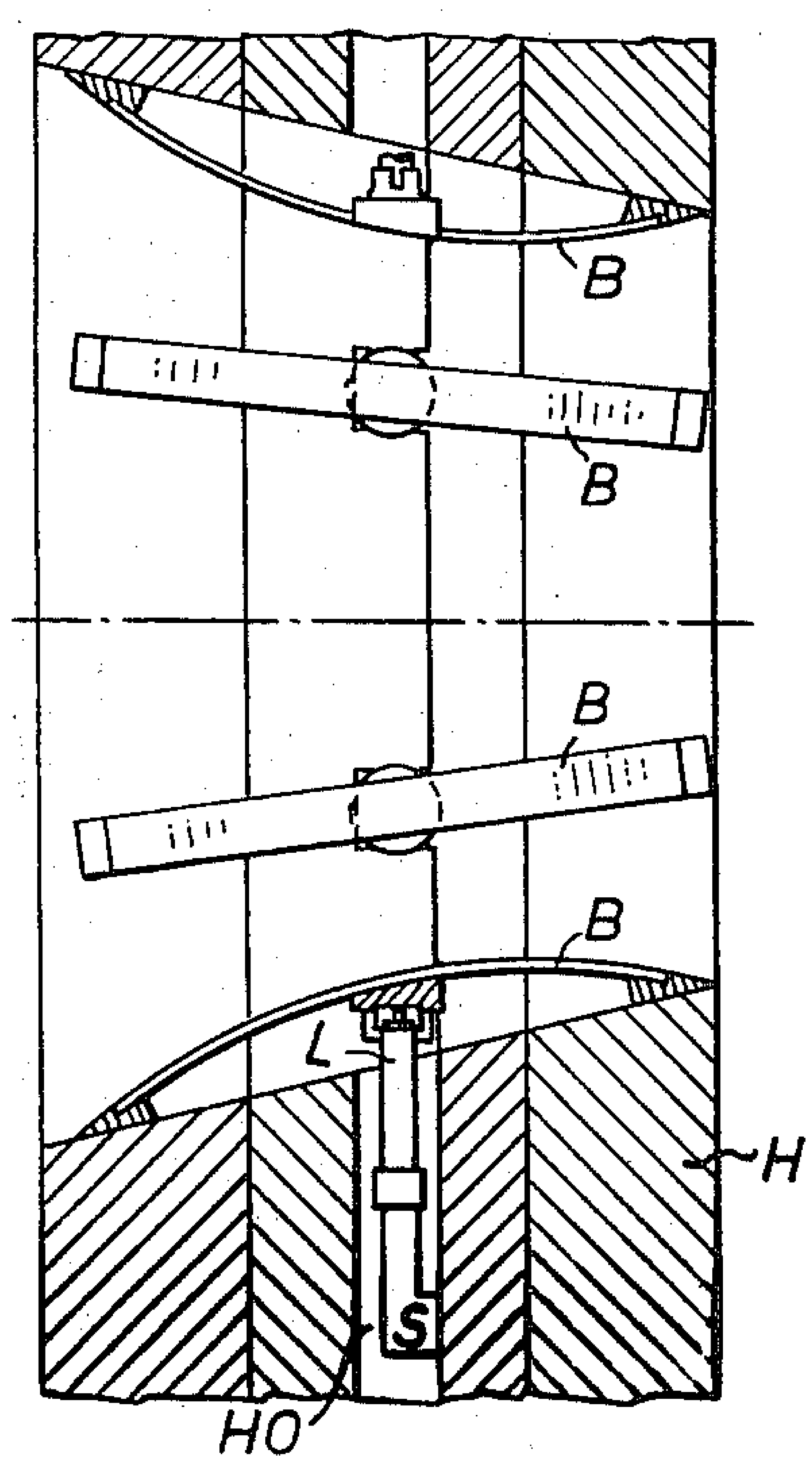

B
B
B
B
L
S
HO
H

FIG.5

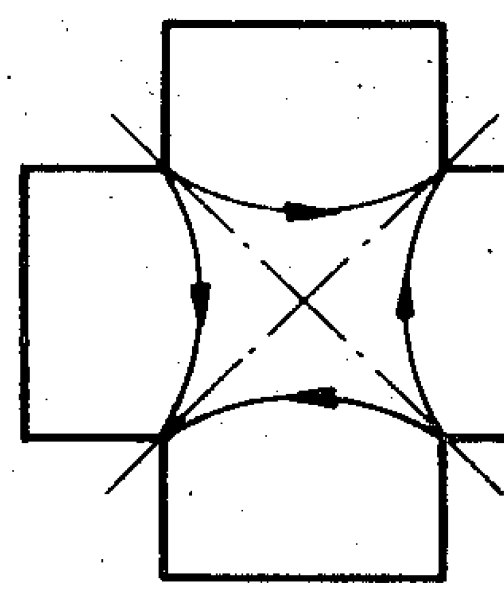


FIG.6a

$(H_{11})_{45°}$

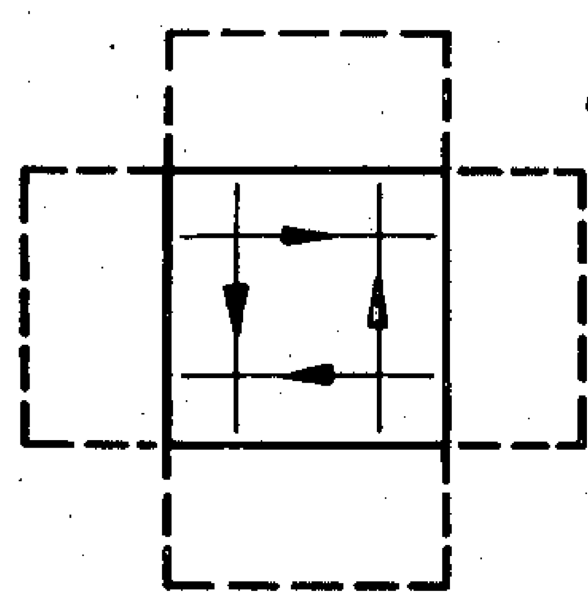


FIG.6b

