June 1, 1948. W. R. KOCH 2,442,695

RADIO PROTECTIVE SYSTEM

Filed Jan. 30, 1943

FIG. 1.

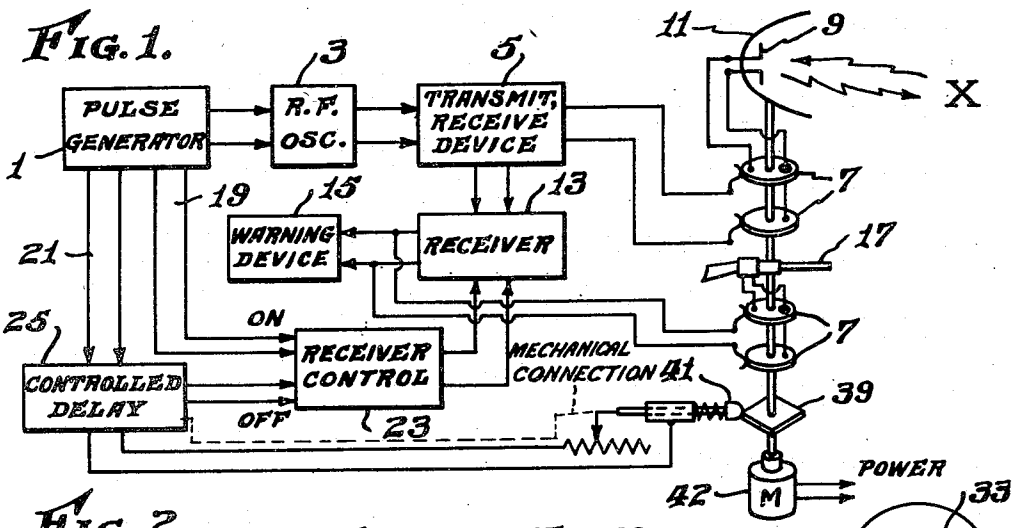


FIG. 2.

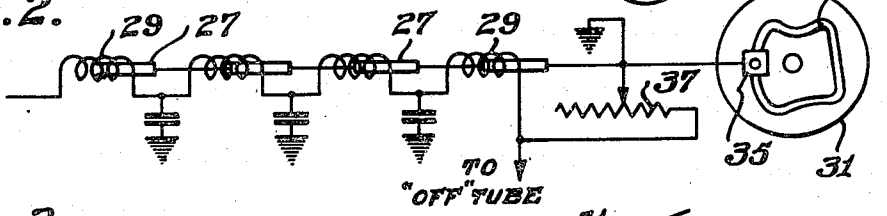
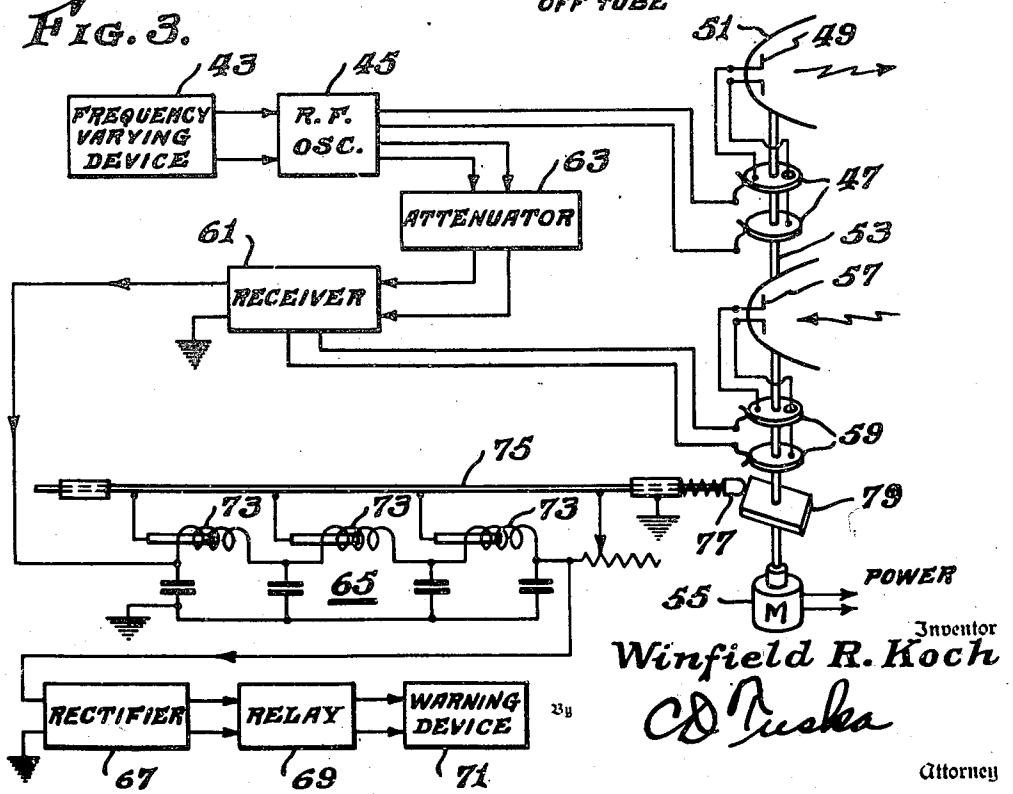


