Nov. 11, 1947.　　W. D. HERSHBERGER　　2,430,568

ANTENNA SYSTEM

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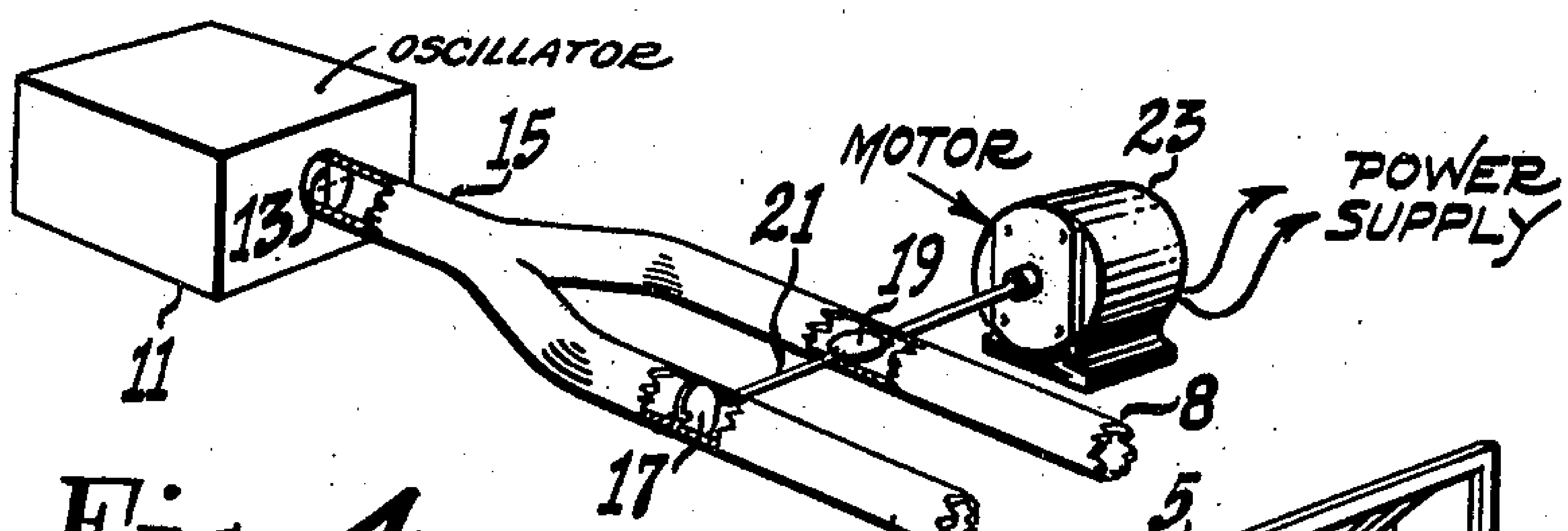

Fig. 4.