$H_{20}+H_{02}$

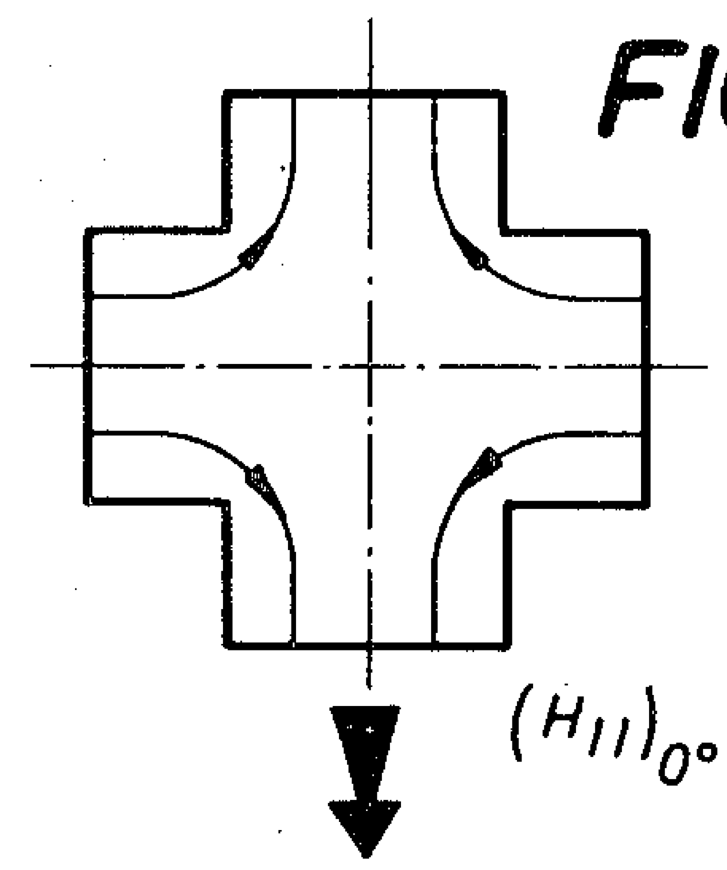


FIG.7a

$(H_{11})_{0°}$

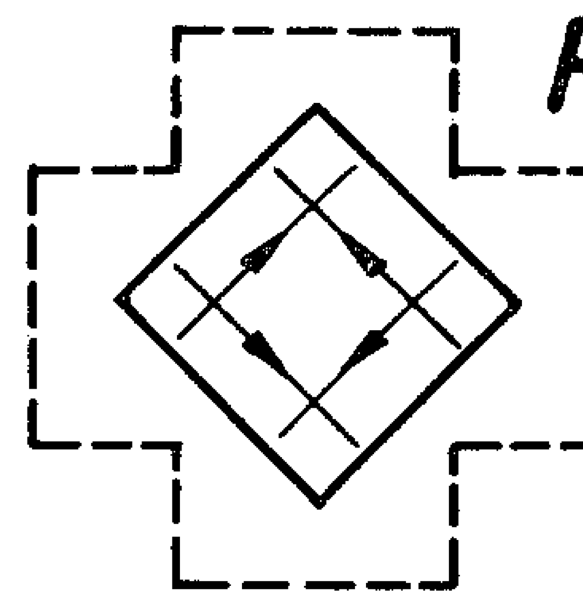


FIG.7b

$H_{20}+H_{02}$

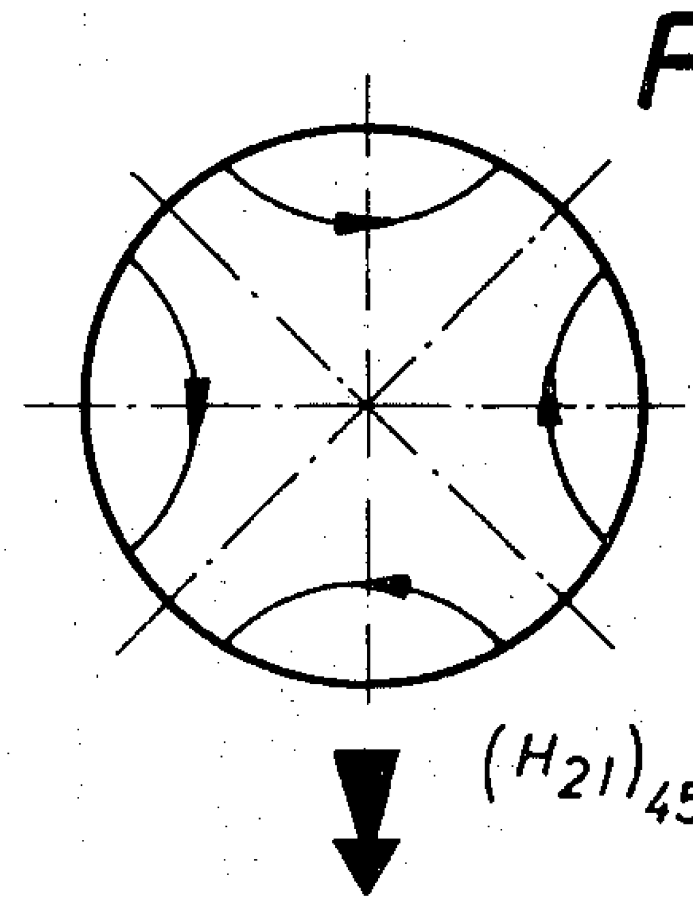


