

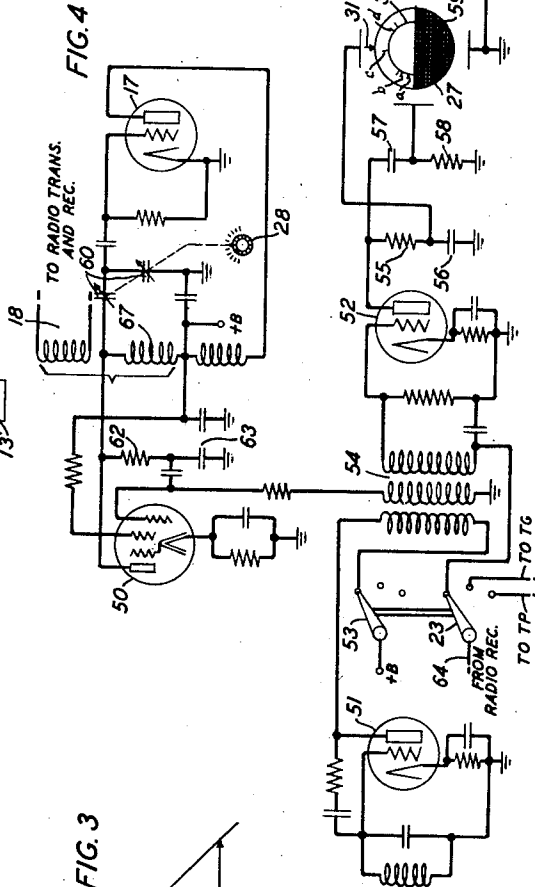
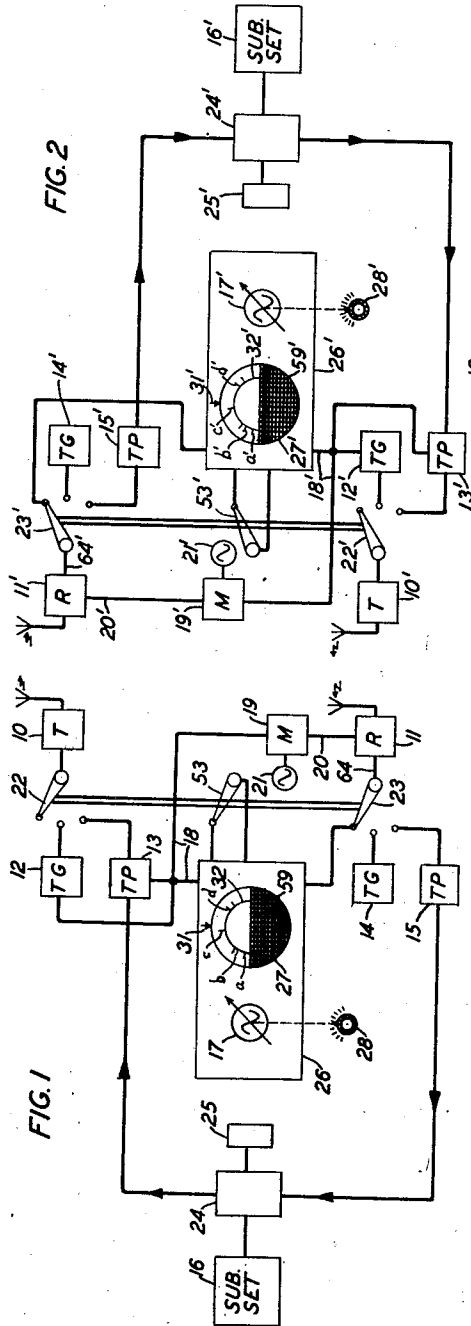
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TWO-WAY RADIO COMMUNICATION

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TWO-WAY RADIO COMMUNICATION

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The present invention relates to radio telegraphy or telephony and especially to means for rapidly monitoring an ether wave band and setting up a communication channel on a wave-length in that band.

An object of the invention is to facilitate finding and putting to use a suitable wave-length for communication purposes especially at the times when many of the available wave-lengths in the ether wave band of interest are already in use.

A feature of the invention comprises a means for simultaneously scanning an ether wave band and tuning a radio transmitter or receiver or both.

A further feature comprises a means for signaling the distant radio station through the scanning or monitoring set of that station.