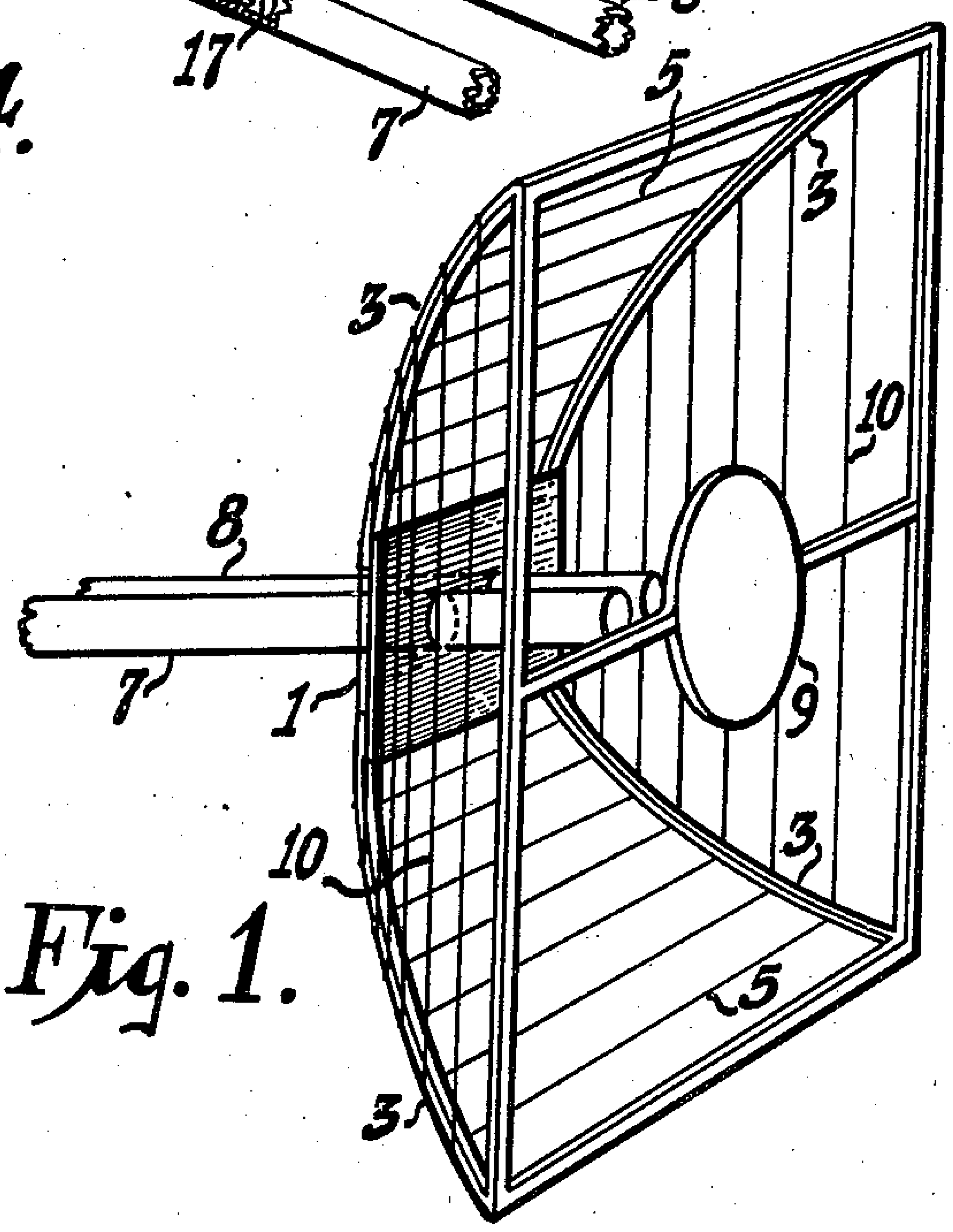

Fig. 1.

