

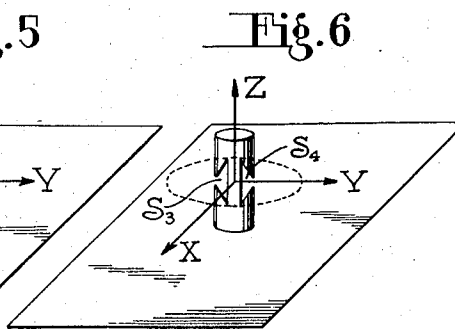
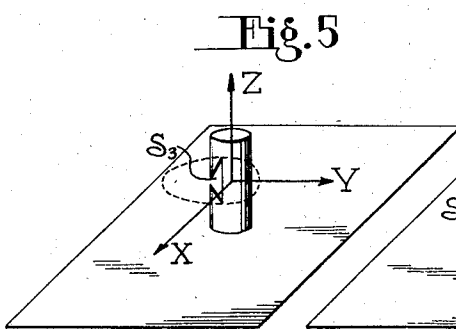
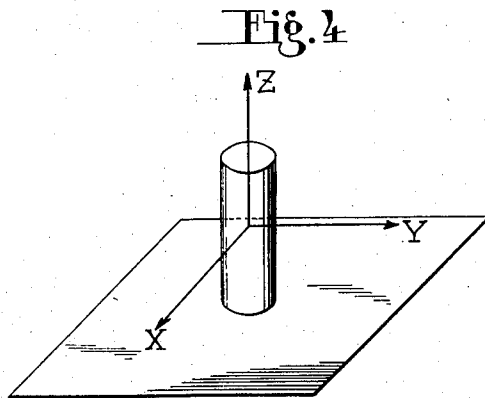
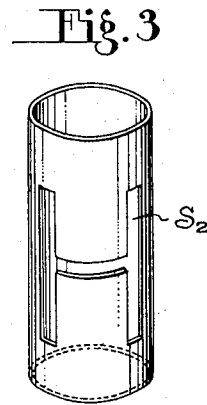
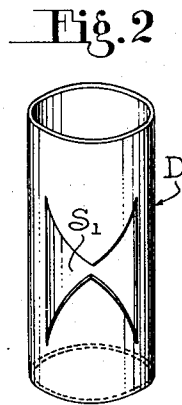
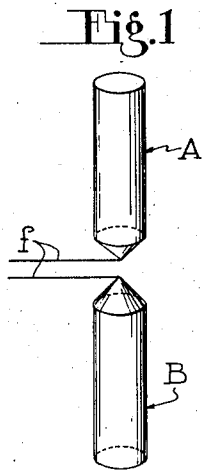
July 14, 1959

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WIDE-BAND ANTENNA

2,895,133

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3 Sheets-Sheet 1



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Fig. 7A

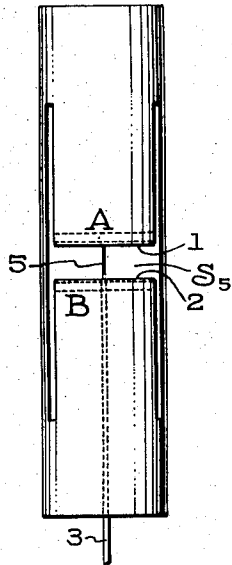


Fig. 7B

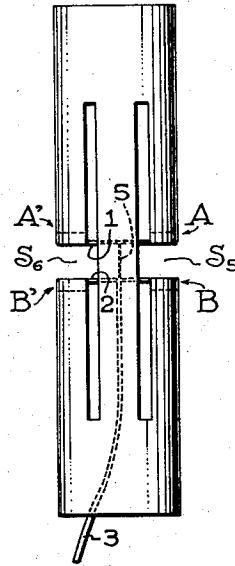


Fig. 8

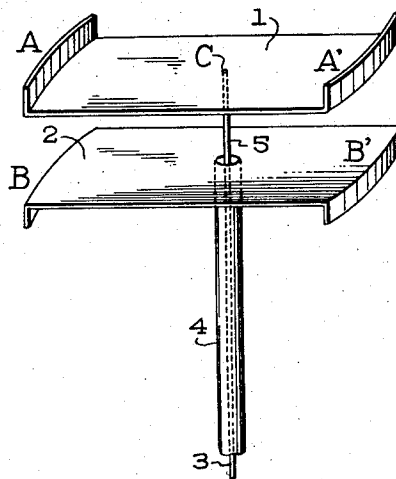
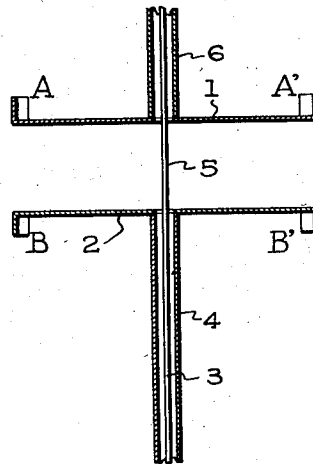


