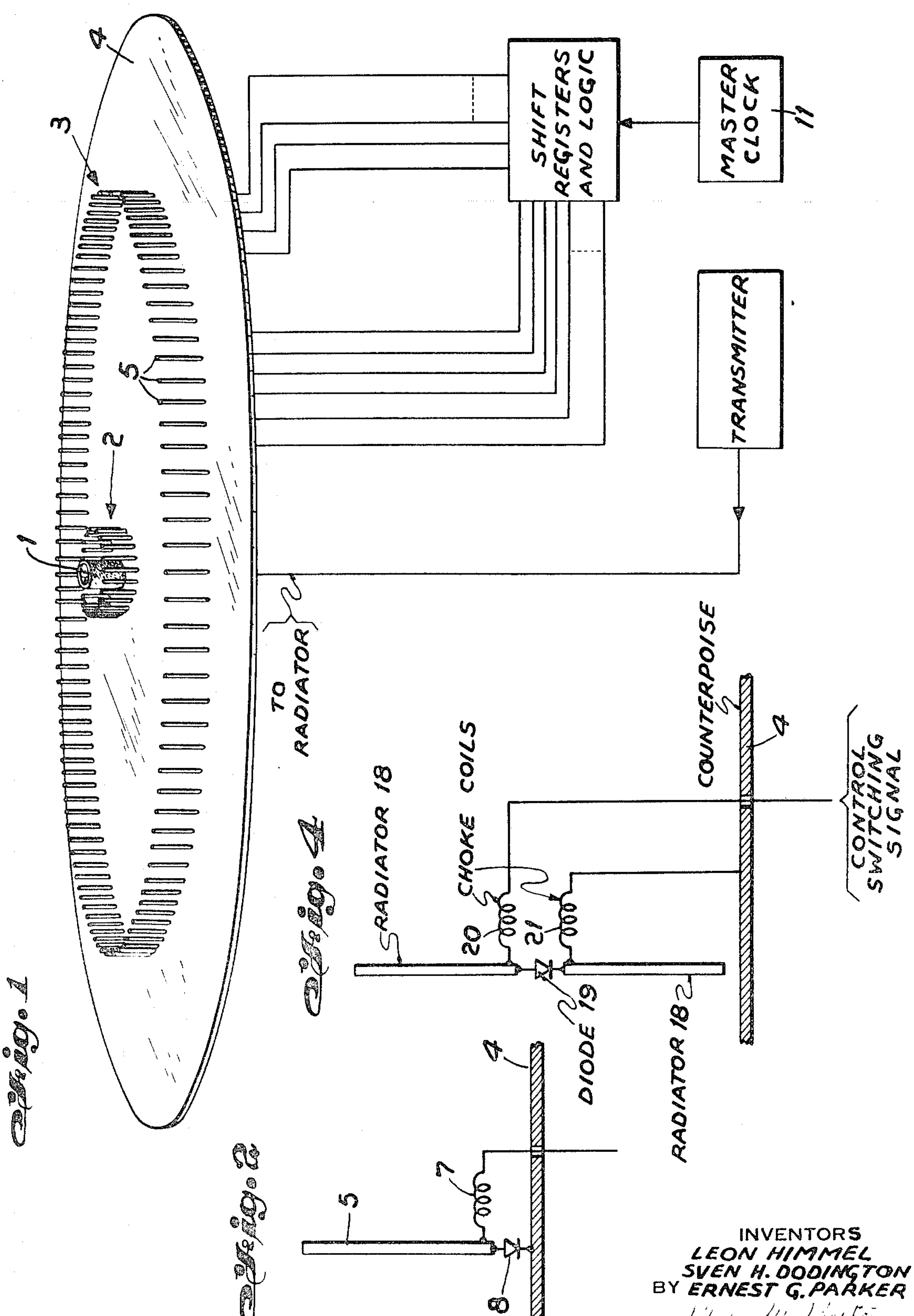
Feb. 2, 1971 L. HIMMEL ET AL 3,560,978

ELECTRONICALLY CONTROLLED ANTENNA SYSTEM

Filed Nov. 1, 1968 2 Sheets-Sheet 1



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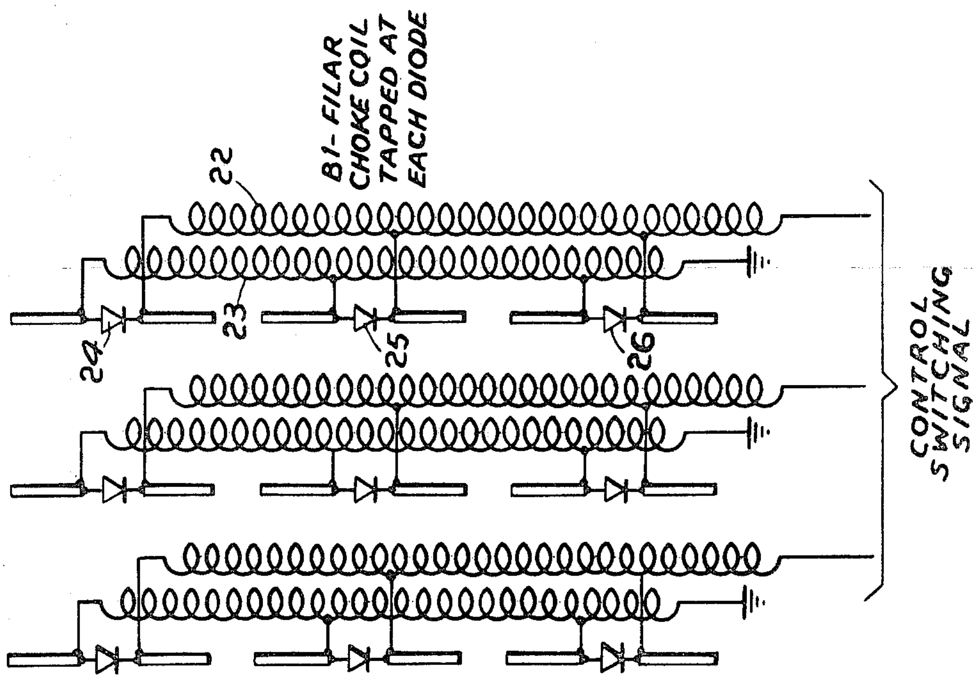

Fig. 5

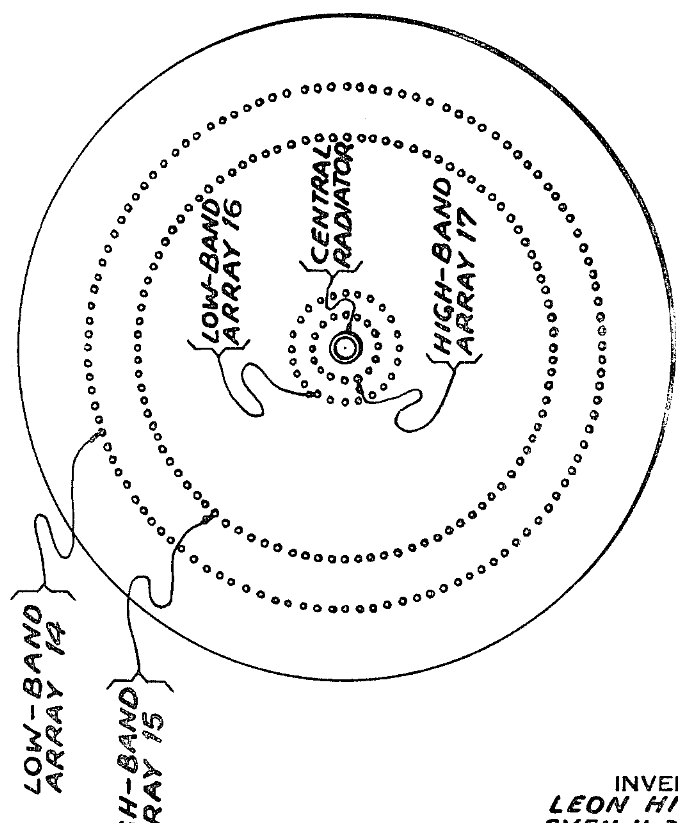

Fig. 3

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1

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ELECTRONICALLY CONTROLLED ANTENNA SYSTEM

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Int. Cl. G01s *1/48*
U.S. Cl. 343—106 **3 Claims**

ABSTRACT OF THE DISCLOSURE

In a TACAN beacon antenna, a monopole radiator surrounded by two or more concentric circular arrays of parasitic elements, which elements are digitally inhibited in sequence in a predetermined manner, is used to produce a rotating radiation pattern capable of producing 15 and 135 cycle-per-second signals at a receiver. Parasitic elements are inhibited by being open circuited by digitally controlled switching diodes. Recirculating shift registers are used to inhibit parasitic elements in the circular arrays to produce the required modulation radiation pattern. A common clock is used to step said registers along to produce the desired rotating pattern.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to an antenna system, and in particular, one which is capable of providing a rotating radiation pattern which can be used with TACAN systems.

Description of the prior art

The tactical deployment of navigation equipment has introduced the requirement that system antennas should be readily transportable. Certain navigational systems, such as TACAN have heretofore used mechanically rotated antennas. Mechanically rotated antennas, although simple and reliable, are bulky, heavy and consume relatively large amounts of primary power.

While electronically rotated scanning antennas have recently come into being, in general, they have been large and weighty.

Accordingly, it is an object of this invention to provide an electronic scanning antenna, which can be made small and light.