FIG.8a

$(H_{21})_{45°}$

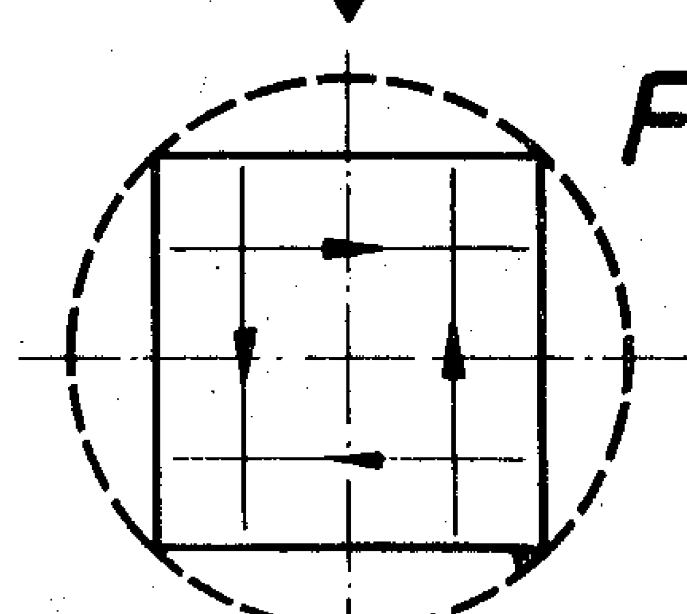


FIG.8b

$H_{20}+H_{02}$

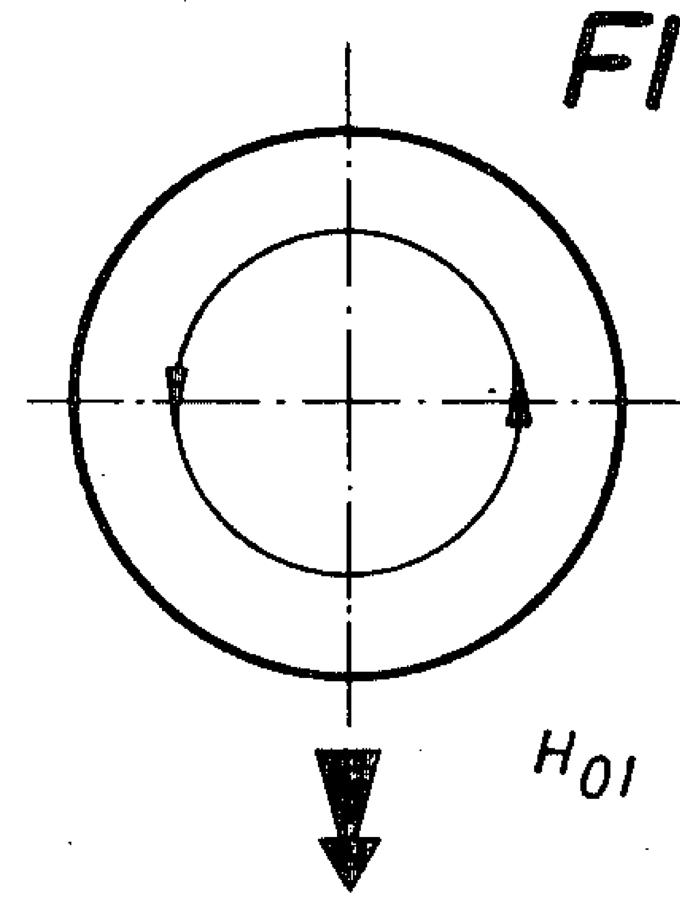


FIG.9a

H_{01}

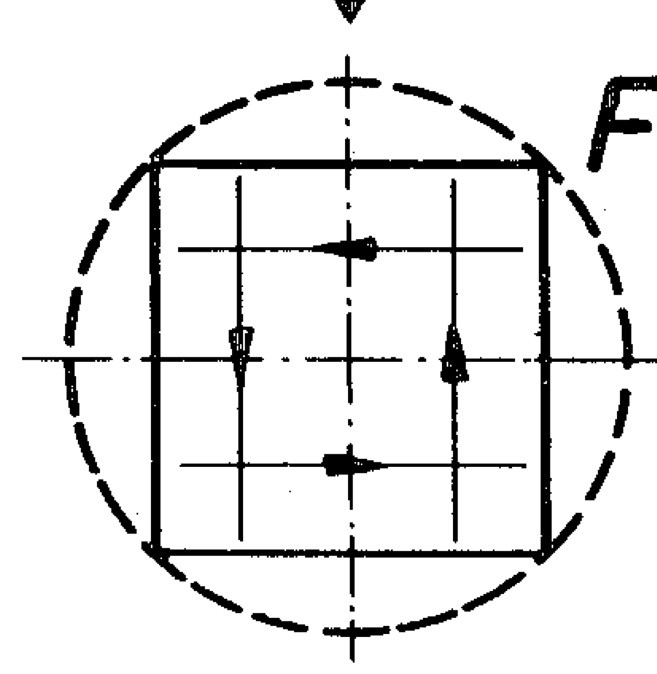