Fig. 9



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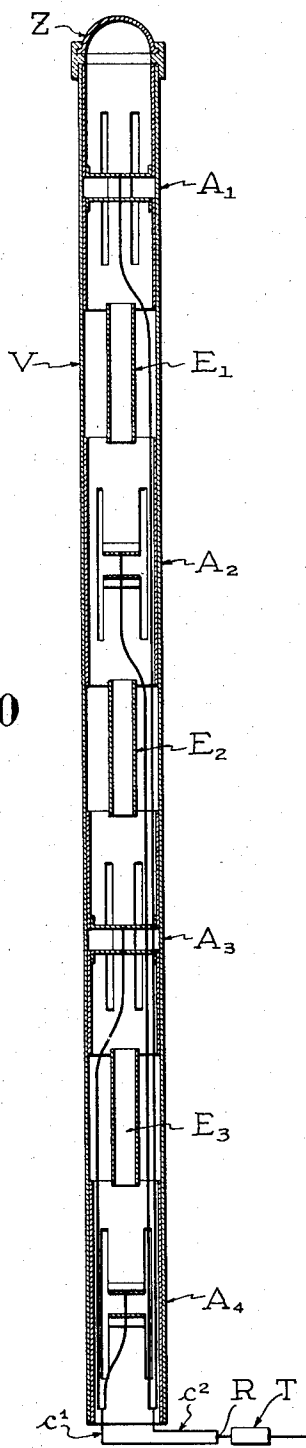
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Fig. 10



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WIDE-BAND ANTENNA

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8 Claims. (Cl. 343-767)

The object of the invention is to provide an antenna obtained by the excitation of a conductor tube by means of slots. The slots are formed in the wall of the cylinder and may have any shape, depending on the characteristics of impedance and directivity of the desired radiation.

A further object of the invention is to provide a stacked array of such cylinders so as to obtain a directional antenna.

Further features and advantages of the invention will be apparent from the ensuing description with reference to the accompanying drawings to which the invention is in no way limited.

In the drawings:

Fig. 1 shows a known dipole antenna with its feeder; Figs. 2 and 3 show shapes of slots used for the excitation of a metallic cylinder;

Fig. 4 shows a system of rectangular co-ordinates which permit the radiation pattern around the dipole antenna to be defined;

Fig. 5 shows the radiation pattern of a cylindrical antenna provided with a single slot;

Fig. 6 shows the radiation pattern of a cylinder in which two slots have been formed in a symmetrical manner;

Figs. 7A and 7B are views at 90° to one another of an antenna embodying the invention, together with its feeder;

Figs. 8 and 9 are views on an enlarged scale of two embodiments of the feeder, and,

Fig. 10 shows diagrammatically the characteristics of a colinear array obtained with antennas of the aforementioned type.

It is known that a cylindrical dipole, half-wave antenna is generally fed symmetrically, as shown in Fig. 1, the two parts A and B being insulated and separately connected to the two conductors of a feeder f .

According to the invention, the insulation between the two cylinders A and B is eliminated by means of the excitation of slots formed in the wall of the cylinder which has a conductive surface.

The shape of these slots could be, for example, that of the slot S_1 shown in Fig. 2, namely composed of two triangular apertures interconnected at their apices, or that of the H-shaped slot S_2 shown in Fig. 3.

The arrangement and the number of these slots depend on the desired radiation pattern. For example, to obtain a directional radiation pattern in the plane xy , a single slot S_3 is formed in the wall of a cylinder of revolution (Figs. 4 and 5). On the other hand, to obtain a substantially circular pattern in the same plane, a further slot S_4 is formed in the cylinder in such position that the slots S_4 and S_3 are symmetrically disposed relative to a diametral plane of the cylinder (Fig. 6).

In this last-mentioned embodiment, the diameter of the cylinder must be much less than the wavelength λ , for example about 0.15λ , λ being a wavelength within the wave band of the antenna.

In the planes containing the axis of the cylinder, the radiation pattern is substantially that of a dipole half-wave antenna so long as the length of the cylinder remains about a half-wavelength.