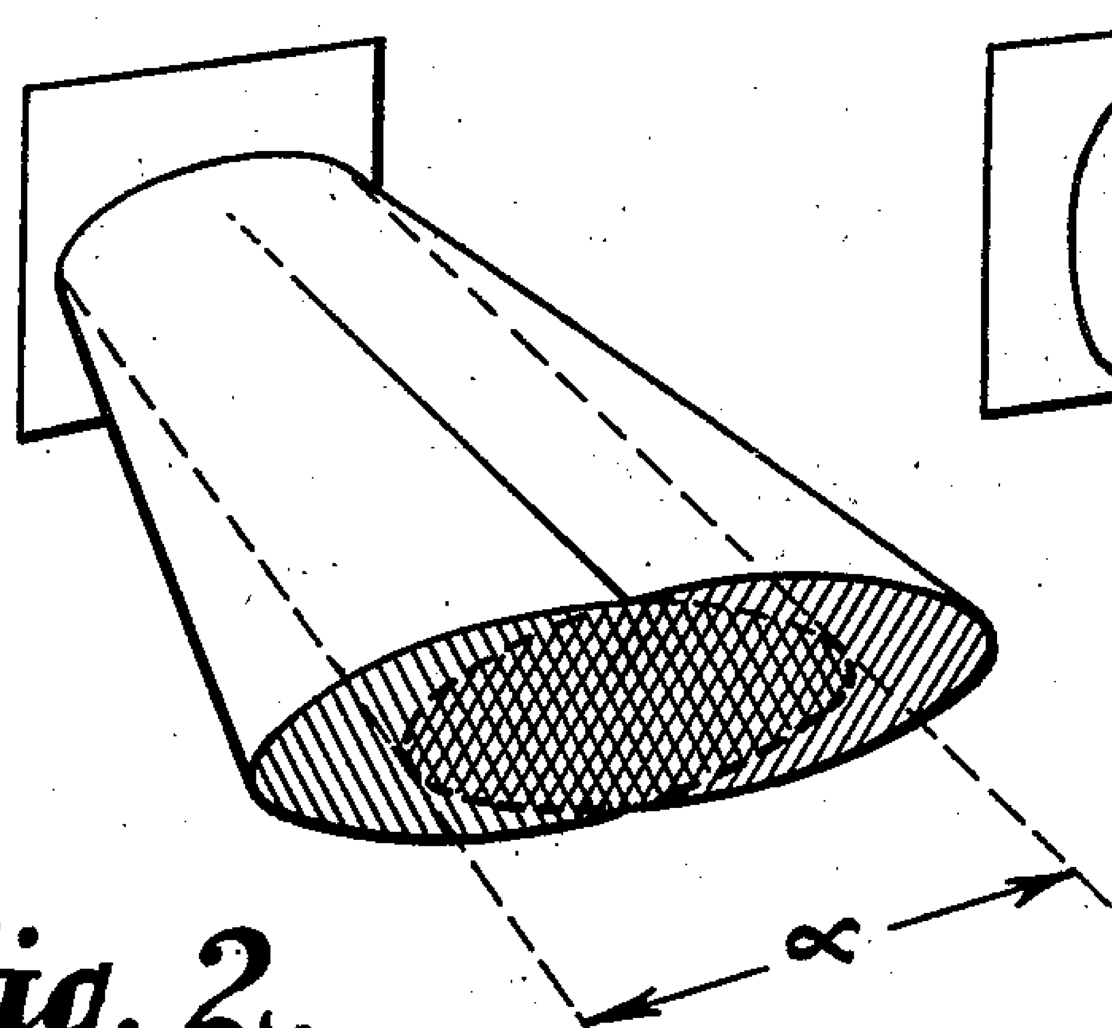

Fig. 2.

