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This invention relates to a radio receiver adapted to receive signal communication from a plurality of transmitting stations, and in which means is provided which is actuated by impulses sent from the transmitting station, for the purpose of identifying the particular station which is transmitting and for permitting the transmitting station to communicate with a desired group of receivers or with an individual receiver of the group. This invention is in the nature of an improvement on the invention disclosed and claimed in application Serial No. 321,378 filed February 29, 1940, in my name. In said application a radio receiver is disclosed which is especially adapted for the reception of carrier waves having a frequency higher than 20 megacycles, and wherein inertialess scanning means are provided for rapidly scanning a portion of the spectrum in which a tone modulated carrier is expected to occur and for causing the receiver to automatically lock on such a carrier. It is desirable in connection with such a receiver to provide an indicating device, such as an alarm, which will notify the operator that a carrier has been locked on and the calling party is ready to speak to him. It is an object of this invention to provide an alarm device which will give an audible signal to the operator when the receiver has locked on a carrier. The alarm device is also operative to indicate the reception of a carrier by scanning a receiver which is provided with a director device for causing it to lock on the first carrier encountered, such a receiver being disclosed in patent application Serial No. 321,377, filed February 29, 1940, in my name.

Where it is desired to establish two-way communication between a plurality of stations such as A, B, C, D, etc., each provided with its own radio transmitter, and a receiver of the type above described, a call may be transmitted from station A directed to station B. If B is to set up a communication channel with A, he must obviously know who is calling so that he may arrange for the transmission of a tone frequency which A's receiver will lock on. It is another object of the present invention to provide a radio receiver of the scanning type with a plurality of indicating devices which are individual to the other transmitting stations of the group and which indicate the particular station to which the receiver has been automatically tuned. In accordance with a preferred embodiment of the invention, this indicating device comprises a series of electric lights on which are painted or otherwise marked the station designation, such as A, B, C, D, etc., and which are lighted in accordance with the station on which the receiver is locked. Upon B finding that A is calling, he may then set up a transmission modulated by the identifying tone upon which A's receiver only will lock and the indicating light marked A on A's receiver will light, indicating that the circuit is complete and that he can commence talking.

It is only after B's receiver has locked on A's carrier that energy impulses may be transmitted by station A to operate the indicator of B's receiver. Different forms of station identifying impulses might be used to operate the indicator as, for example, a selective audio tone in addition to the already existing tone which causes the locking action. It is a further object of the invention to operate the indicator by means of energy pulses in the form of a series of dots. The number of dots will determine the identification of the transmitting station, for example, station A would transmit one dot, station B two dots, station C three dots, etc.

A still further object of the invention is to provide a radio receiver with means whereby communication may be selectively established with all the receivers in a group, with a limited number of such receivers or with only an individual receiver of the group. Considering, for example, a group of 100 receivers, all could be made to lock on the general call tone frequency of, for example, 5000 cycles, and by means of a step-by-step relay having a contact arm movable over a plurality of contact points, the contact arm may be moved to contact number 1 by transmitting one dot. By providing a headphone or loudspeaker connection to number 1 contact and the audio output terminals of each receiver of the group, communication could be had with all the receivers by transmitting the 5000 cycle modulated carrier and after a short interval of, for example, one second, transmitting one dot. Each receiver is preferably also provided with means which cause it to lock on a carrier modulated by another tone frequency. For example, a sub-group of 10 receivers of the entire group of 100 could be made to lock on a tone frequency of 7000 cycles, and by connecting the headphones of the receivers to different contact points, communication could be had with any desired receiver of the group of 10. For example, contact could be established with receiver A by sending two dots, with receiver B by sending three dots, etc. While a total group of 100 receivers has been referred to, it will be understood that the inven-
tion is adapted for use with a considerably greater number of sub-groups of receivers, and practically an unlimited number of receivers in each sub-group.

For better understanding of the invention reference is made to the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a schematic circuit diagram in block form of the receiver portion of a radio receiving system embodying the invention;

Figs. 2 and 3 are schematic circuit diagrams of a radio receiving system embodying the invention;

and

Fig. 4 is a schematic circuit diagram of a radio receiver adapted for use with the invention.