FIG. 3.



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Patented June 1, 1948 2,442,695

UNITED STATES PATENT OFFICE

2,442,695

RADIO PROTECTIVE SYSTEM

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Application January 30, 1943, Serial No. 474,147

10 Claims. (Cl. 343—5)

1

This invention relates to radio protective systems and more especially to a protective system in which a beam of radio frequency energy is arranged to scan only the area to be protected so that reflected signals from within the area indicate the presence of an intruder.

Radio waves have been used to protect an area by establishing standing wave patterns so arranged that a change of pattern indicates the presence of an intruder. An example of this type of system is found in Wolff Patent 2,197,028. Another form of radio protective device employs a beam of radio frequency energy which is reflected from an object to be detected. In general, not only is the reflection an indication of an object within the beam but also the time taken for the energy to travel from the transmitter to the object and back to the receiver is a measure of the distance of the intruder or object. While the power employed in such systems may be used to regulate the effective range, it is very difficult, if not impossible, to adjust the power whereby the range is limited. Moreover, even if the power is adjusted to fit a particular range, it would be difficult to employ a radio protective system arranged to scan an irregular area to be protected.

One of the objects of the present invention is to provide an improved radio protective system. Another object is to provide an improved radio protective system for scanning an irregular area to be protected. Another object is to provide an improved radio protective system in which the effective range is limited to the boundaries of the area to be protected.

The invention will be described by referring to the accompanying drawing, in which Figure 1 is a circuit diagram of one embodiment of the invention, Figure 2 is a circuit diagram of a delay circuit employed in the invention, and Figure 3 is a schematic diagram of a modification of the invention.

Referring to Fig. 1, a pulse generator 1 is connected to key a radio frequency oscillator 3 whose output circuit is connected through a transmit-receive device 5 through slip-rings 7 to a dipole antenna 9 which is arranged within a suitable reflector 11. The reflector and the dipole antenna establish a sharply defined beam of radio energy which is radiated to scan the area to be protected.

The antenna also acts as a receiving means which picks up the signals reflected from an intruder represented by X. The received signals are applied through the transmit-receive device

2

5 to a radio receiver 13 in whose output circuit are connected one or more warning devices 15, 17. The pulse generator includes a pair of connections 19 and 21 which are arranged, respectively, to turn on and off a receiver control device 23. The off circuit includes a controlled delay means 25 which will be described hereinafter by reference to Fig. 2.

Fig. 2 shows one embodiment of a filter or delay circuit in which magnetic cores 27 are inserted within inductors 29. The cores 27 are controlled by a cam member 31 in which is included a cam slot 33. A cam follower 35 is arranged within the slot so that it simultaneously adjusts the cores 27 and a terminating resistor 37. The purpose of the filter network is to provide a transmission line which is properly terminated to provide the required delay.