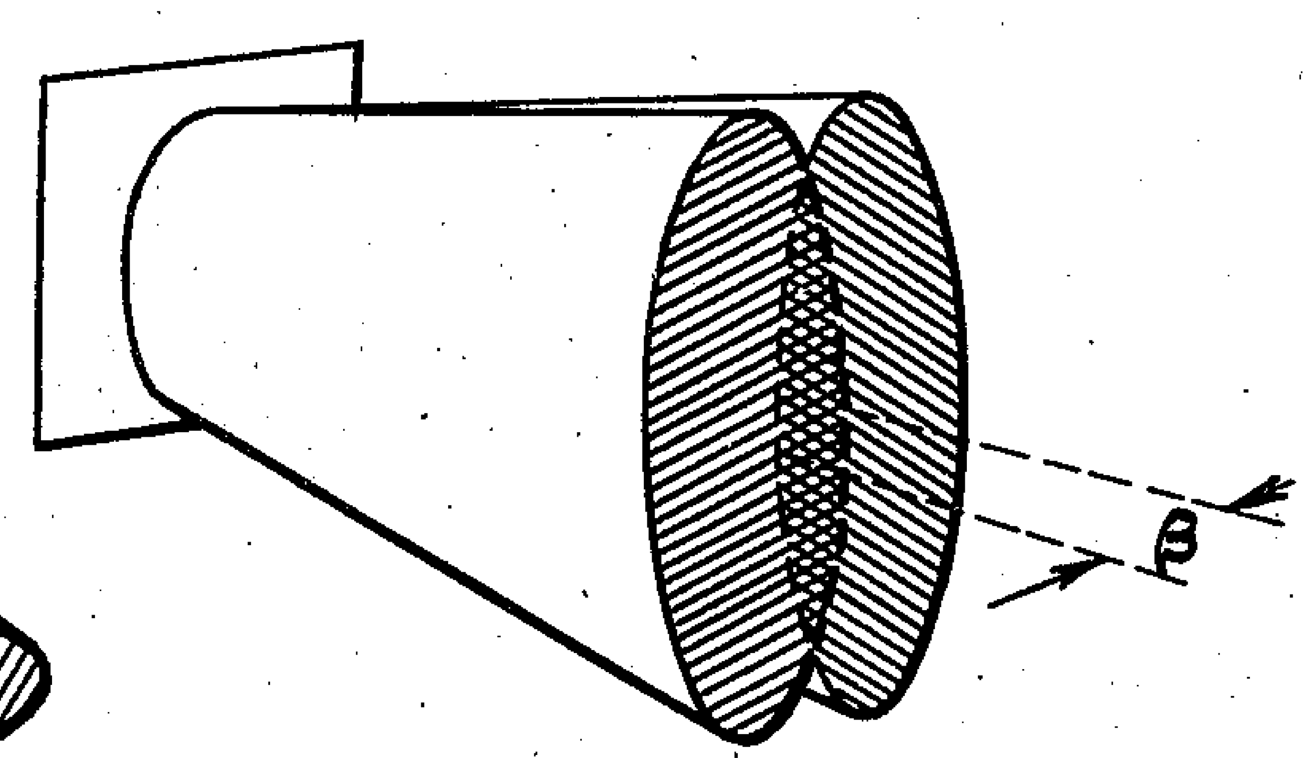

Fig. 3.

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ANTENNA SYSTEM

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2 Claims. (Cl. 250—11)

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This invention relates to devices for radiating electromagnetic waves and more particularly for radiating such waves alternately in different directions and with variable directivity.

Waves having lengths of the order of 50 centimeters and less may be concentrated conveniently by means of parabolic reflectors. The directivity of such arrangements is a function of the particular design and is not ordinarily readily variable. Also when it is necessary to change the direction of maximum radiation, the structure must be moved bodily.

It is an object of this invention to provide an improved means for radiating short electromagnetic waves alternately in different directions without the necessity of mechanically moving said means.

Another object is to provide improved radiating means of variable directivity.

These and other and incidental objects will become apparent to those skilled in the art upon consideration of the following description, with reference to the accompanying drawing, of which Fig. 1 is a perspective view of a radiating structure embodying the invention, Figs. 2 and 3 are perspective representations of radiation patterns which may be produced by the structure shown in Fig. 1, and Fig. 4 is a schematic perspective view of a system for energizing the device of Fig. 1.

Referring to Fig. 1, a rectangular plate or grid 1 of conductive material supports four ribs 3 which are parabolically curved and located in positions defining the traces of an intersection of two parabolic cylinders at right angles to each other. A plurality of wires 5 and 10 of conductive material are stretched at spaced intervals between the ribs 3 in positions corresponding to those of elements of respective parabolic cylindrical surfaces. Wave guides 7 and 8 extend through the member 1 at each side of its center and substantially at right angles thereto and terminate a relatively short distance from a plate 9 of conductive material supported preferably at the center of the mouth of the parabolic structure.

The plate 9 may be flat or dished; if it is flat, it should be positioned at the focus of the parabola; if dished, it should be so placed that it reflects energy from the wave guides 7 and 8 in such a way as to simulate a source located at the focus.