It is found that the ordinary hydrogen reduced iron cores are not all suitable for permeability tuning at frequencies of the order of 100 megacycles. However, it has been found that ferromagnetic cores known under the trade name "Aladdinite" are very satisfactory. These cores are made from a synthetically produced ferromagnetic mass powder consisting substantially wholly of magnetic oxide of iron in the form of minute particles, substantially all of which, as they appear under a microscope, are of generally rounded form. These particles are preferably molded into cores by mixing with several percent of "Bakelite" as a binder.

The output circuit of amplifier 3 feeds in turn a first detector or mixing device 5, an intermediate frequency amplifier 6, a second detector 7, audio frequency amplifier 8, band pass filter 9, and a signal reproducing device 10, herein illustrated as ear phones, but it will be understood that this device is of a suitable type to reproduce any desired type of signal. If desired, the output level of the receiver may be maintained at a substantially constant volume level by an automatic volume control device 11 which may be of any known type. The amplifier 3, mixing device 5, intermediate frequency amplifier 6, detector 7, and audio amplifier 8 may be of any known type used in superheterodyne receiving for the reception of modulated carrier waves. The oscillator frequency is supplied to the mixing device 5 by an oscillator 12, whose frequency is controlled by a control tube 13 which is subject to the control of a sweep oscillator 14 preferably generating a low frequency, such as a half cycle per second. The control tube 13 is also subject to the control of a director device 15 which is in turn controlled by a switch device 16 operated by one of the tone filters 17, 18, which are connected in parallel with the audio frequency amplifier 8. The detailed construction of the amplifier 8, oscillators 12 and 14, control tube 13, director 15, switch 16, and tone filters 17, 18 will be referred to later herein.

In the operation of this receiver, the frequency of the oscillator 12 is automatically controlled over a range of frequencies by the control tube 13 through the action of the sweep oscillator 14. Upon encountering a tone modulated carrier which forms a beat frequency with that of oscillator 12 which lies within the acceptance band of the intermediate frequency amplifier 6, and to which the tone filter 17 is responsive, the switch 15 is operated which causes the director device 15 to overcome the action of the sweep oscillator 14 and maintain the frequency of the oscillator 12 at a constant value, thus locking the receiver on the carrier. The receiver will naturally remain locked on this carrier until the modulation by which the tone filter 17 is responsive disappears or until the carrier disappears, in which event the sweep oscillator 14 again takes control of the oscillator 12 and the scanning action of the receiver is resumed.

As described in the aforesaid application, the tone filter 17 of all the receivers may be made resonant to a common frequency, as for example 5000 cycles, so that upon the transmission of a carrier frequency modulated with this frequency, all the receivers of a group will lock on this carrier frequency, whereupon the operator at the transmitting station may communicate with every receiver in the group. The tone filter 17 is made resonant to a frequency which is individual to only one receiver of the group, so that the chosen receiver of a group may be tuned by modulating his carrier with this particular tone frequency may establish contact with that particular receiver of the group.

Referring now to Figure 2, the heretofore described receiver of Figure 1 is indicated by the reference character 5, the output of the receiver being connected by a transformer 18 to a tone filter 19, which is in turn connected to the coil 20 of a relay 21, through a rectifier 22, a suitable resistor 23 being shunted across the terminals of the relay winding. The armature 24, upon the operation of relay 21, serves to close a circuit through the battery 25 and the coil of a step-by-step relay 26 having an armature 27, pivoted, as at 28, and retained in its normal position against a stop T by a spring 29. At one end of the armature 27 carries a pawl 30 adapted to rotate a ratchet wheel 31, the pawl being normally held in engagement with the ratchet 30 by means of a spring 31, as shown. A friction wheel 32 mounted on a spring 33 may be provided to engage the teeth of the ratchet 30 to prevent over-running thereof. Ratchet 30 is secured to a shaft 34, to one end of which is secured a movable contact arm 35 adapted to selectively engage a series of contacts 36, 37, 38, 39, 40. For the purpose of resetting the contact arm 45 into its normal position engagement with contact 36, a spiral spring 41 is provided, one end of which is connected to shaft 34 and having its other end fixed. The contacts 33, 39 and 40 are connected by means of the circuit shown to the filaments of electric lights on whose globes may be painted or otherwise inscribed the designations of transmitting stations, herein indicated as A, C and D. Since the receiver herein illustrated is that of station B, no indicating light for this station is, of course, necessary. A battery 42 is connected to the contact arm 35 to supply current for energizing the filaments of the lights and also to supply a movable contact to contact 36 for a purpose to be later described.