The present invention, in its more specific aspects, may make use of a visual ether wave band monitoring apparatus, in itself known in the art, such as a cathode ray oscilloscope to indicate on a frequency scale the points corresponding to the wave-lengths that are in use at a given time. In accordance with a feature of the invention, an ether wave band monitoring circuit is coordinated with radio station tuning means to facilitate rapid selection and appropriation of an available frequency. As soon as a frequency is selected and appropriated by the transmission of a carrier wave of the selected frequency, other radio stations having similar equipment receive a "busy" indication showing that such frequency has been taken for use, this indication appearing as a line, spot or other signal on the monitoring oscilloscope of each such station. The wanted station is then called, as for example, by flashing the call signal of that station on the monitoring oscilloscope; and, in accordance with a feature of the invention, the operator at the called station upon noting the call signal can quickly place the station in two-way communication with the calling station by merely moving the station tuning control so that an index on the oscilloscope coincides with the flashing line or spot. There is no necessity of reading a position on a scale and translating the reading into a tuning adjustment since the station tuning control is coordinated with the ether wave band monitoring circuit.

The nature of the invention and its objects and features will appear more fully from the following detailed description in connection with the accompanying drawing.

In the drawing, Figs. 1 and 2 are block schematic diagrams of two radio stations adapted for communication with each other and embodying the present invention;

Fig. 3 is a frequency diagram to facilitate the

description of the general method of operation according to the invention; and

Fig. 4 is a circuit diagram of the scanning or monitoring and tuning circuits such as may be employed in the stations in Figs. 1 and 2.

Referring first to Fig. 1, a radio transmitter 10 is indicated as having a telegraph input circuit 12 and a telephone input circuit 13. Similarly, radio receiver 11 is indicated as having a telegraph output circuit 14 and telephone output circuit 15. The showing of these parts is purely conventional and merely for illustrative purposes; and it is assumed that any suitable known types of apparatus may be used for these parts. The radio transmitter 10, by way of example, may comprise suitable power amplifying and antenna coupling circuits and the telephone input 13 may comprise suitable circuits for modulating the radio wave by input speech waves from subset 16. Carrier waves are supplied to the telegraph input 12 and telephone input 13 from a source 17 over lead 18.

The radio receiver 11 may comprise an antenna coupling circuit and superheterodyne stage, the superheterodyning frequency being furnished from modulator 19 over lead 20. An oscillator 21 delivering to the modulator 19 a wave of the intermediate frequency used in the radio receiver 11 is combined with the carrier wave furnished by lead 18 to supply a heterodyning wave of proper frequency. For example, if the carrier wave used for both transmitting and receiving has a frequency of 2,000 kilocycles and if an intermediate frequency of 100 kilocycles is used in the receiver 11, the source 21 delivers a wave of 100 kilocycles and circuit 20 then applies to the receiver 11 a wave having a frequency of 2,100 kilocycles, which upon beating with the received carrier wave yields an intermediate frequency of 100 kilocycles for selection and detection by radio receiver 11. Ganged switches 22, 23 permit connection of the desired transmitting and receiving circuits to the radio transmitter 10 and receiver 11.

The subscriber's set 15 is shown connected to the telephone transmitting and telephone receiving circuits 13 and 15 by way of hybrid coil 24 provided with balancing network 25. Alternatively, a transmit-receive switch may be used in accordance with known practice controlled, for example, from a push button in the subscriber's set 15.

The ganged switches 22, 23 have three positions: As shown, the upper position is for monitoring, the middle position is for telegraphy, and the lower position is for telephony. The normal position is the upper or monitoring position.

When switch 23 is in monitoring position, the radio receiver 11 is connected to the monitoring circuit indicated generally by the box 26 and the oscilloscope 27. The carrier generator 17 is provided with a manual tuning adjustment 28 and also with a sweep circuit (to be described) in the box 26 for sweeping the carrier frequency over as wide a wave band as is to be scanned at any one time, this band being sufficiently wide to include the frequencies of a number of communication channels in an ether wave band. By means of circuits to be specifically described hereinafter, whenever the frequency of the oscillator 17 in its sweep allows receiver 11 to pick up a carrier wave in use, the corresponding indication appears in the form of a line or spot on the oscilloscope 27. Certain of these marks are indicated in the drawing at *a*, *b*, and *c*. An index mark 31 shows the relative location on the circular sweep scale 32 of the mean frequency of the oscillator 17.

