Feb. 14, 1939. F. W. DUNMORE 2,146,724

RADIO SYSTEM FOR COLLISION PREVENTION

Filed May 11, 1933

2 Sheets-Sheet 1

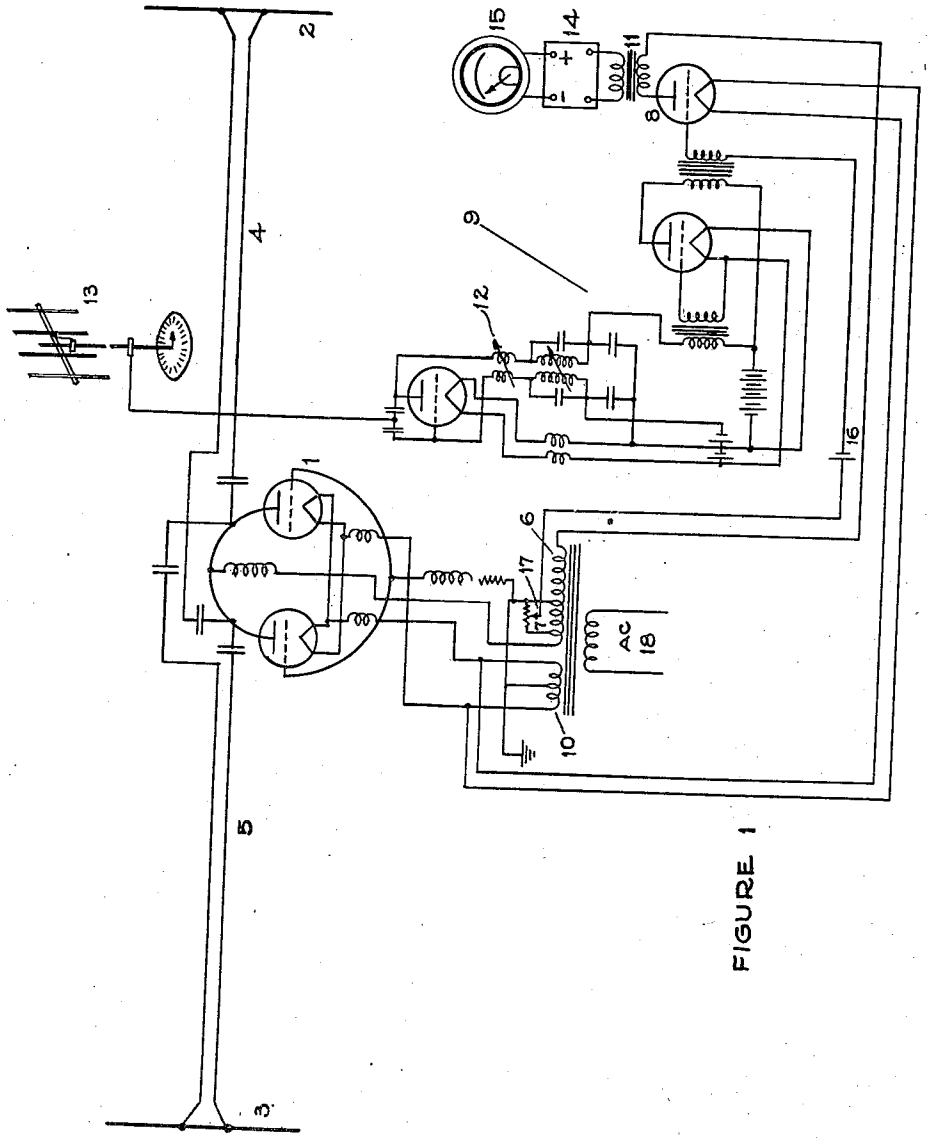


FIGURE 1

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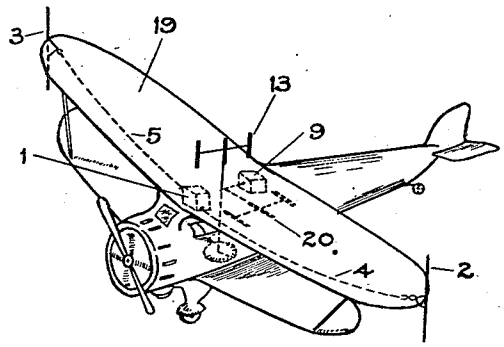