For the purpose of releasing the pawl 28 upon the disappearance of the carrier, a circuit 43 is provided which includes the plate and cathode of an electron discharge tube 44, a battery 45, and an electromagnet 46, the control grid of tube 44 being connected to the automatic volume control of the receiver by the lead 47. Circuit 43 also includes the coil of the relay 48 whose armature 49 is adapted to open and close a cir-
cuit connecting the contact 35 and an alarm de-
vice herein illustrated as a bell 50.

When the receiver is hot locked on any carrier, the contact arm 35 is in engagement with con-
tact 36 and the bell 50 is unenergized. Shortly after the receiver is locked on a tone modulated
carrier by the means heretofore described, the carrier is modulated at the transmitting station with
an audio tone, as for example 800 cycles for a short period, such as one-quarter of a sec-
tound, to form an impulse which is transferred to the relay 26 through the trans-
fomer 18 and the tone filter 19 which serves to
filter out any extraneous noise components in
the modulation frequency, the rectifier 22 serving
to rectify the current supplied to relay 26. The
operation of relay 26 serves to close the circuit
through battery 25 and the coil of relay 26, caus-
ing the armature 27 of the latter to advance the
pawl 29 a distance of one ratchet tooth. This
causes the contact arm 35 to engage contact 37
and light the filament of lamp A which there
by provides a visual indication that station A is
being called. If the bell 50 is not locked, an
indication that some station is calling receiver
B. The operation of the bell 50 continues for a
short time until contact arm 35 is moved away from contact 36 by means of the dot impulse
received. In the illustrated example, after the
receiver of station A is engaged with station
C, three dot impulses are transmitted which
cause the pawl 29 to advance the ratchet wheel
30 three teeth and the contact arm 35 into en-
gagement with contact 39 so that the circuit
through the filament of light C is closed and the
light indicates that station C is calling. At the
termination of the communication, upon the car-
rier wave of the transmitting station being no
longer transmitted, current passes through cir-
cuit 43 and the coil of the electromagnet 46 which
withdraws the pawl 29 to advance ratchet wheel
30 one tooth, thereby causing contact arm 35 to
close contact 37 and the closure of the circuit
52. The operators of all receivers may then listen in on the phones 53 to the com-
munication from station A, thus permitting the
operator of station A to issue a general order to
all the station operators.

Should the operator of station A wish to set up a
communication channel with station B only, he
transmits a carrier frequency modulated with
the 7000 cycle tone frequency to which the sub-
group of receivers including receiver B is respon-
sive. After a short interval, during which the
receivers of this sub-group have locked on his
carrier frequency, station A transmits 3 dots on
the 800 cycle modulated carrier. The impulses
thus transmitted cause pawl 29 to advance ratchet wheel 30 three teeth and contact arm 35 to
engage contact 39 thereby completing the cir-
cuit through lead 51 and the phones 53 and per-
mitting the operator of B to listen to the com-
munication from A. Since receiver B is the only
one of the sub-group whose earphones are con-
nected to the third contact 35, only this par-
ticular receiver receives the communication from
A. It will be understood that in the illustrated
embodiment of the invention, the circuit 52 of
receiver A is connected to its contacts 31 and 32,
and that this circuit of receiver C is connected to
its contacts 37 and 40. At the termination of the
communication, upon the carrier wave of the
transmitting station being no longer transmitted,
current passes through circuit 43 and the coil of
electromagnet 46, which withdraws pawl 29 from ratchet wheel 30, whereupon the spring 41
returns the contact arm 35 into its normal posi-
tion in engagement with contact 36. While in
the illustrated embodiment of the invention, a
series of only 3 contacts is shown associated with
contact arm 35, it will be understood that any
desired number of contacts may be provided in
according with the number of receivers in each sub-group.

It will be noted that little provision has been made for preventing the actuation of the step再生 by static impulses, since the apparatus is particularly intended for use at ultra high frequencies of 100 megacycles and above, where static is seldom if ever encountered. For a more detailed description of the means for causing the receiver to lock on a carrier modulated by a suitable tone frequency reference is made to Fig. 4 in which the audio amplifier is shown comprising the tubes VT1 and VT9 which are resistance coupled, as shown, the latter tube also being provided with an extra plate 54 which cooperates with the tube cathode 55 to provide a diode rectifier. The output circuit of tube VT9 is connected to the earphone 10 by means of a band pass filter 9. The filter comprises a push pull output transformer 56 which is designed to have a considerable amount of leakage resistance and whose primary winding has a condenser 57 connected across it as a filter of the value of this condenser, a sharp cut off above 3000 cycles is obtained so that any tone frequency of 4000 cycles or higher ceases to be annoying to the user, even when the tone frequency is left continuously during the speech transmission. It is found that a filter of this type will allow the usual range of telephonic speech frequencies to pass and provide a rapid attenuation above those limits.

