

Dec. 24, 1946.

E. LABIN

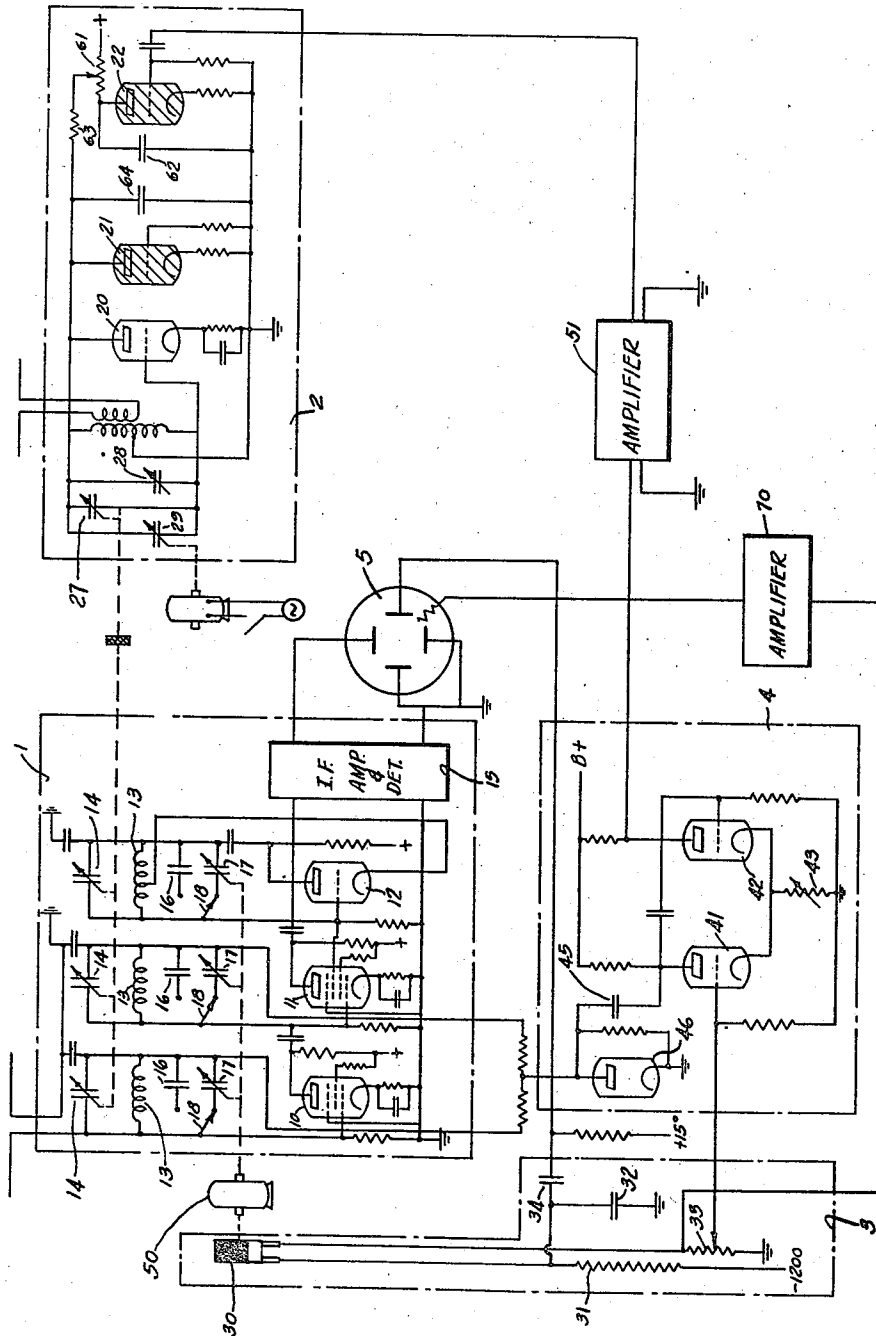
2,412,991

RADIO TRANSMISSION AND MONITORING SYSTEM

Filed July 17, 1942

2 Sheets-Sheet 1

FIG. 1



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FIG. 2

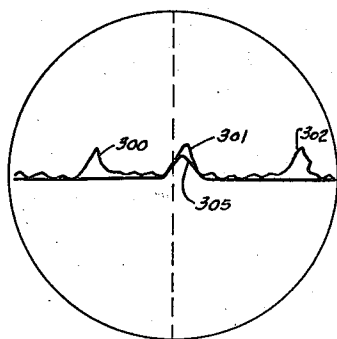
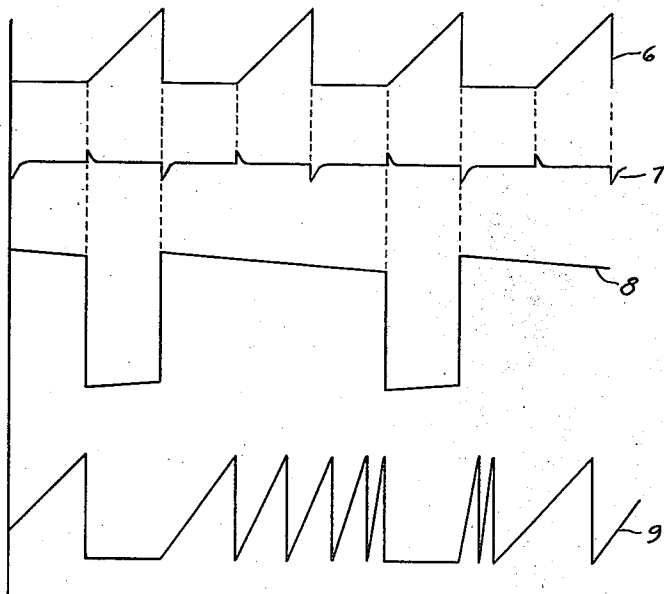


FIG. 3

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RADIO TRANSMISSION AND MONITORING
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Telephone and Radio Corporation, a corpora-
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Application July 17, 1942, Serial No. 451,302

8 Claims. (Cl. 250—17)

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This invention relates to radio systems and more particularly to radio systems for intercepting and interfering with radio transmission from particular stations.

During periods of war in particular, it is often desired to cause interference or jamming of the signals transmitted by enemy stations in order to disrupt their lines of communication. For this purpose systems have been proposed wherein a receiving station is tuned over a band of frequencies in order to locate the enemy transmission stations as to frequency of broadcast or transmission. After such enemy stations have been found then signals are transmitted on the same carrier frequency as the enemy stations and are modulated at a high level with noise signals to substantially blanket the enemy communications. In some of these proposed systems a receiver is provided which is continuously tuned over particular frequency bands so that communications may be continuously detected even though the frequency of transmission is periodically changed. At the same time the transmitter is generally tuned to a frequency somewhat adjacent the center of the slightly varied tuning band of the receiver. After the enemy station has been located then the transmitter may be more precisely tuned to interfere.

It is an object of my invention to provide a continuously tunable radio receiver of an improved type for the purpose of detecting transmitting stations.

It is a further object of my invention to provide a simple oscillating circuit for controlling the scanning of an oscillograph indicator simultaneously with the variation in tuning of a scanning receiver. It is a further object of my invention to provide a switching means for alternately blocking a transmitter and a receiver in timed relationship with the scanning of the detecting receiver.

