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AN AUTOMATIC NAVIGATIONAL RADAR TRANSPONDER

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Automatic radar transponders are known which are designed to identify navigational beacons and to determine position of ships by means of navigational radars.

The known transponders cannot be conjugated with the widely used marine radar stations "Neptun", "Don", and "Donets" and do not ensure identification of navigation beacons at close distances.

These shortcomings are eliminated in the described radar transponder by using a transmitter in it with pulse-time coding and a smooth wobbling inside the answer pulse.

The main super-high frequency bangs radiated by the marine radar are received by antenna 1 (see drawing) of the transponder, are converted to video pulses of the detector section 2, are amplified by broad-band amplifier 3, are shaped by the multivibrator 4, differentiated by the RC circuit 5, and amplified by the pulse amplifier 6. The pulses received at the output of amplifier 6 go to the shaping unit of trigger pulse 7 containing the delay line and blocking oscillator. Shaping of the pulse-time code combinations is performed in shaping unit 8 from pulses taken off the leads of the delay line of the shaping unit. The code combination goes to the input of pulse modulator 9 controlling the oscillations of the transmitter of the transponder. Klystron oscillator 10 can be used as a

transmitter. An oscillatory circuit is connected to the circuit of the reflector plate of the klystron oscillator and is used for a smooth electronic wobbling inside the answer pulse radiated by antenna 11.

Switch-in of the beacon and its maintenance in a switched-in state during reception of super-high frequency pulses at the receiving antenna and also switch-out of the beacon after interrogation pulses cease is performed by an automatic control unit containing multivibrators 12, 13, and 14, lock-on circuit 15, time relay 16, and power relay 17.

The trigger pulse goes from the output of amplifier 6 to multivibrators 12 and 14. Multivibrator 14 directly, and multivibrator 12 through the output multivibrator are connected to relay lock-on circuit 15 controlling power relay 17. When the pulse packet with a repetition period of from three to six seconds is received at the input of the control unit, the lock-on circuit operates on receiving the second packet and will operate during each successive interrogation pulse packet. If the interrogation pulses are received with a period less than three seconds, the lock-on circuit will operate 3, 4, 5 pulses depending on the interrogation frequency. With an increase in the interrogation frequency the lock-on circuit will operate every three seconds.

The lock-on circuit will not operate when single interference pulses are received or with an increase of the interrogation pulse repetition period to six and more seconds, and the beacon is not switched from a waiting to a working regime. During operation of the lock-on circuit, power relay 17 is cut in and the supply voltage is delivered to voltage transformers 18 and 19 which feed the transponder. Simultaneously with supplying power, time relay 16 is switched in thus opening the blocking circuit of power relay 17 30-40 seconds after the arrival of the last interrogation pulse packet.

For constant control of the performance of the transponder without using measuring instruments, transmitter 10 is forcibly closed and part of the emitted

power is branched through coupling element 20 to the input of detector section 2 of the receiver. The magnitude of the coupling is selected so that a signal sufficient for reliably switching on the beacon is supplied to the receiver. This signal after an appropriate amplification and conversion produces trigger pulses which act on the control unit with a self-starting frequency. When these signals act on the control circuit, the relay lock-on circuit 15, to which is connected an electric bulb (not shown in drawing) begins to operate periodically. The periodic flashes of the alarm bulb signal the normal operation of the transponder. For self-control of the transmitter's operation, the power relay is cut in by switch 21, and the blocking oscillator 7 changes to an oscillating regime. Periodic lighting of the electric bulb will attest to the normal operation of the circuit. Since the pass band of detector section 2 exceeds 180 Mc, the receiver of the responder ensures reception of signals of any frequency within the frequency range of the magnetrons used in marine radar "Neptun", "Don", and "Donets". The maximum frequency of the replies of the responder is 2000 pulses per second. Marine radars "Neptun", "Don", and "Donets" when operating at long ranges, exceeding 6 miles, have a main pulse repetition frequency of less than 2000 pulses per second. In this case the responder will send coded reply signals for each interrogation pulse. At shorter ranges the interrogation pulses will be radiated upon arrival to each second interrogation pulse. For identification of the transponders, each of them has assigned a definite pulse-time code combination. A change in the code combination is accomplished by an appropriate switching of the leads of the delay line of unit 7. Since the electronic wobbling of the reply signals emitted by oscillator 10 is carried out within the limits of the tuning frequencies of the radars "Neptun", "Don", and "Donets", the beacon signals are observed on the screen of these radars along with the signals reflected from the surroundings.

The described transponder can be used for identification of navigation

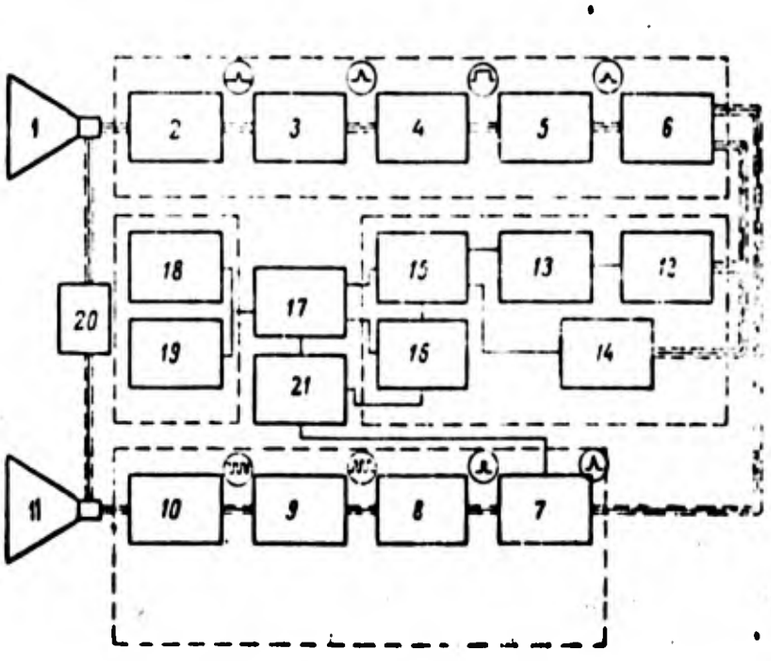
beacons, identification of objects dangerous to navigation, and homing of ships onto landmarks uncharacteristic to radar.

The effective radius of the transponder is 20 miles. The power intake in the waiting regime does not exceed 2 w and in an operating regime, 50-60 w.

Subject of Invention

1. The automatic navigational radar transponder is distinguished by the fact that in order to provide conjugation of the transponder with the "Neptun", "Don", and "Donets" marine radars and to identify navigation beacons, the transmitter has a smooth electronic wobbling inside the answer pulse and a multi-combination pulse-time coding.

2. This same radar transponder, for the purpose of a constant control of the performance of the beam without using measuring instruments, has a transmitter with a forced switch-in and a branching of part of the power emitted to the receiver and to the control circuit signalling the normal operation of the transponder by lighting of an electric bulb.



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