The scanning device 14 comprises the vacuum tubes VT5 and VT6, the plate of each tube being connected to the grid of the opposite tube through the condenser C1 and C2 having a capacity of 0.5 mfd, and the grids of the tubes being connected to their cathodes through the 2.0 megohm resistors R5 and R6, to thereby produce a half cycle sweep voltage of substantially square wave form. This voltage is supplied to the control grid of a control tube VT4 through a lead 58, resistor R7 and condenser C3, the latter serving to block out the direct current voltage. Resistor R3 and condenser C4 act as a filter to take voltage of square wave form at the plate of tube VT6 and change it to a substantially sinusoidal wave form. At the same time the resistor R1, being 10 megohms, reduces the voltage from some hundred volts to about 5 volts. A further advantage in making R1 so large is that it does not destroy the symmetry of the sweep oscillator 14. It will be realized that the half cycle oscillator covers the entire scanning spectrum in one direction completely in one second. A control voltage is also supplied to the control grid of tube VT4 through resistor R9 and the director line 58 by the director device 15.

The director 15 consists of a director driven tube VT1 whose control grid is connected through lead 59 and condenser C5 to the output of the intermediate frequency amplifier 6, the cathode of the tube being connected to ground through the resistors R14 and R15 connected in series. The tube cathode is connected to the supply voltage source through the resistor R13 and the R12. R13 is also connected through the resistor R16 to the screen grid 61 of the tube VT1 and also to the plate of the switching tube VT10, as shown. The plate circuit of tube VT1 comprises the low impedance primary windings 62 and 63 which are coupled, respectively, to the secondary transformer winding 64 which in turn is tapped to form TC and TC2, one of which is tuned to a frequency of 5 to 10 kilocycles above the intermediate frequency, and the other of which is tuned by the same amount below the intermediate frequency. These circuits feed the diodes VT2 to develop a differential voltage across the resistors R1 and R2. As shown, one end of the resistor R1 is grounded and one end of resistor R2 is connected by director line 58 and resistor R9 to the control grid of tube VT4.

The oscillator 12 is shown as comprising the tube VT3 whose cathode is grounded and whose plate circuit is shown to Fig. 4 in which the tube VT3 comprises the coil L1 and condenser C5. It is found that by making the condenser C4 of fixed value and varying the inductance of coil L1 so as to change its permeability, as by means of a powdered ferro-magnetic core, as indicated at 58, substantially equal percentage tuning effects are secured throughout the band of frequencies. This core is preferably of similar construction to the core 4 above described.

Considering the circuit which is grounded at the lower end of coil L1, the oscillator grid receives from the plate energy of tubes VT3 and VT4 representing the mutual inductance of the tickler coil with L1. The grid current at the end of L2 is thus exactly 180° out of phase with the circulating current in L1. Before reaching the grid of tube VT3, the circuit comprising the coil L1 and the series leakage inductance, represented by L2, which produces a reactance of rather small amount, but which is quite effective due to the heavy current flowing through it. At the grid of VT3, energy is supplied which is so phased in relation to the plate tank circuit as to cause the tube to oscillate, but is not quite 180° phase angle from the plate. The amount of phasing may be varied as desired, by making L3 of the proper value, even, if necessary, by winding an additional uncoupled coil in series with the grid, or by more loosely coupling L2, and by making this coil larger we can increase the leakage inductance to any desired amount without having any physical coil, as represented by L3. With this energy, preampliﬁed, as described, the grid of VT3 is further phasaded in the same direction by the series resistance R3.