By observing the markings on the oscilloscope screen, the operator is enabled to tell which portions of the ether wave band that is being scanned are in use and which are free. Assuming that the space between marks *a* and *b* is free and that the operator desires to utilize this part of the band for communicating purposes, he moves the dial 28 to shift the frequency of the source 17 so that index 31 falls in the space between the marks *a* and *b*. In reality the index 31 remains stationary, while the marks, *a*, *b*, *c*, etc., rotate as the dial 28 is turned. When the operator has tuned the oscillator 17 to the desired frequency as indicated on the oscilloscope, he moves the ganged switches 22 and 23 out of the monitoring position into the middle position, thereby connecting the telegraph input and output circuits 12 and 14 to the transmitter 10 and receiver 11, respectively. Movement of a third switch arm 53 (Fig. 4) out of its monitoring position stops the sweeping action of the oscillator 17 and leaves the frequency set in accordance with the positioning of the dial 28, in a manner to be described in connection with Fig. 4. This causes the carrier wave from the oscillator 17 to be transmitted continuously from the transmitter 10 except as it may be interrupted or modulated by the telegraph input circuit 12.

The equipment at the station shown in Fig. 2 and at other idle associated stations is identical with that in Fig. 1 and the parts are indicated by the same reference characters primed. When the foregoing operations have taken place, therefore, and with ganged switches 22' and 23' in monitoring position, an additional line or spot appears on the oscilloscope 27', between the lines *a'* and *b'*, since receiver 11' detects the carrier waves sent out from oscillator 17. The operators at the station in Fig. 2 and other idle associated stations, upon observing this line or spot, do not as yet know which station is being called. Assuming, however, that the station in Fig. 2 is to be called from the station in Fig. 1, the operator at the latter station actuates telegraph input circuit 12 to interrupt the transmitted carrier wave in accordance with the telegraph code of the call letters of the station in Fig. 2 so that the line or spot on the oscilloscope 27' resulting from the carrier wave from oscillator 17 in Fig. 1 flashes in accordance with the code of these call letters. The operator at the station in Fig. 2, upon noting his coded call letters, turns the dial 28' until the index 31' exactly coincides with the flashing line or spot,

whereupon he moves the ganged switches 22', 23' to their middle position. Movement of a third switch arm 53' out of its monitoring position stops the sweeping action of the oscillator 17' and leaves the oscillator set at the same frequency as oscillator 17 of the calling station in Fig. 1. The operator at the station in Fig. 2 may then actuate his telegraph input circuit 12' to communicate with the station in Fig. 1; and both stations are now in condition to communicate with each other either by telegraph or by telephone, depending upon the position of the ganged switches.

It is thus seen that tuning at the oscillator 17 is coordinated with the indications on the oscilloscope 27 so that the operator is relieved from taking any actual numerical readings or translating readings on the oscilloscope into settings on the dial 28. The entire operation is reduced to relative positioning of lines or spots on the oscilloscope with reference to the index 31.

The indications on the oscilloscope 27 represent frequencies spaced above and below some mid-band or mean frequency. This is indicated in Fig. 3 where the scale is shown as a straight line instead of a circle, for convenience. Several mean-frequency settings are indicated at $F_0, F_1 \dots F_n$. These mean frequencies are determined by the manual adjusting means 28. Concentrating attention for the moment on mean frequency F_3 , the heavy horizontal line indicates that the sweep with this mean-frequency adjustment extends between about F_0 and about F_n as limited by the visible portion of the oscilloscope 27. Markings corresponding to intercepted waves are shown at *a*, *b*, *c*, etc. If the wavelength corresponding to frequency F_2 is to be selected for use, the dial 28 is moved to bring the index 31 at the top into a position between marks *b* and *c*, these being indicated in the diagram of Fig. 3 on the horizontal line *x*. With this manual adjustment, the sweep now extends between an upper frequency in the neighborhood of F_3 and a lower frequency somewhat below F_0 . From one point of view, diagonal line *y* in the diagram represents the position of the index 31; and the several horizontal lines show how the markings *a*, *b*, *c*, etc. are shifted with respect to the index 31 as the manual adjustment of the oscillator is shifted.

Referring to Fig. 4, the source 17 is shown as a vacuum tube oscillator of conventional design having a resonant frequency determining circuit including as elements the tuning condensers 60 which are adjustable by the knob 28 to change the frequency. The circuit 18 of the output carrier wave is coupled to the resonant circuit inductance 61.