If the system in question is to be used at the center of a rectangular area, a square cam 39 is used to control a cam follower 41. The cam is adjusted in synchronism with the rotating beam by a motor 42 which rotates the radio scanning beam.

The mode of operation of the system of Fig. 1 is essentially as follows: The pulse generator 1 keys on the oscillator 3 so that a pulse of radio energy is radiated from the directive antenna 9, 11. Just after the radiation the receiver is turned on through the receiver control which corresponds to an automatic volume circuit. The receiver is thus made responsive to the reflected pulse energy which is applied to the warning device 15. After an interval of time sufficient for the pulse to travel to the boundary of the area to be protected and back to the receiver, the receiver control circuit is turned off so that signals from objects beyond the boundaries are not received and thus the effective range of the device is limited to the area to be protected.

It should be understood that the cam device 39, 41 may be shaped to correspond to any irregular area such as indicated by the cam 33 of Fig. 2. The irregular area is defined by a line disposed at varying distances from the point of origin of said beam, or by a line formed by a point rotated at a non-uniform distance about the point of origin of said beam. Moreover, the warning device may consist of a light, flashlight or audible alarm. The warning device may even take the form of a repeating shotgun which is aimed in synchronism with the radio beam whereby a warning shot may be fired toward the intruder. It is assumed that such drastic means would only be used to protect a fenced

area or to operate against an enemy in wartime. It is clear that the warning device can take on different forms to obtain the desired warning or protective results.

In the modification shown in Fig. 3, a frequency varying device 43 is connected to a radio frequency oscillator 45 whereby the oscillator frequency is varied throughout a predetermined cycle. In accordance with the disclosure of Bentley's U. S. Patent 2,011,392 the radio frequency power is applied through slip-rings 47 or other suitable means to a dipole antenna 49 arranged within a suitable reflector 51. The reflector and antenna are mounted on the shaft 53 which is driven by a motor 55. A second antenna 57, which may also be made directive, is mounted on the shaft 53 and connected through slip-rings 59 to a radio receiver 61. A connection is made from the oscillator 45 through an attenuator 63 to the receiver, whereby the outgoing radio frequency current is mixed with the incoming radio frequency signal to establish a current whose frequency corresponds to the difference in frequency of the outgoing and incoming signals. These currents are applied through a filter 65 to a rectifier 67 and hence to a relay 69 which operates the warning device 71.

The filter 65 includes variable elements 73 which are controlled by the rod 75. The rod is connected to a cam follower 77 which engages the cam 79 which is driven by the motor 55. The function of the adjustable filter is to limit the currents from the receiver output to the frequency range including the frequencies which are derived from reflections at the boundaries of the area to be protected. While the cam shape in the instant arrangement is that of a rectangle, it should be understood that it may take on any other desired form whereby the receiver output corresponds only to signals received from reflections from objects within the limited range.

Thus the invention has been described as a radio protective system in which a beam of radio frequency energy is made to scan the area to be protected. Reflections from objects or intruders within the protected area are received and applied to operate a warning device. By means of a cam operated in synchronism with the scanning beam, the system is limited to the effective range defined by the boundaries of the protected area. While the effective range is determined primarily by controlling the receiver, it is also recognized that the relative rates of the transmitter cycle and the rate of scanning the area may be used to control further the effective range. For example, if the scanning is rapid, the directive characteristics of the beam will eliminate reflected signals which will then lie outside the response pattern of the antenna.

I claim as my invention:

1. A radio protective system including means for radiating a continuously rotating radio beam to scan an area to be protected, said area being bounded by a line disposed at varying distances from the point of origin of said beam, means for receiving said radio beam after reflection from an object within said area, means responsive to the output of said receiver for indicating the radio beam reflected from and hence the presence of said object, and means synchronized with said continuously rotating radiating means for limiting the effective radio range to the boundaries of the region to be protected.

2. A radio protective system including means for radiating a continuously rotating beam of radio energy, means for directing said beam thereby to scan an area to be protected, said area being bounded by a line disposed at varying distances from the point of origin of said beam, means for receiving said radio beam after reflection from an object within said area, means responsive to the output of said receiver for indicating the radio energy reflected from said object, and means synchronized with said continuously rotating radiating means for limiting the effective radio range to the boundaries of the region to be protected.