For the purpose of controlling the frequency of the oscillations generated by oscillator VT3, the plate of tube VT4 is connected to that of a control tube VT4 and both plates are connected to the mixing device 5 through a condenser 56. Control tube VT4 is provided with the usual supply voltage, its inner grid being given a normal bias of approximately 6 volts by connecting its cathode to the bleeder resistor 57 at a point approximately this number of volts above ground. This permits the operation of the tube at the mid-point of its control range, as determined by plotting a curve of grid bias against oscillator frequency which results in a S-shaped curve, so that as we approach the mid-point thereof. The voltage generated by the sweep oscillator 14 is arranged to be a total peak-to-peak of 6 volts so that the effective voltage at the grid of control tube VT4 from the sweep oscillator is 1.5 volts. The voltage swing changes the frequency of the oscillator tube VT4 by an amount sufficient to sweep the receiver through a range of frequencies approximately 1% of the carrier frequency. When the director is rendered operative, in a manner to be described, it generates a voltage of 1 to 2 volts on the weakest signal for which the system is designed. This voltage is sufficient to overpower the sweep voltage and
to tune the receiver to the incoming carrier within approximately 1 kilocycle, at a carrier frequency of 150 megacycles.

The means for rendering the director operational and to carry the carrier modulated by the proper tone frequency comprises the switching tube VT10 which is energized by the tone filter 17 or 17' (Fig. 1). This filter comprises an amplifying tube VT8 whose grid is connected to the audio amplifier through a small condenser C7 and the coupled resonant circuits TC3 and TC4 which may be permeability tuned to the desired tone frequency, as indicated at 68. Where the identifying tone frequency is within the preferred range of from 4500 to 20,000 cycles, each of these circuits is tuned to that frequency.

The selected tone frequency voltage is amplified by tube VT8 in a resistance coupled stage and rectified by the circuit including the diode 54, 55 and resistor R11, one end of which is grounded. The grid of the audio output tube VT9 is normally biased to -10 volts by means of the self-biasing resistor 69 which is shunted by a condenser 70. This arrangement provides a normal negative voltage of -10 volts on the plate 54 of the diode with reference to its cathode 85. A signal must, therefore, develop a potential on the positive peaks in excess of the 10 volts negative bias in order to permit the diode to rectify. A weak desired signal which may, for example, be modulated at a tone frequency of 5000 cycles for purposes of station identification, be scanned by the action of the oscillator 12, control device 13 and sweep oscillator 14, and in about 3 milliseconds builds up in the resonant circuits TC3 and TC4 to approximately full amplitude. This voltage is amplified by tube VT6 and impresses substantially 20 volts positive, is added to the plate of the plate 54, thus overcoming its 10 volts negative bias and producing a rectified output voltage across R11 of the order of 10 volts. This voltage is filtered by the filter circuit comprising resistor R12 and C8 and will be hereafter referred to as the operating voltage.

It is assured that no director voltage is developed when the receiver is passing through the extremely strong undesired carrier by maintaining the screen 61 at a potential of from 20 to -10 volts positive with respect to the cathode. The cathode of this tube remains at substantially 50 volts above ground, the screen voltage is 30 volts negative with respect to the cathode.

When a desired signal is encountered and current of the tone frequency builds up the switch operating voltage as before described, this voltage is negative due to the passage of current through the diode 54, 55 and resistor R11. This negative voltage being applied to the grid of tube VT10 is sufficient to block this tube with the result that the flow of current through resistor R16 is considerably decreased and the voltage of screen 61 immediately rises to about 150 volts above ground and VT1 is then operative upon the reception of a carrier signal being received, resonant voltages are built up in the circuit TC1 and TC2, the differential voltage developed being applied to the grid of the control tubes VT4. This voltage is sufficient to override the sweep voltage developed by the sweep oscillator 14 and lock the receiver on the carrier. The noise voltages appearing in the director line 68 are preferably filtered out by the filter circuit which comprises the internal resistance of the director device which is about 2 megohms, and the condenser C4 which has a capacity of 0.5 microfarad.

It is to be noted that both the tone and the carrier must be present to maintain this condition. If either one disappears for more than a few milliseconds, the director drive tube VT1 becomes blocked so that no director voltage is developed and the receiver instantly resumes the scanning condition under the control of the sweep oscillator 14.

Should a very strong undesired carrier be encountered having, for example, 6000 cycles modulation on it, the requisite switch operating voltage will not be developed by the resonant circuits TC3, TC4.