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The matching of such an antenna to the characteristic impedance of the feeder depends on the shape of the slots and on the connecting line at their excitation points.

A further object of the invention is to provide an excitation system comprising two H-shaped slots S_5 and S_6 formed symmetrically in the wall of a cylinder of revolution (Figs. 7A and 7B).

The edges AA' and BB' are interconnected in the embodiment shown in Figs. 7A and 7B by two plates 1, 2 which form a high characteristic impedance line (Fig. 8).

The outer conductor tube of the coaxial feeder is connected to the plate 2 and the inner conductor is fixed to the plate 1. The introduction at point C of a series reactance, for example a section of a series line (Fig. 9), permits the impedance curve to be compensated for the extreme frequencies of the band. Thus an antenna constructed in accordance with Figs. 7A and 7B, having a length L and an outside diameter of the cylinder equal to $0.24 L$, permits covering wavelengths ranging between $1.5 L$ and $3 L$ for a voltage standing wave ratio of about 2 in a coaxial feeder having a characteristic impedance of 100 ohms.

The interest of the invention resides in the following possibilities: on one hand, the simple construction of a wide band antenna which takes up only a small amount of space and, on the other hand, the practical construction of a stacked array of such antennas, this stacked array permitting either superimposing a plurality of radiators within a small space, having a low interaction, or constructing a highly directional antenna.

It is to be understood that the invention is intended to cover for example the embodiment described hereinafter.

This embodiment is shown in Fig. 10 and comprises four identical cylinders which are excited in accordance with the method of excitation described hereinbefore and shown in Figs. 7A, 7B, 8 and 9.

Said cylinders are fixed inside a tube V of insulating material, which ensures that the assemblage is fluid-tight and strongly constructed. A beacon lamp surmounts the tube.

Each antenna A_1, A_2, A_3, A_4 may be fed by a separate feeder extending through the interior of the antennas.

Each antenna may, furthermore, be matched to a separate coaxial feeder having an impedance Z (for example $Z=100$ ohms), these feeders being connected in pairs to coaxial feeders C_1, C_2 having an impedance $Z/2$ (50 ohms). The feeders C_1, C_2 are connected at R and, through the medium of a matching transformer, to a single feeder having an impedance Z_0 . The lengths of the feeders are chosen in accordance with the desired radiation pattern.

Z_0 may be, for example, between 50 and 75 ohms.

Said antenna, which is constructed to cover a frequency band ranging from 225 to 400 mc./s., has high directivity in the plane containing the axis of the antenna and provides a substantially circular radiation pattern in the plane normal to said axis.

It will be obvious that it is possible to construct a directional antenna for shorter or longer wavelengths by multiplying the given dimensions by the ratio between the middle wavelengths of the selected band and those of the band of said embodiment.

Although specific embodiments of the invention have been described, many modifications and changes may be made therein without departing from the scope of the invention as defined in the appended claims.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a half-wave antenna comprising a hollow conductive cylinder; no more than two slots formed in the wall of said cylinder, the length of the contour of each

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of said slots being such that each of said slots is individually at resonance at a frequency within the range of the operating frequencies; the length L of said cylinder being equal to $\lambda/2$, λ being a wavelength within the range of the operating wavelengths, and the diameter of said cylinder being no more than $0.3 L$; and means for feeding said antenna to produce polarization parallel with the axis of said cylinder.

2. In a half-wave antenna comprising a hollow conductive cylinder; no more than two slots formed in the wall of said cylinder, each of said slots having a shape which is symmetrical relative to a generatrix of said cylinder and relative to the median plane perpendicular to the longitudinal axis of said cylinder, and the length of the contour of each of said slots being such that each of said slots is individually at resonance at a frequency within the range of the operating frequencies; the length L of said cylinder being equal to $\lambda/2$, λ being a wavelength within the range of the operating wavelengths, and the diameter of said cylinder being no more than $0.3 L$; and means for feeding said antenna to produce polarization parallel with the axis of said cylinder.

3. In a half-wave antenna comprising a hollow conductive cylinder; no more than two slots formed in the wall of said cylinder, each of said slots being in the form of an H the down strokes of which are parallel with the axis of said cylinder, and the length of the contour of each of said slots being such that each of said slots is individually at resonance at a frequency within the range of the operating frequencies; the length L of said cylinder being equal to $\lambda/2$, λ being a wavelength within the range of the operating wavelengths, and the diameter of said cylinder being no more than $0.3 L$; and means for feeding said antenna to produce polarization parallel with the axis of said cylinder.

