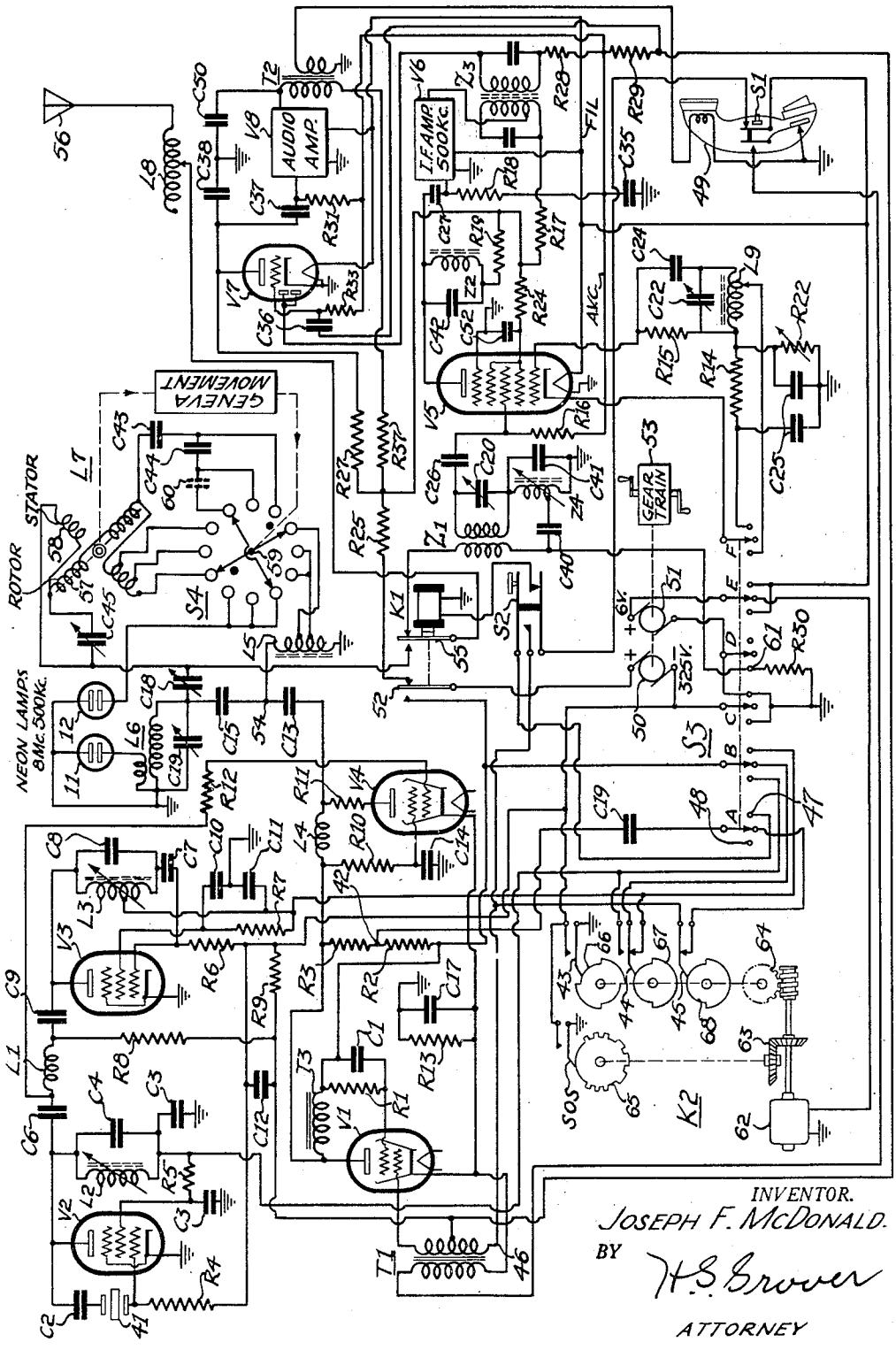
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TWO-WAY RADIO EQUIPMENT FOR LIFEBOAT SERVICE

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TWO-WAY RADIO EQUIPMENT FOR LIFEBOAT SERVICE

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8 Claims. (Cl. 250—13)

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This invention relates to two-way radio equipment which is especially adapted for service in lifeboats.