The voltage developed by the circuits TC3, TC4 as determined from their combined selectivity curves at 6000 cycles is only about one-tenth of that developed at their resonant frequency of 5000 cycles. But this voltage difference itself would be insufficient to prevent the development of an effective switch operating voltage which might lock the receiver on an undesired carrier which may be 100,000 times stronger. One of the means which has been found effective to prevent the development of the switch operating voltage for an undesired carrier comprises the tube VT7, the constants of this tube and its associated circuits being designed so that the maximum power developed in its plate circuit is substantially 100 milliwatts. This amount of energy is insufficient to develop more than about 7 peak volts across the diode 54, 55 when a very strong signal modulated at 6000 cycles is encountered since to get any substantial response from a resonant circuit off its resonant frequency, a considerable amount of power is required to drive it. The 7 volts developed across the diode is 3 volts less than the minimum voltage required to develop any direct current voltage across R11 so that no output voltage whatsoever is developed in the diode circuit and the tone switch is not operational to render the director effective to lock the receiver on the 6000 cycle modulated carrier.

When a very strong undesired carrier is swept over, a large transient voltage is developed as the slope of the resonance curve of the receiver slides past the carrier frequency. This strong transient does, by shock excitation, cause the oscillation of circuits TC3, TC4 at their own resonant frequency, but due to the extremely limited driving power provided in the output circuit of tube VT1, only about 5 volts is generated across the circuit TC4 after amplification by VT8 which is, of course, insufficient to overcome the biasing voltage of diode 54, 55 so that no switch operating voltage is developed.

The sweep oscillator 14 and its associated filter circuit comprising R7 and C4 illustrated develops a substantially sine shaped voltage wave to effect the scanning action, but it will be understood that a source which generates a voltage wave of other desired shapes such as triangular, sawtooth, etc., may be used.

It has been noted after considerable experience with receivers of this type that as the frequency is raised we can attain such a frequency that the
ordinary noises which prove so troublesome in ordinary reception, such as static, diathermy machines, sparking commutator motors and ignitions, noise, gradually die out, and at some vague point, probably below 150 megacycles, become extremely rare in a sharp receiver. There is left, of course, the thermal agitation noise in the circuits and the noise and shot effects in the tubes. This is a more or less regular hiss which is present throughout a definite and dependable character and is easily recognized by anyone skilled in the art.

Where space and weight are no consideration in designing a receiver of this type, we should probably always prefer a definite sweep voltage such as that produced by the 0.5 cycle oscillator shown in Figure 4, but experience has shown that if the switch SW2 be closed, the fluctuating noise voltages produced in the output of the audio stage VT1 by the amplification of the thermal agitation and shot effect current of the first stage is sufficient to sweep the control tube through its entire range quite rapidly and at random, but in a given period we find we cover the entire useful range of sweep in less than a second, although it is recognized that several pulses of the same polarity may follow each other rather than the smooth pulses of always alternate polarity which we obtain from the more disciplined action of the 0.5 cycle oscillator, which is, of course, omitted under this condition. The above condition obtains only when the receiver is of great sensitivity, i.e., so sensitive as to develop on peaks a voltage sufficient to fully control the control tube.

In a receiver designed for operation over a tuning range of from 100 to 200 megacycles the following circuit constants are found suitable.

\[
\begin{align*}
R_1 &= R_2 = 0.5 \text{ megohm} \\
R_3 &= R_4 = 0.2 \text{ megohm} \\
R_5 &= R_6 = 2.0 \text{ megohms} \\
R_9 &= 5.0 \text{ megohm} \\
R_7 &= 10 \text{ megohms} \\
R_{10} &= 25,000 \text{ ohms} \\
C_1 &= C_2 = C_3 = C_4 = 0.05 \text{ mf.} \\
R_{17} &= 125,000 \text{ ohms}
\end{align*}
\]

The general B+ supply is 250 volts. Vacuum tubes of the following types are found suitable for use with the circuits described:

- VT1 = type 6J7 pentode
- VT2 = type 6H6 double diode
- VT3 = type 555 acorn triode
- VT4 = pentode 564 acorn pentode
- VT5, VT6 = type 6N7 double triode
- VT7, VT8 = type 6N7 double triode