FIG.9b

$H_{20}+H_{02}$

FIG. 10

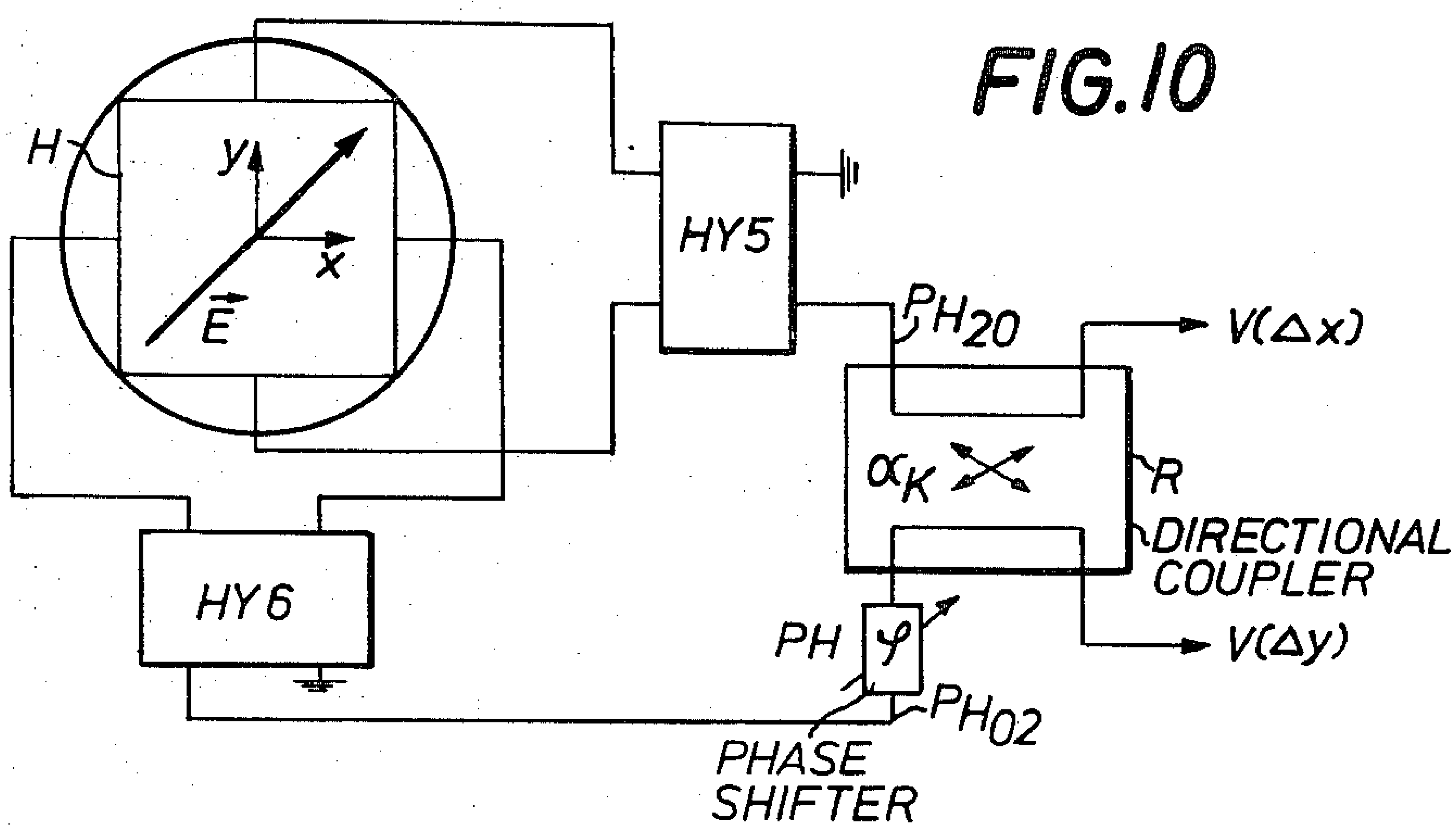


FIG. 11

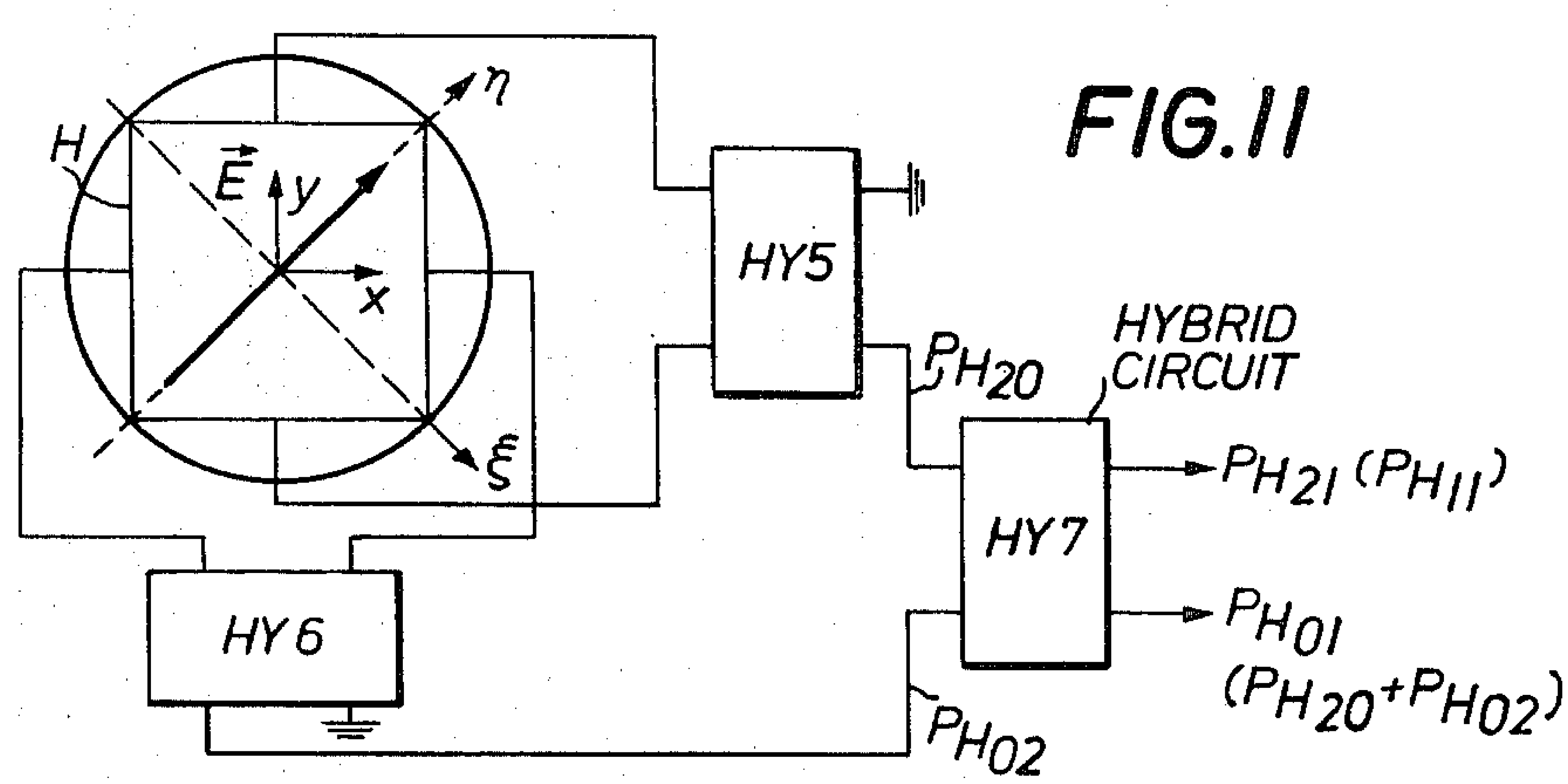
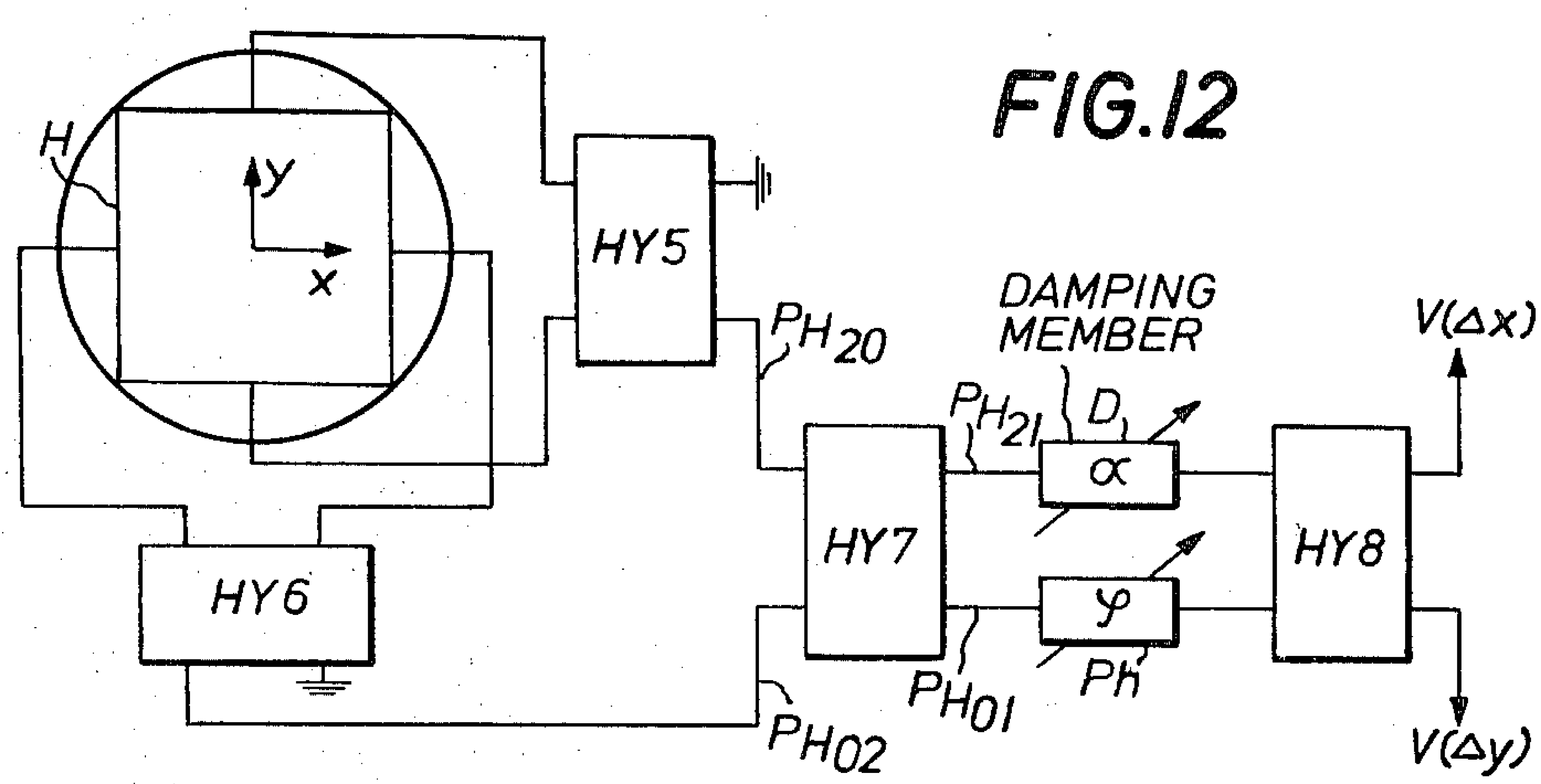