For the purpose of providing a sweep, a reactance control tube 50 is provided for changing the frequency of the oscillator 17 as a function of the voltage impressed on the control grid of the tube 50. For this purpose, the plate circuit of the tube 50 is connected across the inductance 61 while the control grid is coupled to the oscillator circuit through a phase shifting circuit comprising resistance 62 and capacity 63 in a manner known in the art. When relatively low frequency voltages are applied to the control grid of tube 50, corresponding changes are made in the oscillator frequency.

A sine wave sweep generator 51 of conventional design is provided for supplying to transformer 54 a sweep controlling frequency of, for example,

25 or 50 cycles per second or any other suitable frequency. One winding of this transformer is included in the control grid circuit of tube 50 so that the frequency of the oscillator 17 is caused to vary up and down from its mean-frequency setting as indicated in Fig. 3.

The oscilloscope 27 is shown as having vertical and horizontal plates connected to the output of amplifier tube 52 through the medium of phase shifting circuits 55, 56 and 57, 58 to provide a rotating field for the oscilloscope beam when a sine wave of suitable frequency is applied to the grid of amplifier 52. Such a sine wave is applied through a third winding on the transformer 54 from the sweep generator 51. The beam is, therefore, caused to rotate and trace a circular path 32 on the screen. The grid circuit of the amplifier 52 is shown connected through one arm of switch 23 in the monitoring position to the conductor 64 leading from radio receiver 11 in Fig. 1. When the frequency of the oscillator 17 is cyclically swept through its monitoring range, the receiver 11 has its tuning swept over the desired ether wave band; and, whenever wave energy is intercepted, it is applied from conductor 64 over switch 23 to the grid of amplifier 52 and appears as an impulse which is applied to both the vertical and horizontal plates of the oscilloscope with the result that a radial deflection of the oscilloscope beam occurs and produces such a line or spot as *a*, *b*, or *c*, at a point along the path 32 indicative of the frequency of the intercepted wave.

Since the control tube 50 and the oscilloscope driving tube 52 are both coupled to the sweep generator 51, the readings on the oscilloscope are coordinated with the instantaneous frequency of the oscillator 17. In order to adjust the operating wave-length of the station in Fig. 1 to correspond with any part of the frequency scale of the oscilloscope, it is, therefore, only necessary to move the knob 28 until the mean frequency given by the index 31 coincides with the desired indication of instantaneous frequency given by the radial deflections *a*, *b*, etc. or by space between them.

When the desired adjustment has been made, switch 23 is moved clockwise in Fig. 4 to either the middle or lower position, depending upon whether telegraph or telephone communication is desired. Upon movement of the switch 23 out of its monitoring position, the plate circuit of the sweep generator 51 is broken by means of switch 53 ganged to switch 23; and connection from the radio receiver to the input of amplifier 52 is broken at switch 23. In this way, the operation of the sweep generator 51 is stopped, leaving the oscillator 17, transmitter 10 and receiver 11 tuned to a frequency corresponding to the setting of the knob 28; and the oscilloscope 27 is disconnected from the receiving circuit.

What is claimed is:

1. A two-way radio station comprising a radio transmitter and a radio receiver, means to supply a radio wave of adjustable frequency to said transmitter and a radio wave of adjustable frequency to said receiver to enable two-way communication on one of a plurality of channels, means for monitoring an ether wave band to indicate available frequencies, means to coordinate the monitoring means with the radio wave supply means to facilitate adjustment of the radio waves supplied to the transmitter and re-

ceiver to correspond with the indications on the monitoring means, and means to disable the monitoring means and appropriate a selected communication channel.

2. A two-way radio station comprising a radio transmitter and a radio receiver, means to supply a radio wave of adjustable frequency to said transmitter for transmitting purposes and a radio wave of adjustable frequency to said receiver for enabling reception of selected radio communication waves, means connected to the receiver and to the means for supplying adjustable frequency waves to both the transmitter and receiver for monitoring an ether wave band to indicate wave frequencies in use, means to prevent transmission from said transmitter during monitoring, means to adjust the frequency of the radio waves supplied to said transmitter and receiver in accordance with the indications on said monitoring means, and means operable after completion of the adjustment for disabling both said monitoring means and said means for preventing transmission whereby said station is conditioned for transmitting and receiving at the adjusted frequency of said supply means.