In using the receiver, the operator tunes the input circuit of the radio frequency amplifier so that it will pass the carrier frequency or frequencies of the transmitter or transmitters with which it is desired to establish contact. In the illustrated embodiment this tuning is effected by manual adjustment of the permeability tuning means which is uncontrolled in any known manner with the tuning means of the oscillator. Since the frequency of oscillator vibrations is being cyclically varied through the action of the control tube VT4 whose reactance is in turn being cyclically varied by the sweep oscillator VT5, VT6, as soon as a carrier appears which forms a beat frequency with the oscillator frequency which lies within the frequency band passed by the intermediate frequency amplifier, an energizing voltage is applied through lead 59 to the control grid of the director driver tube VT1. If the received carrier is not modulated by the proper tone frequency, the tube VT1 is blocked in the manner above explained and no director voltage is built up in the circuits TC1, TC2, so that the receiver is not locked on the carrier, but the oscillation continues under the control of the sweep oscillator 14. Upon receiving a desired carrier which is modulated with the tone frequency to which the tone filter circuits TC3, TC4 are resonant, a tone switch operating voltage is developed across the diode 30 and 40 grid of the director driver tube WT1 which will capacitively block the tube VT10. This action causes the voltage of screen 51 to rise very substantially, so that the plate current of VT1 energizes the director VT2, and a minimum director voltage of ±50 volts is developed and through line 58 is applied to the heavy plate transformer and tube VT4. This high voltage overpowers the control voltage of ±3 volts developed by the sweep oscillator and serves to maintain the reactance of the control tube at a substantially constant value, thereby maintaining the oscillator frequency at a substantially constant value which heterodynes with the carrier frequency to produce the proper beat frequency which lies within the band of frequencies passed by the intermediate frequency amplifier 6. The receiver remains in this condition to follow each carrier, but is blocked when a modulated carrier is received. If the carrier disappears, no voltage is supplied through line 59 to energize the director with the result that no director voltage is developed and the receiver resumes the scanning condition under the control of the sweep oscillator 14. If the carrier continues to be received but the tone modulation disappears, no currents are available of the tone modulation frequency in the output circuit of tube VT1, so that no switch operating voltage is developed by the tone filter. This causes the tube VT10 to draw almost no current and the voltage of screen 51 to drop low enough to block the director driver tube VT1. Since no director voltage is now developed or applied to the control grid of the control tube, the sweep oscillator resumes control of the control tube and the scanning operation is resumed.

When a receiver of this type is to be used in point-to-point communication where there is no possibility that the carrier wave will seriously weaken once contact has been established, it is perfectly feasible to operate the receiver in the "tone lock, carrier hold" condition. In this condition the tone is impressed on the carrier only for a second or so to be sure the receiver has had time to lock on the designated carrier, and the tone is then removed leaving the receiver locked on the carrier. Means for doing that include the connection 71 and the switch SW1. Upon closure of this switch the receiver is placed in the "tone lock, carrier hold" condition, since any negative voltage developed across R1 will be applied to the grid of VT10, the switch tube. Assuming a receiver to have scanned its usual portion of the spectrum, and encountered a carrier having a proper tone to which TC3 and TC4 are tuned, the necessary switch operating voltage will appear across R41, and be applied to VT10. While the receiver is scanning, of course, VT1 is blocked and no voltage can appear across R4. However, once VT10 switch tube has been blocked, VT1 in turn is unblocked and a negative voltage builds up across R4 due to the carrier wave. This negative voltage is applied to the grid of VT10 through the connection 71 and is of sufficient amplitude to maintain VT10 in a fully blocked condition. If the tone
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is now removed from the carrier, the voltage from R1 will hold the system in operative condition until such time as the carrier wave disappears. If this happens, that once the carrier disappears, the receiver resumes the scanning condition and will again lock only when a carrier identified by the proper tone is encountered.

While the receiver shown in Fig. 1 and above described is a single superheterodyne, the apparatus in which the invention was developed was a double detection type superheterodyne with a first intermediate frequency of 17.5 megacycles and a final intermediate frequency of 0.46 megacycle.

I have described what I believe to be the best embodiments of my invention. I do not wish, however, to be confined to the embodiments shown, but what I desire to cover by Letters Patent is set forth in the appended claims.

I claim:

1. A radio receiver comprising, in combination, a signal reproducing means, an input portion receptive to signal modulated carrier waves of a single predetermined frequency transmitted from any one of a plurality of transmitting stations and indicating means other than said signal reproducing means coupled to said receiver and responsive to modulations other than the signal modulations on the received carrier for indicating the identity of the transmitting station, said indicating means comprising a member selectively adjustable between an initial position and terminal positions and means responsive to the disappearance of the carrier for automatically returning said member from a terminal position to its initial position.