According to a feature of my invention, a system is provided wherein a condenser is periodically charged and discharged through the medium of a mechanical switching arrangement to produce blanked saw-tooth waves for controlling the scanning of a cathode ray oscillograph. Also the saw-tooth wave may be used to blank out the return trace of the cathode ray oscillograph. At the same time this mechanical control of the oscillating circuit may be operated in timed relationship with the adjustment of mechanically variable tuning elements in a receiver so that the scanning of the beam of the oscillograph will coincide with the changes in tuning of the re-

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ceiver. Furthermore, the saw-tooth waves may be used to synchronize a multivibrator circuit or other switching circuits for the purpose of alternately blocking the transmitter and a receiver. In addition the transmitter may be provided with a separate variable condenser arrangement which will wobble the carrier frequency of the transmitter through a given range in order that the system may serve for the purpose of jamming the frequency modulated stations as well as amplitude modulated stations.

A better understanding of my invention and the objects and features thereof may be had from the particular description made with reference to the accompanying drawings in which:

Fig. 1 is a schematic circuit diagram illustrating a radio system incorporating the features of my invention;

Fig. 2 is a set of curves used to explain the operation of the system illustrated in Fig. 1; and

Fig. 3 is a view of a cathode ray oscillograph screen illustrating a type of indication which may be shown thereon.

Turning first to Fig. 1, reference character 1 designates a scanning receiver which may be automatically tuned over a given frequency range to produce scanning indications on a cathode ray oscilloscope indicator 5. A transmitter is represented at 2 which may be manually tuned simultaneously with receiver 1 to maintain the frequency of the transmitter substantially in line with the mean frequency of the receiver 1. At 3 is shown the blanked saw-tooth vibrator which serves to produce the sweep frequency for oscilloscope 5 and to synchronize the operation of a multivibrator 4 which in turn serves to alternately block receiver 1 and transmitter 2.