FIGURE 2

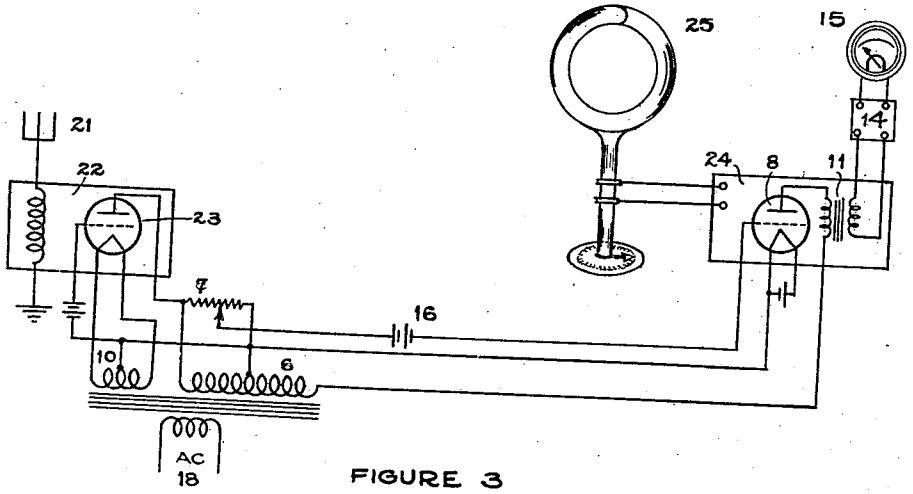


FIGURE 3

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UNITED STATES PATENT OFFICE

2,146,724

RADIO SYSTEM FOR COLLISION PREVENTION

Francis W. Dunmore, Washington, D. C., assignor to the Government of the United States, represented by the Secretary of Commerce

Application May 11, 1933, Serial No. 670,423

2 Claims. (Cl. 250—11)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government of the United States for governmental purposes only, without the payment of any royalty thereon.

My invention relates to a combination transmitter and receiver for use on a mobile object, both receiver and transmitter operating on the same radio frequency and both operating in effect simultaneously, that is, at an audio frequency rate or higher, without interference. The receiver having a directive antenna makes possible the determination of the direction to a second mobile object equipped with similar apparatus, thus avoiding a possible collision.

In this invention the transmitting set and receiving set are operated in a push-pull fashion such that when the transmitter is in operation the receiver is rendered inoperative. This changeover is made sufficiently rapid that the receiver is in effect continuously operative for the detection of signals from a second mobile object. Other uses for and advantages of my invention will be more clearly understood by reference to the following description and diagrammatic drawings.

In these drawings—

Figure 1 shows the circuit arrangement of one form of my invention in which a high frequency transmitting and receiving set are used with a double transmitting antenna to prevent shadows and a directional receiving antenna.

Figure 2 shows the application of this invention to an airplane when the two transmitting antennas are located on the wing tips and the directional receiving antenna amidship.

Figure 3 shows the application of my invention to the marine type of low power mobile beacon now coming into use, showing the ship's direction finder which may function while the mobile beacon is operating on the same radio frequency and on the same ship without interference.

In the form illustrated in Figure 1 the output from a high frequency transmitting set, 1 serves as a means for feeding antennas 2 and 3 through transmission lines 4 and 5. The antennas 2 and 3 are so located one on each wing tip that a signal will be sent in all horizontal directions without shadow effects. 6 is a center tap transformer with one end of the secondary supplying power to the plates of transmitting set 1. A resistance 7 shunted across part of this same end of the secondary supplies negative bias voltage to the grid of last tube 8 in a high frequency receiving set 9. The other portion of this secondary supplies the plate of the tube 8 through an audio transformer. A circuit 12 may be of the superregenerative type, the input of which is connected to a direction antenna 13 which may be orientable about a vertical axis and collapsible so that it folds down within the airplane. 14 is an oxide rectifier and 15 a current indicating means. A direct current bias is supplied from a suitable source, which may be a battery 16. The alternating current bias on the grid of the tube 8 may be set at the proper value to give minimum reading on 15 with no signal coming in; by means of a slider 17. Alternating current is supplied from a suitable source 18.