2. A radio receiver having an input portion receptive to signal modulated carrier waves of a single predetermined frequency transmitted from any one of a plurality of transmitting stations, indicating means coupled to said receiver and responsive to modulations on the received carrier for indicating the identity of the transmitting station, an alarm device, means connected to said receiver and responsive to a received carrier for causing the operation of the alarm device, and means responsive to the disappearance of the carrier for restoring the indicating means to its initial condition.

3. A radio receiver having an input portion receptive to signal modulated carrier waves of a predetermined frequency transmitted from any one of a plurality of transmitting stations, a signal reproducing device responsive to the signal modulations continually coupled to the output of said receiver, a sound producing device, means connected to said receiver to automatically cause said sound producing device to become operative upon the reception of carrier current in the input portion of the receiver, a tone filter electrically connected to said receiver and means responsive to the passage of current through said tone filter to automatically render said sound producing device inoperative.

4. A radio receiver adapted to receive speech modulated carrier waves, said receiver comprising in combination, a translating device for reproducing the speech modulations, a movable switch arm, and a circuit arranged to connect the output of the receiver to said translating device, said circuit including a portion having one end thereof continuously connected to the output of the receiver and its other end to said movable switch arm, said switch arm being normally positioned so as to disconnect the translating device from the output of the receiver and means connected to the receiver and responsive to a single tone modulated carrier impulse for moving the switch arm from its normal position into position to connect the translating device to the receiver.

5. A radio receiver adapted to receive signal modulated carrier waves comprising, in combination, a translating device arranged to reproduce the signal modulations, a movable member connected to said output circuit and adjustable between an initial position and at least two other positions, a circuit arranged to connect the translating device to said movable member in response to the adjustment of the movable member into either of said other positions and means responsive to modulations on a received carrier for selectively adjusting the movable member from its initial position to either of said other positions.

6. A radio receiver adapted to receive signal modulated carrier waves comprising, in combination, a circuit tunable over a range of frequencies, means for automatically tuning said circuit over the frequency range, means responsive to the reception of modulation on a carrier having a frequency within said range for rendering ineffective the action of said automatic means on the modulation on the tuning of said circuit, a signal reproducing device and means responsive to modulations other than the signal modulations on a received carrier for selectively causing the signal reproducing device to remain inoperative or to cause it to reproduce the signal modulations on the carrier.

7. A radio receiver of the superheterodyne type adapted to receive signal and tone modulated carrier waves, said receiver comprising, in combination, a first detector, an oscillator, means for automatically varying the frequency of the currents generated by said oscillator, means responsive to the tone modulations on a received carrier for rendering ineffective the action of said automatic means on the oscillator, a signal reproducing device and means responsive to modulations other than the signal modulations on a received carrier for selectively causing the signal reproducing device to remain inoperative or to cause it to reproduce the signal modulations.

8. A radio receiver system for receiving signal and tone modulated carrier waves comprising at least two radio receivers of the superheterodyne type, each of said receivers comprising, in combination, a first detector, an oscillator, means for automatically varying the frequency of the currents generated by said oscillator, means responsive to the tone modulation on a received carrier for rendering ineffective the action of said automatic means on the oscillator and a signal reproducing device, means responsive to a predetermined number of modulations on a received carrier for causing the signal reproducing devices of all the receivers to reproduce the signal modulations on the carrier and means responsive to a different number of modulations on the carrier for causing the signal reproducing device of only one receiver to reproduce the signal modulations on the carrier.

9. A radio receiver adapted to receive signal modulated carrier waves comprising, in combination, a translating device arranged to reproduce the signal modulations, a movable member connected to said output circuit and adjustable between an initial position and at least two other
positions, a circuit arranged to connect the translating device to said movable member in response to the adjustment of the movable member into either of said other positions, means responsive to modulations on a received carrier for selectively adjusting the movable member from its initial position into either of said other positions and means for automatically returning the movable member to its initial position in response to the disappearance of the carrier.

10. A radio receiver comprising, in combination, a signal reproducing means, an input portion receptive to signal modulated carrier waves of a predetermined frequency transmitted from any one of a plurality of transmitting stations, a plurality of spaced contacts, an alarm device connected to a first of said contacts, an indicating device other than the signal reproducing means connected to a second of said contacts and adapted to indicate the identity of a transmitting station, a switch blade movable along said contacts and normally positioned on said first contact, means responsive to the reception of a carrier wave to automatically cause the operation of said alarm device while said switch blade is on said first contact and means responsive to modulations on the carrier to advance said switch blade from said first contact onto said second contact to thereby cause the operation of said indicating device.

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