3. A two-way radio station comprising a radio transmitter and a radio receiver, an oscillator for supplying a radio wave to said transmitter and a heterodyning wave to said receiver, a reactance control tube for said oscillator, an oscilloscope, a sweep generator coupled to both said reactance control tube and said oscilloscope, a switch having a monitoring position and one or more communicating positions, said switch in its monitoring position disabling said transmitter and connecting said radio receiver to said oscilloscope, means for manually adjusting the frequency of said oscillator to vary the mean frequency of the monitoring band, said switch in any other than its monitoring position disabling said sweep generator to permit the oscillator frequency to remain at the frequency set by said manual control and rendering said transmitter operative.

4. In a two-way radio communicating system, a transmitting station and a distantly located receiving station, means at the transmitting station to monitor an ether wave band to determine an energy-free region, means to appropriate a radio wave frequency in such region by sending out a wave of the appropriated frequency, means to interrupt said wave to call the distant station, means at the latter station to monitor the same ether wave band, an oscillator at said latter station for generating transmitting carrier waves and receiving heterodyne waves, means to tune said oscillator, means coordinating said monitoring means at said receiving station with the tuning of said oscillator to facilitate manual adjustment of the oscillator frequency to frequencies indicated on the monitoring means, means causing said monitoring means to pick up the interrupted waves from said transmitting station and indicate the frequency thereof.

5. In a two-way radio communicating system, a local calling radio station and one or more distant radio stations of which one is to be called, means at the local station to monitor an ether wave band to determine an energy-free region, an oscillator for generating a transmitting carrier wave, means to appropriate a radio wave frequency in such region by transmitting a carrier wave of the appropriated frequency to give an indication at each distant station, means to trans-

mit code signal by said wave to call a particular distant station, means at each distant station to monitor the same ether wave band, an oscillator at each distant station for generating a carrier wave for the transmitter and a heterodyne wave for the receiver, means to tune said oscillator, means coordinating said monitoring means at each distant station with the tuning of said oscillator to facilitate manual adjustment of the oscillator frequency to a selected frequency indicated on the monitoring means, means causing said monitoring means to pick up the coded waves from said local station and indicate the frequency thereof.

6. A two-way radio station comprising a radio transmitter and a radio receiver, a switch having a first, second and subsequent positions, a wave band monitoring oscilloscope, a radio wave oscillator of adjustable frequency coordinated with said oscilloscope to have instantaneous frequencies definitely related to each monitored wave frequency, said switch in its first position disabling said radio transmitter and connecting said wave band monitoring means to said radio receiver to receive ether wave energies, said switch in its second or a subsequent position enabling said transmitter to transmit radio waves generated in said oscillator and disabling said monitoring means.

7. A two-way radio station comprising a radio transmitter and a radio receiver, a tunable oscillator feeding a transmitting carrier wave to the transmitter and a heterodyne wave to the receiver, an oscilloscope, a sweep generator coupled to said oscilloscope and to said tunable oscillator to vary the frequency thereof in cyclical manner about a mean frequency, a switch normally connecting said oscilloscope to said receiver to cause scanning of an ether wave band, said switch nor-

mally disabling said transmitter, said oscilloscope while scanning also indicating coded call signals received over a channel of particular frequency, manually operated tuning means to adjust the frequency of said oscillator to correspond with said particular frequency, and means controlled by said switch for enabling said transmitter to transmit and for stopping the cyclic variations in frequency of said oscillator.

8. In combination a radio receiver, a normally inactive radio transmitter, means for simultaneously controlling the frequency to be radiated by said transmitter and the frequency to which said receiver is responsive, cyclically varying means for causing said transmitter and receiver frequencies to sweep over a range of frequencies, means for monitoring the output of said receiver to indicate the frequencies in use within said range of frequencies, and means for interrupting the sweeping action and rendering said transmitter active at a selected frequency in said frequency range.

9. The method of establishing two-way communication between two radio stations comprising producing visual indications at both stations of the frequencies in an ether wave band that are in use, selecting at the calling station a carrier frequency that is not in use and tuning the calling station transmitter to emit a wave of the selected frequency, interrupting said emitted wave in accordance with a code signal indicative of the called station whereby a visual indication is given at the called station of both the called station and the frequency of the selected wave, and adjusting the called station carrier frequency to the indicated value.

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