4. In a half-wave antenna comprising a hollow conductive cylinder; no more than two slots formed in the wall of said cylinder, each of said slots having a contour which is symmetrical relative to the median plane perpendicular to the longitudinal axis of said cylinder and each of said slots comprising at least one transverse aperture having two arcuate edges, and the length of said contour being such that each of said slots is individually at resonance at a frequency within the range of the operating frequencies; the length L of said cylinder being equal to $\lambda/2$, λ being a wavelength within the range of the operating wavelengths, and the diameter of said cylinder being no more than $0.3 L$; and means for feeding said antenna to produce polarization parallel with the axis of said cylinder, said feeding means comprising an upper plate and a lower plate which are parallel with one another and extend transversely of and within said cylinder and are respectively connected to said two arcuate edges, and a coaxial feeder whose outer conductor is connected to said lower plate and whose inner conductor is connected to said upper plate.

5. In a half-wave antenna comprising a hollow conductive cylinder; no more than two slots formed in the wall of said cylinder, each of said slots having a contour which is symmetrical relative to the median plane perpendicular to the longitudinal axis of said cylinder, and each of said slots comprising at least one transverse aperture having two arcuate edges, and the length of said contour being such that each of said slots is individually at resonance at a frequency within the range of the operating frequencies; the length L of said cylinder being equal to $\lambda/2$, λ being a wavelength within the range of the operating wavelengths, and the diameter of said cylinder being no more than $0.3 L$; and means for feeding said antenna to produce polarization parallel with the axis of said cylinder, said feeding means comprising an upper plate and a lower plate which are parallel with one another and extend transversely of and within said cylinder and are respectively connected

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to said two arcuate edges, and a coaxial feeder whose outer conductor is connected to said lower plate and whose inner conductor is connected to said upper plate, said plates being so shaped and arranged as to allow, between a portion of their edge and the cylinder wall portion which is not interrupted by said slots, sufficient space for the passage of a feeder for an adjacent antenna, whereby said feeder is not in contact with and is not coupled to any other antenna than that with which said feeder is connected.

6. In an array of antennas comprising a tube of insulating material, and disposed within said tube, a number of antennas in stacked relation; each antenna comprising a hollow cylinder, no more than two slots formed in the wall of said cylinder, the length of the contour of each of said slots being such that each of said slots is individually at resonance at a frequency within the range of the operating frequencies, the length L of said cylinder being equal to $\lambda/2$, λ being a wavelength within the range of the operating wavelengths, and the diameter of said cylinder being no more than $0.3 L$; insulators separating said antennas, feeding means for said antennas to produce polarization parallel with the cylinder axis of said antennas; and at least one feeder connected to said feeding means of said antennas.

7. In an array of antennas comprising a tube of insulating material, and disposed within said tube, a number of antennas in stacked relation; each antenna comprising a hollow cylinder, no more than two slots formed in the wall of said cylinder, each of said slots having a contour which is symmetrical relative to the median plane perpendicular to the longitudinal axis of said cylinder, and each of said slots comprising at least one transverse aperture having two arcuate edges, the length of the contour of each of said slots being such that each of said slots is individually at resonance at a frequency within the range of the operating frequencies, the length L of said cylinder being equal to $\lambda/2$, λ being a wavelength within the range of the operating wavelengths, and the diameter of said cylinder being no more than $0.3 L$; feeding means to produce polarization parallel with the axis of said cylinders of said antennas, each of said feeding means comprising an upper plate and a lower plate which are parallel with one another and extend transversely of and within said cylinder and respectively connected to said two arcuate edges, and a coaxial feeder whose outer conductor is connected to said lower plate and whose inner conductor is connected to said upper plate; said plates being so shaped and arranged as to allow, between a portion of their edge and the cylinder wall portion which is not interrupted by said slots, sufficient space for the passage of a feeder for an adjacent antenna, whereby said feeder is not in contact with and is not coupled to any other antenna than that with which said feeder is connected; insulators separating said antennas; and at least one feeder connected to said feeding means for said antennas.

8. An array of antennas as claimed in claim 7, wherein each antenna is matched to a separate feeder having a characteristic impedance Z , said feeders being connected in pairs to feeders having an impedance $Z/2$, and said feeders having an impedance $Z/2$ being connected through a matching transformer to a single feeder having an impedance Z_0 , the length of said feeders being chosen in accordance with the desired radiation pattern.

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