3. A radio protective system including means for radiating a continuously rotating beam of radio energy, means for directing said beam thereby to scan an area to be protected, said area being bounded by a line disposed at varying distances from the point of origin of said beam, means for receiving said radio beam after reflection from an intruder within said area, means responsive to the output of said receiver for establishing a warning signal indicating the presence of said intruder, and means synchronized with said continuously rotating radiating means for limiting the effective maximum radio range to the boundaries of the region to be protected.

4. A radio protective system including means for radiating a continuously rotating sharply defined radio beam to scan an area to be protected, said area being defined by a line formed by a point rotated at a non-uniform distance about the point of origin of said beam, means for receiving said radio beam after reflection from an object within said area, means responsive to the output of said receiver for indicating the radio beam reflected from and hence the presence of said object, and means synchronized with said continuously rotating radiating means for limiting the effective maximum radio range to the boundaries of the region to be protected.

5. A radio protective system including means for radiating a continuously rotating beam of radio frequency energy to scan an area to be protected, said area being defined by the line formed by a point rotated at a varying distance about the point of origin of said beam, means for receiving said radio frequency energy reflected from an intruding object within said area, an indicator including an alarm connected to said receiver output and responsive thereto, and means synchronized with said continuously rotating radiating means for controlling the receiver response to limit the effective maximum range to the radio frequency energy reflected from objects along said line defining said area.

6. A radio protective system including means for radiating a continuously rotating beam of radio frequency pulses of radio frequency energy to form a sharply defined beam to scan an area irregularly disposed about the point of origin of said beam, means for receiving said radio frequency energy reflected from an intruding object within said area, an indicator including an alarm connected to said receiver output and responsive thereto, and means synchronized with said continuously rotating radiating means for controlling the receiver response in time relation to the radiation of said pulses to limit the effective maximum range to the radio frequency energy reflected from objects located on the boundary line of said irregularly disposed area.

7. A radio protective system including a transmitter for radiating a continuously rotating

beam of radio frequency energy throughout an area to be protected, said area being irregularly disposed with respect to the point of origin of said beam, a receiver responsive to said energy after the energy is reflected from intruding objects within said area, and means synchronized with said rotating beam for limiting the effective response of said receiver to the different ranges defined by the different times taken for said energy to travel from said transmitter to the boundaries of said area and back to said receiver.

8. A radio protective system including a transmitter for radiating a continuously rotating beam of radio frequency energy throughout an area to be protected, said area being irregularly disposed with respect to the point of origin of said beam, a receiver responsive to said energy after the energy is reflected from intruding objects within said area, and means synchronized with said rotating beam and connected to said transmitter and receiver for limiting the effective response of said receiver to the different ranges defined by the different times taken for said energy to travel from said transmitter to the boundaries of said area and back to said receiver.

9. A radio protective system including means for generating radio frequency energy, means for radiating said energy in a sharply defined beam, means for scanning an area to be protected by applying thereto said beam, a receiver responsive to said radiated energy after reflection from objects within said area, cam means operated in synchronism with said scanning means, control means connected to said receiver and to said cam means for controlling the response of said receiver to limit its effectiveness to reflections from objects within said area.

10. A radio protective system including means for radiating a beam of radio frequency energy to scan an area to be protected, said area being irregularly disposed with respect to the point of origin of said beam, means for varying the frequency of said energy as a function of time, means for receiving said radio frequency energy reflected from an intruding object within said area, an indicator including an alarm connected to said receiver output and responsive thereto, and cam means operated in synchronism with said scanning beam for controlling the receiver response as a function of frequency to limit the effective maximum range to the radio frequency energy reflected from objects located along the boundaries of said irregular area.

WINFIELD R. KOCH.

REFERENCES CITED

The following references are of record in the file of this patent:

FOREIGN PATENTS

Number	Country	Date
113,233	Australia	June 2, 1941