A more detailed description of the apparatus will serve more fully to explain the operation of the system. The saw-tooth oscillator 3 comprises rotating switch disc arrangement 30 which is half conducting and half insulating as illustrated. This switch is operated by means of a motor 50. A negative charging potential of relatively high value, for example 1200 volts, is applied across a resistor 31 during the time that disc 30 is in insulating position to charge condenser 32. The charge in condenser 32 slowly builds up in a manner indicated by the sloping portion of curve 6, Fig. 2, until disc 30 rotates around to a conducting position such as shown in Fig. 1. Condenser 32 then immediately discharges over this disc in series with a relatively small resistor 33 producing the straight line vertical portion of curve 6. The discharged condition of the con-

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denser prevails then for another half period corresponding to the horizontal portion of curve 6 of Fig. 2 because of the conducting section of disc 30 after which the cycle is again repeated. It can thus be seen that the simple system serves to produce saw-tooth wave forms in which the alternate cycles are effectively blanked out. This saw-tooth voltage is then fed over a coupling condenser 34 to the horizontal scanning electrodes of indicator 5.

At the same time the condenser discharges, a small portion of the voltage across resistor 33 is applied to the control grid of tube 41 of the multivibrator circuit 4. These peaks may be substantially of the form shown in curve 7 of Fig. 2 and serve to synchronize the operation of the multivibrator 4 with the operation of the oscillograph 5. Multivibrator 4 comprises the two vacuum tubes 41 and 42 connected so that their operation is controlled over a common cathode resistor 43 in the manner more fully described in my copending application, Serial No. 449,595, filed July 3, 1942.

These peak impulses occur during the straight return or fly-back period of scanning of the oscillograph. In order to prevent this return stroke from showing on the indicator, impulses tapped from resistor 33 are fed over an amplifier 70 to a control grid of oscillograph 5.

The output of multivibrator 4 has the form generally shown in curve 8 of Fig. 2. The small upward peaks of curve 7 serve to key the multivibrator in one direction at the beginning of every second pulse of curve 6, and the larger reverse peaks serve to return the multivibrator to its initial condition at the end of the initiating saw-tooth oscillation. Thus, the multivibrator output from tube 42 to amplifier 51 is positive substantially three-fourths of the time and negative one-fourth of the time. The output wave is reversed in amplifier 51 prior to application to transmitter 2 for blocking operation thereof. The output of amplifier 51 serves to key transmitter 4 so that the transmitter is effective substantially three-fourths of the time and blocked the other quarter. The blocking operation will be described in more detail with the complete description of the transmitter. It is preferable in a system for jamming to have the transmitter on for a substantially longer period than the receiver since this way it is more difficult for the enemy stations to carry on communication despite the interference.

The output for blocking the receiver is taken from tube 41 of the multivibrator so that the quarter period time is positive and the three-quarter period is negative. This output is fed over condenser 45 to the grid of tubes 10, 11 and 12 of receiver 1. The blocking potential for the receiver is preferably made of such value that when the transmitter is in operation the blocking may be overcome so that the transmitted signals may be received for monitoring purposes as will be described more fully later. However, the receiver sensitivity is sufficiently reduced by the blocking signal so that ordinary reception can no longer take place. In order that negative voltages may be applied to the receiver during the longer blocking intervals without influencing the normal receiver bias during the short intervening intervals when reception is desired, a rectifier 46 is provided in the output of the multivibrator to short circuit the positive portions of the multivibrator wave applied thereto.

Receiver 1 is provided with a radio frequency

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amplifier tube 10, a mixing tube 11 and a heterodyne oscillator 12, the output of the mixing stage being applied to an intermediate frequency amplifier and detector arrangement 15. Signals received over the receiver antenna are applied across the vertical scanning plates of oscillograph 5. The tuning circuits for tubes 10, 11 and 12 are represented by coils 13, variable condensers 14 and in addition fixed condensers 16 and frequency scanning condensers 17. The receiver is manually adjustable by means of the variable condensers 14 to a desired mean frequency. After tuning to this mean band, operation of condensers 17 by motor 50 serves to vary the tuning of the receiver over a given frequency range simultaneously with the scanning of the cathode ray beam in oscillograph 5. Signals received from any stations will then be indicated on the screen of the oscillograph tube by peaks such as 300, 301 and 302 shown in Fig. 3.