FIG. 12



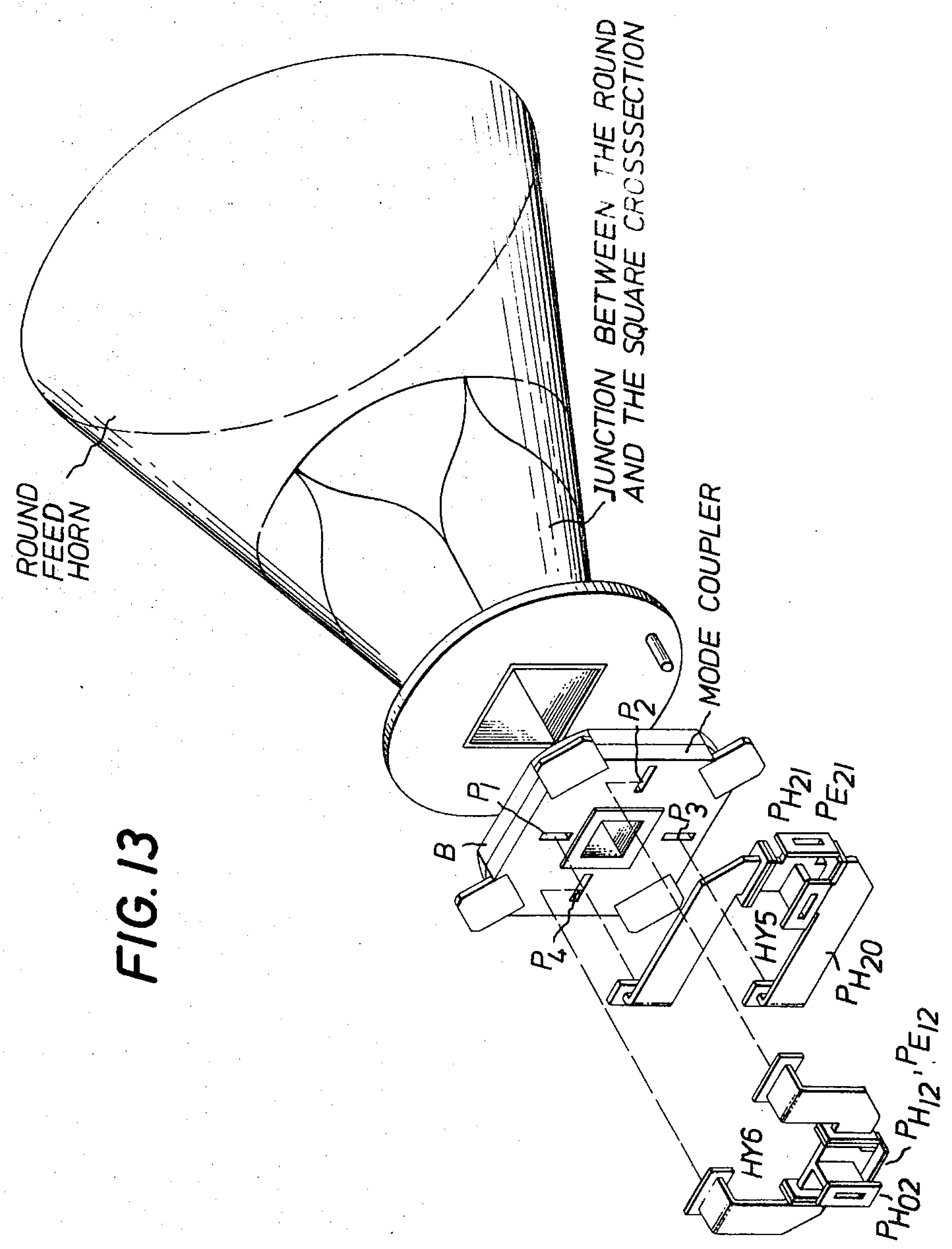

ROUND FEED HORN
JUNCTION BETWEEN THE ROUND AND THE SQUARE CROSSSECTION
MODE COUPLER
B
P_1
P_2
P_3
P_4
P_{H21}
P_{E21}
HY5
P_{H20}
HY6
P_{H12}, P_{E12}
P_{H02}

FIG. 13

ARRANGEMENT FOR AN AUTOMATIC RESETTING SYSTEM FOR MICROWAVE ANTENNAS

BACKGROUND OF THE INVENTION

The present invention relates to an arrangement for an automatic direction finding system for resetting microwave antennas when signals are received from a moving transmitter, in that the higher waveguide wave modes which are produced in the azimuth plane and in the elevational plane upon an angular deflection are utilized as deviation information.

The direction finding system is a contributing factor for the quality of a satellite ground station. In such a system, it must be endeavored to beam the antenna as accurately as possible toward the satellite in order to prevent energy losses. The system must thus be capable of producing resetting signals for angular deviations in the azimuth and elevational planes which signals permit accurate alignment of the antenna with the transmitter via a control loop.

Direction finding systems in which higher waveguide wave modes are evaluated are widely used, and in these systems the amplitude of the wave mode in the exciter constitutes a measure for the angular deflection. The exciters employed are quite generally square or circular exciters, with operation being possible in both cases with linearly or circularly polarized waves.

To decouple the wave modes containing the deviation information, coupling arrangements are used which will be referred to as mode couplers hereinafter.

At the present time automatic resetting systems for microwave antennas which operate with H wave modes are gaining in significance since these modes are able to propagate in the modern types of exciters having rotationally symmetrical lobes, e.g. (a corrugated horn).

In systems with square waveguides and square exciters it has been possible to produce mode couplers for the H_{20} and H_{02} waves which operate over a wide frequency band without retuning and which only slightly influence the useful wave. An automatic tracking system for microwave antennas using H_{20} and H_{02} modes is described in the Rantec-Document Nos. 90,003 and 91,130, Rantec Division, Emerson Electric Company, July 15 and Oct. 1, 1969.