Referring to Fig. 4, an ultra high frequency oscillator, generally designated in the drawing by the block 11, energizes an antenna 13 which is

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supported at the end of a wave guide, 15. The antenna 13 may be arranged to be rotatable from the vertical position to the horizontal position as indicated by the dotted line, in order to rotate correspondingly the plane of polarization of the energy transmitted through the wave guide 15. The wave guide 15 is bifurcated a short distance from the oscillator 11 to form the two guides 7 and 8.

To provide alternate transmission through the wave guides 7 and 8, disks 17 and 19 of conductive material are supported in the respective guides in planes at right angles to each other on a shaft 21. The shaft 21 is continuously rotated by a motor 23.

In the operation of the device, energy conducted through one of the wave guides 7 and 8 strikes the plate 9 and is reflected to the surfaces defined by the wires 5. The plate 9 thus acts like a source of energy substantially in the plane of the focus of the parabolic reflector and slightly to one side of the center, depending on which wave guide is delivering the energy. By supplying energy to first one and then the other of the guides 7 and 8, overlapping radiation lobes may be established alternately, as illustrated in Figs. 2 and 3 which are hereinafter described.

The ability of spaced conductors to reflect electromagnetic waves having wavelengths greater than 2π times the conductor spacing depends upon the polarization of the waves striking the conductors. If the electric vector lies in a direction substantially parallel to the wires, reflection occurs. If the electric vector lies at right angles to the wires, very little reflection takes place. This phenomenon is utilized in the structure described above by employing plane polarized waves. If the plane of polarization is horizontal, the horizontally extending wires 5 (Fig. 1) function as elements of a parabolic cylindrical reflector lying horizontally, and the vertically disposed wires 10 are of no effect. The radiation is thereby concentrated in relatively wide, flat lobes, with a considerable angle α of overlapping, as illustrated in Fig. 2. Conversely, if the plane of polarization is vertical, the radiation lobes are narrow and high, and overlap only within a relatively small angle, as shown in Fig. 3. Thus it is possible to change the angular width of the overlapping portion of the two radiation lobes by merely rotating the plane of polarization of the wave through an angle of ninety degrees.

Thus the invention has been described as a device for radiating directively electromagnetic waves alternately in overlapping lobes and with controllable directivity. A reflector is arranged at or near the focus of a larger parabolic reflector. Energy is transmitted through a wave guide to the smaller reflector and thence to the parabolic reflector, producing a beam, or lobe of radiation. By employing two or more wave guides directed at points off the center of the smaller reflector, overlapping beams are produced. In order to control the amount of the overlap, plane polarized waves are used and the parabolic reflector is made of groups of parallel wires arranged to concentrate the radiation predominantly in planes lying parallel to the plane of wave polarization, which may be rotated to give either broad or sharp overlapping.

I claim as my invention:

1. A device for radiating electromagnetic waves including two groups of conductive wires disposed in positions corresponding respectively to the elements of a pair of intersecting parabolic cylinders, a plate of conductive material positioned within the space defined by the intersection of said cylinders, and wave guide means terminating near said plate and directed so that energy transmitted through said wave guide means is reflected by said plate to said conductive wires.

2. A system for alternately establishing overlapping radiation lobes comprising two coaxial spaced reflectors, one of said reflectors including two groups of conductive wires in positions corresponding to the elements of a pair of intersecting parabolic cylinders, the wires of one of said

groups being at right angles to those of the other of said groups, and a plurality of separate wave guide means extending through said parabolic cylindrical reflector with their axes parallel to the axis of said reflectors and terminating near the surface of the other of said reflectors, whereby alternate energization of said wave guides in one plane of polarization produces radiation lobes overlapping throughout a relatively small angle, and alternate energization of said wave guides in a plane of polarization at right angles to said first-mentioned plane produces radiation lobes overlapping throughout a relatively wide angle.

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