At the same time receiver 1 is adjusted to the mean frequency the oscillating circuit of transmitter 2 may be controlled by means of a tuning condenser 27 adjustable simultaneously with condensers 14 of Fig. 1. The transmitter comprises an oscillator 20 and a pair of gas discharge tubes 21-22 connected to operate at tandem saw-tooth vibrators. The saw-tooth vibrator arrangement for producing modulating signals for modulating the jamming oscillator is described more fully in my copending application Serial No. 449,091, filed June 30, 1942. A brief description is given herein, however, in order to explain the operation of the entire system. A charging potential is applied over resistance 61 to condenser 62 causing a building up of the voltage on tube 22 sufficient to break down this tube. This produces a relaxation oscillation of saw-tooth wave form which is preferably quite slow, for example, in the order of from 5 to 10 oscillations per second. The variable voltage output of tube 22 is then applied as the controlling potential on the second relaxation oscillation generator 21. The time constant of the circuit for the second relaxation oscillator is determined by resistor 63 and condenser 64 and is preferably very short with respect to the time constant of the first relaxation oscillator. Preferably, this second relaxation generator is made of such a short period that the variable voltage applied from the first relaxation oscillator will cause the production of saw-teeth of the second oscillator to vary between about 800 and 1200 cycles per second during each scanning period of the first relaxation oscillator. This saw-tooth modulation is applied by plate modulation to the power oscillator constituting vacuum tube 20 and its tank circuit.

The blocking signals for the transmitter are applied from amplifier 51 to the grid of tube 22 to periodically block the operation of the transmitter in the periods when receiver 1 is operated. The short positive or blocking portion of the applied signal serves to maintain tube 22 conductive so that it operates as an ordinary triode and no potential builds up on condenser 62. The longer negative portion biases the grid of tube 22 negative so that it normally carries no current and will periodically break down to provide the normal gas discharge tube function as a saw-tooth generator.

Curve 9 of Fig. 2 represents in principle the type of saw-tooth oscillations produced in transmitter 2 for the purpose of modulating the transmitter carrier wave.

In addition to tuning condenser 27 a trimmer condenser 28 is provided for the purpose of more precisely adjusting the frequency of the transmitting system. It is thus possible to adjust transmitter 2 to precisely the frequency indicated in the enemy station which is to be jammed. To facilitate this adjustment receiver 1 is preferably enabled to receive signals from transmitter 2 even though the receiver is blocked for all weaker signals. This transmitted signal is then shown on the screen of the oscillograph as indicated at 305 of Fig. 3. Tuning of the transmitter is adjusted until the peak 305 coincides with one of the peaks such as 301 which represents the station to be jammed.

While the adjustment of the transmitter for jamming may be accomplished in the above manner, more efficient and closer adjustment may be made by using the receiver at a fixed tuning position, that is, without operating scanning condenser 17 and merely relying on the manual adjustment. Accordingly, in this case, switches 18 may be operated into their upper position to substitute fixed condensers 16 in the circuit in place of the variable condensers 17. Preferably then, the scanning signal is still applied to the oscillograph 5 in order to spread out the indication on the screen of the cathode ray tube for better observation of the signal as well as for estimation of the mean amplitude thereof. The receiver is then adjusted by manual tuning until a maximum indication of the station it is desired to block shows on the screen. Then the transmitter is tuned by means of trimmer 28 until the indications on oscillograph 5 show that the effect of this transmitter is also a maximum at the signal frequency of the received wave. With this adjustment then the most efficient control for jamming the particular station is achieved. However, it is desirable then to switch back to the receiver scanning position so that any new transmissions of the enemy may be readily detected for the purpose of jamming if this is desired.

The system as described above is completely adequate for jamming the amplitude modulated transmission or for interrupting radio transmission. If frequency modulated signals are to be jammed, it is desirable however, to wobble the carrier frequency from transmitter 2. For this purpose a small variable condenser 29 is provided in shunt with condenser 28. This condenser is continuously tuned by means of a motor drive to wobble the carrier frequency both sides of its normal mean position. This will then serve to jam frequency modulated waves as well as those which are amplitude modulated. It is preferable, however, when amplitude modulated waves alone are to be jammed to permit the transmitter to operate at a steady carrier frequency since the frequency wobbling of the carrier serves to somewhat reduce the effectiveness of the system.

While I have described above a preferred embodiment of my invention, it is to be clearly understood that this serves merely by way of illustration and is not intended to define the scope of my invention. It is clear, for instance, that instead of using the saw-tooth arrangement shown in Fig. 1 the systems may be such that the condenser is gradually discharged over a permanently connected resistance unit and is periodically connected to the charging source to rapidly and completely charge the condenser. It is also clear that other types of jamming signals may be used if desired and that any form of transmitter and receiver may be provided. Furthermore, the block-

ing arrangement may be another type of system instead of the particular multivibrator unit shown and many other modifications will occur to those skilled in the art within the scope of my invention.