SUMMARY OF THE INVENTION

It is therefore the object of the present invention to utilize the advantages of the H_{20}-H_{02} mode coupler for square waveguides for other types of exciters, e.g. circular, cross-shaped and octogonal exciters. This is accomplished in that the arrangement includes a junction or transition section between an antenna exciter having a circular, octogonal or cross-shaped cross section, i.e. a generally doubly polarizable waveguide cross section, and a subsequent waveguide section with a square cross section to which is connected a mode coupler which is provided with a microwave network which separates the deviation information for the antenna of the receiving system from the useful signal. The H_{20}-H_{02} output signal from the mode coupler containing the deviation information is fed to a comparator network for processing. Thus a wave mode conversion is effected in the junction between exciter cross section and square cross section.

According to one embodiment of the invention the comparator network includes a directional coupler whose inputs are connected via a phase shifting member, with the H_{20} and H_{02} outputs (P_H and P_H) of the mode coupler and at whose outputs the setting voltages for the two perpendicular antenna deviations are obtained.

According to a further embodiment of the invention, the comparator network is provided in the form of a hybrid circuit whose two inputs are connected with the H_{20} and H_{02} outputs of the mode coupler (P_H and P_H) and at whose outputs two different types of deviation information can be obtained.

According to still a further embodiment of the present invention the comparator network includes two series-connected hybrid circuits between which a phase member and a damping member are disposed, the first hybrid circuit being connected with the H_{20} and H_{02} outputs of the mode coupler (P_H and P_H). Two different types of deviation information are available at the outputs of the second hybrid circuit.

According to a further feature of the invention, it is advantageous to design the coupling elements of the mode couplers as longitudinal bar couplings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1***a* and **1***b* illustrate the electrical field configurations in a square waveguide.

FIGS. **2***a* and **2***b* illustrate the electrical field configurations in a cross-shaped waveguide.

FIGS. **3***a* and **3***b* illustrate the electrical field configurations in a circular waveguide.

FIG. **4** is a schematic illustration of mode coupler for a square waveguide used in the resetting system according to the present invention.

FIG. **5** is a schematic cross-sectional view showing the coupling elements of a mode coupler of FIG. **4.**

FIGS. **6***a* and **6***b* and FIGS. **7***a* and **7***b* show various wave modes in a waveguide with a cross-shaped cross section and their conversion into wave modes of a waveguide with a square cross section.

FIGS. **8***a* and **8***b* and FIGS. **9***a* and **9***b* show various types of wave modes in a waveguide with a circular cross section and their conversion into wave modes of a waveguide with a square cross section.

FIG. **10** shows one embodiment of an arrangement according to the invention having a directional coupler in the comparator network.

FIG. **11** shows another embodiment of an arrangement according to the invention having a series-connected hybrid circuit in the comparator network.

FIG. **12** shows a modification of the embodiment of FIG. **11** wherein for a system with a circular antenna exciter the comparator network includes a further hybrid circuit.

FIG. **13** shows a physical embodiment of an antenna-tracking-system consisting of a round Feed-Horn, a junction between the round and the square cross section of the following H_{20}-H_{02}-mode coupler.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following description of the invention, all of the discussion relating to antenna exciters with a cross-shaped cross section also applies without limitation to the antenna exciters with an octogonal shaped cross section.

Referring now to FIGS. **1 – 3** there is shown the electrical field configurations of the higher wave modes in antenna exciters or horns having a square (FIGS. **1***a* and **1***b*), a cross-shaped (FIGS. **2***a* and **2***b*) and a circular (FIGS. **3***a* and **3***b*) cross section for evaluation in monopulse direction finding systems, where these wave modes are excited when a linearly polarized ($\overline{E} = Ey$) wavefront impinges on the antenna from a nonaxial direction.

The transmitted signal (S) is projected into the aperture plane of the exciter and the deviation from the exciter axis appears as a deviation $x(a)$ or $y(b)$.

Of the higher wave modes, only those of the H type are of interest in this connection. During the polarization of E = Ex and with a deviation Y <> 0 there appear wave modes in a waveguide of square cross section which are obtained by rotating FIG. **1***a* about 90°; for example with a square exciter or horn the H_{02} wave results.

In an exciter with a cross-shaped cross section (FIGS. **2***a* and **2***b*) two types of H_{11} waves can appear, whose lines of symmetry are inclined with respect to one another by 45°. Like conditions appear for the H_{21} waves of a circular exciter (FIGS. **3***a* and **3***b*).

In a waveguide with a square cross section, the H_{20} wave and the H_{02} wave are suitable for providing the signals for bringing about an automatic resetting of the antenna since they can be decoupled over a wide band by means of a mode coupler such as shown in FIGS. **4** and **5.** This mode coupler which is provided with a microwave network is the prerequisite for all the other disclosed embodiments.

The mode coupler shown in FIG. **4** comprises a square waveguide section H with a defined opening angle and whose square cross-sectional area decreases along the axis thereof so that the section forms a truncated pyramid. The opening angle is such that the H_{20} (and H_{02}) wave can propagate only in the front portion of the waveguide H so that standing waves result which are coupled out by a total of eight coupling elements (K1 - K8) disposed symmetrically in pairs about the periphery of the square waveguide H. Coupling elements K1–K4 are coupled to the H_{20} wave and coupling elements K5–K8 are coupled to the H_{02} wave. The spacing between the coupling elements of each pair e.g. K1 and K2, is $a/2$, where a is the length of a side of the square cross section, and the coupling elements are disposed in the field intensity maxima of the wave modes to be coupled out. The field amplitude of the H_{20} wave is marked A in order to simply explain the functioning of the coupler, without consideration of the characteristic impedance. Each coupling element (K1–K4) decouples the amplitude A/2 with the coupling elements of each pair decoupling the amplitude A/2 at opposite phases. For example, the coupling element K1 decouples amplitude −A/2 while the coupling element K2 decouples amplitude +A/2. Additionally, the oppositely disposed pairs of coupling elements e.g. K1–K2 and K3–K4 decouple the amplitude with a mirror-image phase (180°). Each pair of coupling elements K1–K2 and K3–K4 feeds a respective 180° hybrid circuit HY1 and HY2 which form part of an inner comparator network HY1–HY4. In hybrid circuit HY1 the opposite phase components from coupling elements K1 and K2 are combined to form the amplitude $+A/\sqrt{2}$ at one output 4 thereof and in the hybrid circuit HY2 the opposite phase components from coupling elements K3–K4 are combined to form the amplitude $-A/\sqrt{2}$ at one output 4 thereof. The outputs 4 of the hybrid circuits HY1 and HY2 are each connected, via lines of the same length, with the two inputs of 180° hybrid circuit HY5 (outer comparator network) at whose output 4 the full amplitude −A of the original H_{20} wave appears, i.e. $P_{H_{20}}$. At output **3** of the hybrid circuit HY**5**, the decoupled energy component of the HE_{21} wave (not a direction finding type) is present which will eventually appear in the square cross section. In a like manner the amplitude components of coupling element pairs K**5** – K**6** and K**7**–K**8** are combined in respective 180° hybrid circuits HY**3** and HY**4** whose outputs are combined in a further 180° hybrid circuit HY**6** at whose outputs appear the energy portions of the H_{02} wave and of the HE_{12} wave. Since only the H_{20} output and the HE_{02} output of the hybrid circuits HY**5** and HY**6** are required for the direction finding process, the HE_{21} output and the HE_{12} output of each of the hybrid circuits are connected either to an absorber or to a short circuit. A specific physical embodiment of the mode coupler including hybrid circuits is found in applicants copending U.S. Pat. application Ser. No. 272,138 filed on July 17, 1972, now U.S. Pat. No. 3,758,880, issued Sept. 11, 1973.