SUMMARY OF THE INVENTION

According to the invention, an antenna system comprises a radiator, a plurality of parasitic elements associated with said radiator, means coupled to each of said parasitic elements for inhibiting the operation thereof and control means for selectively operating said inhibiting means in a predetermined manner.

BRIEF DESCRIPTION OF THE DRAWINGS

The above mentioned and other objects of this invention will become apparent by reference to the following description in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective schematic diagram illustrating an electronically controlled antenna system,

FIG. 2 is a schematic diagram of a monopole parasitic element and its associated grounding circuitry,

FIG. 3 is a schematic plan view of a two frequency band electronically controlled antenna,

FIG. 4 is a schematic diagram of a dipole parasitic element and its associated grounding circuitry,

FIG. 5 is a schematic diagram of parallel connected dipole parasitic elements and their associated grounding circuitry.

2

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In a first embodiment, as illustrated in FIG. 1, a central radiator **1**, mounted on a counterpoise **4** is surrounded by two concentric rings, **2** and **3**, of closely spaced parasitic monopole elements.

Each parasitic monopole element **5**, is illustrated in FIG. 2 is coupled to the counterpoise **4** via a diode **8**. A switching signal is applied to the diode via an R.F. isolating inductor **7**. The switching signal controls the R.F. impedance between the parasitic monopole element **5** and the counterpoise **4** such as to be either an R.F. open circuit or effectively a short circuit to ground.

When an R.F. signal is applied to the monopole radiator **1** it radiates a signal which is modified by the parasitic elements **2** and **3**, located as shown in FIG. 1, to produce a desired field pattern. The desired field pattern can be effectively created or modified by grounding selected parasitic elements.

A TACAN radiation pattern is a composite pattern comprising a single lobe of cardioid pattern, upon which is superimposed nine secondary variations or ripples. In the presently discussed antenna, selected parasitic elements in the innermost ring **2** are grounded to produce a cardioid field pattern and selected parasitic elements in the outermost ring **3** are grounded to produce the secondary variations in the desired field pattern.

With an appropriate static radiation pattern produced, as above described, it is possible to rotate the pattern by progressively grounding the parasitic elements around the array. This is accomplished as is schematically illustrated in FIG. 1 by coupling a master clock **11** to two programmed recirculating shift registers, the first of which has its separate bits coupled to the innermost ring of parasitic elements **2** and the second of which has its separate bits coupled to the outermost ring of parasitic elements **3**.

The effective radiation pattern depends, for a given radiating frequency, upon the diameters of the concentric rings of parasitic elements. In a second embodiment, as illustrated in FIG. 3, in order to obtain an antenna operative over two frequency bands four concentric rings, two inner and two outer, are used. Rings **15** and **17** may be kept inoperative by appropriate switching circuits while rings **14** and **16** provide a rotating pattern or rings **15** and **17** can provide a pattern while rings **14** and **16** are inactive.

Up to this point, only parasitic monopole elements have been discussed, however, in a third embodiment, parasitic dipoles as shown in FIG. 4 are used to create the radiation pattern. In said embodiment dipole halves **18** are coupled to and separated by a diode **19** one end of which is D.C. coupled to ground via an R.F. choke coil **21** and the other end of which is coupled to a switching signal via R.F. choke coil **20**. The switching signal causes the diode **19** to be either an R.F. open or R.F. short and thereby controls the radiation characteristics of the dipole halves.

In a fourth embodiment, as shown in FIG. 5, a stacking technique is used instead of a single parasitic element to obtain an improvement in vertical directivity. In this arrangement parasitic dipoles **24, 25, 26** are stacked one upon another, and are separately coupled to bi-filar R.F. chokes **22, 23** which provide a DC path for control switching signals.

We claim:

1. An antenna system for providing a rotating radiation pattern, comprising:

a central radiator;

a first plurality of parasitic elements associated with said radiator positioned to form a first concentric array around said radiator;

a second plurality of parasitic elements associated with said radiator positioned to form a second concentric array;

means coupled to each of said parasitic elements of said first and second arrays for inhibiting the operation thereof;

a first control means coupled to said first array via said inhibiting means to produce a rotating lobe pattern; and

a second control means coupled to said second array via said inhibiting means for superimposing minor lobes on said rotating lobe pattern.

2. An antenna system according to claim 1 wherein said inhibiting means comprises a switching diode coupled from the parasitic element to ground, an R.F. choke and a voltage source coupled via said R.F. choke to bias said diode on and off.

3. An antenna system according to claim 1 wherein said inhibiting means comprises a first inductor, a second

inductor grounded at one end, a plurality of diodes coupled to spaced points on said first and second inductors, said parasitic elements comprising dipole halves coupled to each of said diodes, and a control voltage source connected to one end of said first inductor.

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