What is claimed is:

1. A radio receiver system comprising a radio receiver, means for continuously tuning said receiver over a predetermined frequency band, means for blocking said receiver, an oscillograph indicator in the output of said receiver, scanning means for scanning said indicator while said continuous tuning is taking place, a resistance-condenser circuit mechanically controlled means for charging and discharging said resistance condenser circuit, means for deriving from said circuit scanning waves for application to said scanning means, means for deriving blocking pulses from said circuit, means for synchronizing said means for continuously tuning with said mechanically controlled means, and means for applying said blocking pulses to said blocking means to synchronize said blocking means with said tuning means.

2. A radio system comprising a radio receiver, a radio transmitter means for continuously tuning said receiver over a predetermined frequency band, an oscillograph indicator in the output of said receiver, scanning means for scanning said indicator while said continuous tuning is taking place, means for alternately blocking said transmitter and receiver, mechanically controlled means for charging and discharging a resistance condenser circuit, means for producing scanning waves for application to said scanning means and for producing control impulses for said blocking means to commonly control the time relation between said blocking and said scanning, and means for synchronously controlling said means for continuously tuning and said mechanically controlled means.

3. A radio system comprising a radio receiver, means for continuously tuning said receiver over a predetermined frequency band, means for blocking said receiver, a cathode ray indicator in the output of said receiver, means for scanning the beam of said indicator over the screen thereof during said continuous tuning, a relaxation circuit comprising a resistance and condenser in series with a source of potential and mechanical keying means for alternately short-circuiting said source of potential, a common drive means for operating said continuously tuning means and said mechanical keying means, connections from said relaxation circuit to the scanning means of said indicator to synchronize said scanning with said continuous tuning, and connections from said relaxation circuit to said means for blocking said receiver to synchronize said blocking with said tuning.

4. A radio system comprising a radio receiver, a radio transmitter, means for continuously tuning said receiver over a predetermined frequency band, a cathode ray indicator in the output of said receiver, means for scanning the beam of said indicator over the screen thereof during said continuous tuning, a multi-vibrator, means for connecting said multi-vibrator to said transmitter and receiver for alternately blocking said transmitter and reducing the sensitivity of said receiver, a relaxation circuit comprising a resistance and condenser in series with a source of potential and rotary keying means for alternately short-circuiting said source of potential, a common drive means for operating said continuously tuning means and said rotary keying means

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whereby said tuning and said relaxation circuit are operated in timed relationship, connections from said relaxation circuit to said multi-vibrator to synchronize the blocking of said transmitter and the reduction of sensitivity of said receiver with said tuning, and connections from said relaxation circuit to the scanning means of said indicator to synchronize said scanning with said continuous tuning.

5. A radio system comprising a radio receiver, a radio transmitter, means for continuously tuning said receiver over a predetermined frequency band, a cathode ray indicator in the output of said receiver, means for scanning the beam of said indicator over the screen thereof during said continuous tuning, a control grid for controlling the beam of said indicator, a multi-vibrator means for connecting said multi-vibrator to said transmitter and receiver for alternately blocking said transmitter and reducing the sensitivity of said receiver, a relaxation circuit comprising a resistance and condenser in series with a source of potential and rotary keying means for alternately short-circuiting said source of potential, a common drive means for operating said continuously tuning means and said rotary keying means whereby said tuning and said relaxation circuit are operated in timed relationship, connections from said relaxation circuit to said multi-vibrator to synchronize the blocking of said transmitter and the reduction of sensitivity of said receiver

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with said tuning, connections from said relaxation circuit to the scanning means of said indicator to synchronize said scanning with said continuous tuning and further connections from said relaxation circuit to said control grid of said indicator for blanking out the beam during the return period of said scanning.

6. A radio system according to claim 4 further comprising tuning means in said transmitter for continuously varying the transmitted carrier wave over a range of frequencies.

7. In combination, a radio transmitter, a radio receiver, means for continuously tuning said receiver over a band of frequencies, an oscilloscope in the output of said receiver, means for alternately blocking said transmitter and receiver, means for producing a scanning potential, means applying said scanning potential to said oscilloscope, means deriving blocking pulses from said last means, means applying said blocking pulses to key said blocking means, and means for synchronizing said tuning means with said potential producing means so that a timed relationship is effected between said tuning means and said blocking means.

8. The combination of claim 7, further comprising means for selecting the band to be tuned by said receiver, means for tuning said transmitter, and manually adjustable means for simultaneously operating said last two means.

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