The type of coupling elements K1–K**8** utilized is of high significance since the coupling elements determine the degree of coupling, the band width and the interference in the useful channel. Preferably the coupling elements are designed as so-called longitudinal bar couplings which convert a waveguide wave to a coaxial wave. With this type of coupling good coupling values are attained even with relatively low immersion depths. Such a longitudinal bar coupling is described for example in German Pat. No. 1,292,223.

FIG. **5** is a schematic longitudinal sectional view of the mode coupler of FIG. **4** at the location of the coupling elements K1–K**8** and showing four of the coupling elements. The bar B (the so-called longitudinal bar) of each of the coupling elements is connected approximately in its center with a respective coaxial conductor L. This coaxial conductor L leads to a laterally attached cavity HO which is coupled in by way of coupling loops S. This cavity HO is part of one of the hybrid circuits HY**1**-HY**4** shown in FIG. **4.** All of the hybrid circuits may if desired be constructed as magic T network.

Publications describing some possible physical embodiments of the hybrid circuits are

1. MTT Radiation Laboratory Series: Microwave Transmission Circuits, page 706; Waveguide Handbook, page 386
2. Matthaei, Young, Johns,: MICROWAVE FILTERS, IMPEDANCE-MATCHING NETWORKS, AND COUPLING STRUCTURES, pages 793 and 811, McGraw Hill (1964).

The bandwidth of the H_{20}–H_{02} mode coupler of FIGS. **4** and **5** is 20% of midband frequency. In order to utilize the square mode coupler of FIGS. **4** and **5** for exciters with other types of cross sections, the wave modes occurring in them must be converted to H_{20} and H_{02} waves of the square cross section. This wave mode conversion is possible only for certain modes. Where possible, according to the invention the mode conversion is effected in a junction between the exciter cross section and the square cross section of the subsequent waveguide. FIG. **6***a* shows this wave mode conversion.

In FIGS. **6–9,** FIGS. **6***a* to **9***a* show various wave modes of exciters with cross-shaped and circular cross sections and FIGS. 6b–9b show respectively the conversion of these wave modes of FIGS. 6a–9a into wave modes of a waveguide with a square cross section. In particular FIG. 6a shows the $(H_{11})_{45°}$ wave in the cross-shaped cross section of an exciter while FIG. 6b shows the converted wave form of the H_{20} and H_{02} modes in the waveguide with a square cross section. Similarly, FIG. 7a shows the $(H_{11})_{0°}$ wave in the cross-shaped cross section of an exciter while FIG. 7b shows the converted wave form of the H_{20} and H_{02} modes in the waveguide with a square cross section; FIG. 8a shows the $(H_{21})_{45°}$ wave in the circular cross section of an exciter while FIG. 8b shows the converted wave form of the H_{20} and H_{02} modes in the waveguide with a square cross section; and FIG. 9a shows the H_{01} wave in the circular cross section of an exciter while FIG. 9b shows the converted wave form of the H_{20} and H_{02} modes in the waveguide with a square cross section.

The conversion of the H_{20} and H_{02} waves of an exciter or section of waveguide with a cross-shaped cross section to those of the square waveguide is trivial and obvious, and therefore is not shown separately in the drawings.

The H_{01} wave of the circular waveguide of the exciter will always be converted to H_{20} and H_{02} waves approximately of the same amplitude in the square waveguide. For the H_{11} waves of the cross-shaped waveguide and the H_{21} waves of the circular waveguide, the wave mode conversion into H_{20} and H_{02} waves in the square waveguide is effected to a maximum degree only when the lines of symmetry of the field configuration, as illustrated in FIGS. 6–9 by the dash-dot lines, lie diagonally to the series-connected square waveguide. If these lines of symmetry lie parallel to the edges of the subsequently connected square waveguide, no conversion into H_{20} and H_{02} waves is possible. Accordingly the square waveguide sections must be oriented relative to the output waveguide sections of the exciter as shown in FIGS. 6b–9b for the various types of exciter waveguide modes. In order to provide signals for the automatic resetting of the antenna, it is necessary to combine the various H_{20}, H_{02} components originating from the various wave modes with the energy components $P_{H_{20}}$ and $P_{H_{02}}$ provided by the mode coupler so that unambiguous deviation criteria are produced. This is done by means of an additional comparator network which is series-connected to the H_{20}, H_{02} outputs of the mode coupler of FIG. 4 at which appear the respective energy components $P_{H_{20}}$ and $P_{H_{02}}$. This combination is necessary since the participating wave modes have varying phase velocities in the exciter.

According to one embodiment of the invention as shown in FIG. 10, the wave modes $P_{H_{20}}$ and $P_{H_{02}}$ which are produced as a result of a pure deviation in the X or azimuth direction (FIGS. 2a, 3b) and which are converted to H_{20} and H_{02} energy components and appear at the outputs of the mode coupler of FIG. 4, are combined in a directional coupler R having the required coupling attenuation to form a single signal V (Δx) at one of its outputs. In the decoupled branch of the directional coupler R, a signal V (Δy) will then appear only when a deviation in the y or elevation direction is present. A prerequisite here is that the polarization of the wave has a y component for an x deviation and an x component for a y deviation. This is always the case with circularly polarized waves. With linear polarization the exciter or horn is advisably rotated in such a manner that the polarization vector $\vec{E}$ lies along the diagonal of the series-connected square cross section. With a circular horn this rotation may take place at the point of the smallest circular cross section; the remainder of the horn may remain stationary.

The circular or cross-shaped horn is connected to the mode coupler shown in FIG. 4 and the H_{20} and H_{02} outputs of the outer comparator network HY5, HY6 of the mode coupler at which appear the energy components $P_{H_{20}}$ and $P_{H_{02}}$ are connected to the directional coupler R, which has an adjustable coupling attenuation factor α_K, via a settable phase shifting member PH. The coupling attenuation factor α_K must be set in dependence on the operating frequency of the system since the distribution of the P energies into H_{20} and H_{02} components is frequency dependent. The necessary condition for the coupling attenuation is given by the relationship $\alpha_K = 10 \log(P_{H_{20}}/P_{H_{02}})$. The phase between the two signals fed to the directional coupler R is corrected with the settable phase member Ph.

A publication describing a physical embodiment of a directional coupler with tunable coupling attenuation is Brodwin et al., "Continuously Variable Directional Couplers in Rectangular Waveguide" JEEE TRANS. ON MJT, 11, 1963 p. 137–142.