The circuit functions as follows: This transmitter functions during that half-cycle of the alternating current voltage supplied at 18, when the plates of the tubes in the transmitting set 1 become positive. During this half-cycle, however, the plate of the tube 8 is negative rendering it inoperative so that the signal sent out by 1 cannot be received on indicator 15. However, during the next half of the cycle of the current supplied at 18, the plates of the tubes in the transmitter 1 become negative, rendering this unit inoperative while the plate of the tube 8 becomes positive allowing this tube to pass on any signal coming in on the grid of this tube. When the plate of the tube 8 is positive, the grid is made sufficiently negative by means of the battery 16 and the position of slider 17 on the resistor 7. Thus, during every alternate half-cycle of the voltage supplied at 18, the transmitter 1 operates and the receiver 9 is dead and during the intermediate alternate half-cycle the transmitter 1 is dead and the receiver 9 is functioning. By means of the directive antenna 13 which is rotatable about a vertical axis, the direction of the signal being received by 9 may be determined by manually rotating it to determine the position for a maximum signal.

With this arrangement, therefore, a mobile object may send a continuous signal of a note depending upon the frequency of the current supplied at 18, which signal will be detected by a second mobile object in the neighborhood, while at the same time the directional receiver on the first mobile object functions continuously to detect the signal sent from the second mobile object. As there are no synchronizing means between the transmitters on the various mobile objects and different frequencies may be used at 18, the receiver 9 will always be intermittently operating during some portion of the cycle of transmission of other transmitters.

igure 2 illustrates another form of my inven-
. as applied to an aircraft. Here 19 repre-
:s the aircraft; 2 and 3 the vertical doublet
ennas for transmitting the warning signal in
horizontal directions. 13 represents the di-
tional receiving antenna rotatable about a
tical axis and collapsible into the wing as
wn at 20. 4 and 5 represent the transmis-
1 lines, 1 the transmitting set, and 9 the re-
ving set.

Figure 3 shows an application of my invention
ere a lower radio frequency is used such as
marine use. Here 21 represents a non-direc-
nal transmitting antenna, 22 is a standard
v power marine beacon transmitter such as are
mmonly used, 6 is a center tap transformer one
le of the secondary of which supplies plate
ltage to the tube 23 of the transmitter 22 and
e other side 10 supplying plate voltage to the
st tube or two tubes in a direction finder re-
iving set 24. 25 is a direction finder coil ro-
table about a vertical axis. These circuits
nction as explained under Figure 1, except at
lower radio frequency.

While the above are forms of my invention,
is understood that other means of applying the
oltage from transformer 6 to the receiving set
lay be used to render it operative and then
ioperative. Therefore, I do not wish to be lim-
ed to these specific embodiments, since modifica-
ions may be made both in the circuits and ap-
aratus within the scope of my invention.

Among such modifications would be the inclu-
sion of an audible signal device in the output of
tube 8.

What I claim is:

1. In a radiant energy system for indicating the close proximity of one craft to another craft, means carried by each of said craft for transmitting vertically polarized radiant energy of a preselected wave length from each of said craft in all azimuthal directions in space, means carried by each of said craft for directionally receiving the vertically polarized radiant energy of preselected wave length transmitted from other craft, switching means carried by each of said craft for alternately putting into operation the transmitting means and the receiving means carried by said craft, and means for operating the switching means carried by each of said craft at different frequencies, whereby the receiving means carried by each of said craft will be cyclically put into operation during a part of the time the transmitting means carried by any and all other craft is energized.

2. A system as set forth in claim 1 in which the wave length of the energy transmitted is small in comparison to at least one physical dimension of the craft carrying the means for transmitting vertically polarized radiant energy.

FRANCIS W. DUNMORE.