Another possibility for combining the components from a circular or cruciform exciter is shown in FIG. 11. As shown in this figure by connecting a hybrid circuit HY7 to the outputs of the hybrid circuits HY5 and HY6 of the mode coupler, it is possible in the case of an exciter with a circular cross section to separate the energy components P of the H_{01} and the H_{21} waves. With circular polarization of the excited wave, automatic resetting of the antenna is possible with only the H_{01} energy component $P_{H_{01}}$. With linear polarization however, two wave modes are required. The square mode coupler is here again adjusted in such a way that the polarization vector $\vec{E}$ lies along the diagonal of the square waveguide as shown in the figure. In this case the H_{01} energy component $P_{H_{01}}$ furnishes a measure for the ξ deviation; and the H_{21} components $P_{H_{21}}$ furnishes a measure for the η deviation.

If instead of an exciter with a circular cross section, one with a cruciform cross section is used, then the energy components shown in parantheses at the outputs of hybrid circuit HY7 are used.

FIG. 12 shows a modification of the comparator network of FIG. 11 which includes a further hybrid HY8 and a phase shifter PH'. With an exciter having a circular cross section, this embodiment makes it possible to compare the H_{01} and H_{21} energy components $P_{H_{01}}$ and $P_{H_{21}}$. Particularly with circular polarization of the waves, this results in the advantage that separate resetting signals are obtained for the x and y deviations. The amplitude of the H_{01} wave is approximately equal to the amplitude of the H_{21} wave when there is no y deviation. The phase shifter Ph' is used to shift the phase of one of the input signals to hybrid circuit HY8, e.g. the P_H signal as illustrated, to produce an oppositely phase pair of signals at the input of hybrid HY8. With this arrangement, one output of hybrid circuit HY8 will yield a resetting voltage V (Δx) while the output of hybrid circuit HY8 will yield a resetting voltage V(Δy). In order to compensate for small level differences in the connections of hybrid circuits HY7 and HY8, a variable damping member D may be additionally employed.

FIG. 13 shows a physical embodiment of an antenna-tracking-system consisting of a round feed-horn, a junction or trasition section between the round and the square cross section of the following H_{20}-H_{02}-mode coupler. The hybrid circuits HY1–HY4 of FIG. 4 are integrated as Magic-T circuits in the body (B) of the coupler. The hybrid circuits HY5 and HY6 are connected to the coupler by means of symmetric wave-guide components. The two output ports of these hybrids ($P_{H_{20}}$ and $P_{H_{02}}$) must be connected to an additional hybrid (HY7 of FIG. 11) which is not shown in FIG. 13. All these hybrids may be magic T's and the overall electrical lengths between the output ports P_1–P_4 and the input ports of HY7 must be equal. The output ports P_1–P_4 correspond to the ports 4 of the hybrids HY1–HY4 in FIG. 4.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

I claim:

1. In an automatic direction finding system for resetting microwave antennas when signals are received from a moving transmitter wherein the antenna exciter has a generally doubly polarizable wave-guide cross section and wherein means are provided for detecting and using the higher waveguide modes produced in the azimuth plane and in the elevational plane of the antenna exciter as the deviation information used to reset the antenna; the improvement comprising:

a transition section between said antenna exciter cross section and a waveguide with a square cross section;

a mode coupler means, which is provided with a microwave network, connected to said waveguide for separating the deviation information in the received signal from the useful signal and producing an output signal containing same; and

comparator circuit means connected to the output of said mode coupler and responsive to the output signal therefrom containing the deviation information for processing same to produce the deviation signals necessary to reset the antenna.

2. An automatic direction finding system for polarized signals as defined in claim 1 wherein said square cross section of said waveguide is oriented relative to the said cross section of said exciter so that the higher wave modes in said exciter are converted to H_{20} and H_{02} waves in said waveguide; and wherein said mode coupler means decouples said H_{20} and H_{02} waves and produces respective output signals corresponding to the energy components of the H_{20} and H_{02} waves at two respective outputs thereof.

3. An automatic direction finding system as defined in claim 2 wherein said comparator circuit means includes a phase shifter connected to one of said two outputs of said mode coupler means, and a directional coupler means, having two outputs and having one of its two inputs connected to the other of said two outputs of said mode coupler means and the other of its two inputs connected to the output of said phase shifter, for combining the two input signals thereto to provide the resetting voltages for the two perpendicular directions of antenna deviation at its respective outputs.

4. An automatic direction finding system for polarized waves as defined in claim 2 wherein said comparator circuit means comprises a hybrid circuit having its two inputs connected respectively to said two outputs of said mode coupler means and at whose two outputs two different deviation informations are obtained.

5. An automatic direction finding system for polarized waves as defined in claim 4 wherein said antenna exciter has a cross-shaped cross section and wherein said hybrid circuit provides the energy component of the H_{11} wave at one output thereof and the energy components of the H_{20} and H_{02} waves at the other output thereof.

6. An automatic direction finding system for polarized waves as defined in claim 4 wherein said antenna exciter has a circular cross section and wherein said hybrid circuit provides the energy components of the H_{21} and the H_{01} waves at its respective outputs.

7. An automatic direction finding system for polarized waves as defined in claim 6 wherein said comparator circuit means further includes a phase shifter means having its input connected to one of the outputs of said hybrid circuit for shifting the phase of the input signal thereto so that it is of the opposite phase to the signal at the other output of said hybrid circuit; and a further hybrid circuit having one of its two inputs connected to the output of said phase shifter means and the other of its two inputs and connected to said other output of said hybrid circuit, and at whose two outputs appear respectively the two resetting voltages for the two perpendicular directions of antenna deviation.

8. An automatic direction finding system for polarized waves as defined in claim 7 wherein said comparator circuit means further includes a variable damping means connected between the said other output of said hybrid circuit and the said other of the two inputs of said further hybrid circuit for providing compensation for small level differences in the connections between the hybrid circuits.

9. An automatic direction finding system as defined in claim 1 wherein said mode coupler means includes a plurality of coupling elements and wherein said coupling elements are longitudinal bar couplings.

10. In an automatic direction finding system for resetting microwave antennas when signals are received from a moving transmitter wherein means are provided for detecting and using the higher waveguide modes produced in the azimuth plane and in the elevational plane of the antenna exciter as the deviation information used to resest the antenna; the improvement comprising:

a transition section with arbitrary cross section for propagating two orthogonally polarized waves with a following waveguide with a square cross section, in which useful modes of the arbitrary cross section for deviation information are converted into H_{20} and H_{02}-modes;

a mode coupler means, which is provided with a microwave network, connected to said waveguide for separating the deviation information in the received signal from the useful signal and producing an output signal containing same, said mode coupler means includes a plurality of coupling elements with said coupling elements being longitudinal bar couplings, and

comparator circuit means connected to the output of said mode coupler and responsive to the output signal therefrom containing the deviation information for processing same to produce the deviation signals necessary to reset the antenna.

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