It is an object of my invention to provide improvements in such radio equipment for the purpose of facilitating signalling by skilled and unskilled operators.

Another object is to enable SOS signals to be sent out by radio equipment of my invention even though no skilled operator is available.

Another object is to provide switching facilities in radio equipment such that signals may be transmitted and received on either of two carrier frequency channels.

Another object is to provide automatic switching while sending SOS signals so that the transmitter will operate alternately on one and the other of two carrier frequency channels.

Another object is to provide radio equipment including a microphone and earphone hand-set, a telegraph key, and switching means for enabling communications to be established either by voice signals or by code signals.

Another object is to provide alternate modes of operation of the first tube stage of a receiver such that in one case it will act as a tuned radio frequency amplifier and in the other case as a heterodyne oscillator and converter.

The transmitter unit of the equipment is designed to operate on pretuned frequencies, one of which is the frequency channel allocated especially for SOS signals. The other frequency is preferably in the 8-megacycle band, and is controlled by a crystal. My system is arranged and adapted to operate in conformity with any one of three types of "emission," namely, types A_1, A_2 and A_3, as approved by the Federal Communications Commission. Type A_1 refers to telegraphy by the keying of an unmodulated carrier wave. Type A_2 refers to keyed tone modulation of a carrier wave. Type A_3 refers to voice modulation of a continuous carrier wave. Automatic SOS keying is accomplished by means of a motor driven cam having the dots and dashes represented by teeth on the periphery of the cam.

My invention will now be described in more detail, reference being made to the accompanying drawing, the sole figure of which shows diagrammatically a preferred circuit arrangement including the essential apparatus units whereby sending and receiving of signals may be accomplished.

In the transmitter system I provide two separate oscillator tubes V2 and V3, each having associated therewith a suitable frequency determining circuit. Tube V2 has its anode connected to one terminal of a tank circuit comprising inductance L2 and capacitance C4. The other terminal of this tank circuit is coupled to radio frequency ground across one of two capacitors C3. The other of these capacitors C3 couples the screen grid of tube V2 to ground. The cathode is grounded. Anode and screen grid potentials are supplied when needed from a source 50, as will be hereinafter explained. Feedback potentials are carried from the anode through a capacitor C2 and a piezoelectric crystal 41 to the first grid of the tube. The third grid acts as a suppressor and is grounded. The oscillator circuit of tube V2 is preferably tuned to a frequency of about 8 megacycles, more or less.

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The circuit arrangement for the other oscillator tube V3 is similar in most respects to that of tube V2 except that no crystal is provided for the low frequency which is generated. This oscillator circuit is preferably tuned to 500 kilocycles so as to transmit SOS signals on the carrier wave internationally adopted for this purpose.

The oscillator tube V3 has associated therewith a tuned inductance L3 in parallel with a capacitor C8. One terminal of the tuned circuit is connected to the anode; the other terminal is coupled across capacitor C7 to the first grid. The cathode is grounded. The first grid in tube V3 derives feedback potentials from the tank inductance L3, the feedback circuit including a capacitor C7. Low impedance paths to ground are provided by capacitor C10 which is connected to said second grid, and by capacitor C11 which is connected to a tap on inductance L3.

Anode and screen grid potentials are fed to one or the other of the tubes V2 and V3 through selective switching means (presently to be described) so that only one carrier frequency will be generated at any time.

A modulator tube VI has two alternate uses. In one case it serves as an amplifier for applying voice signals to the transmitter. In the other case it serves to generate an audible tone frequency, say in the 500 cycle range. This is a keying tone frequency which is applied only to the 500 kc. carrier during telegraphic keying. The modulation generator VI is inoperative and delivers no output energy when operating the 8-megacycle generator V2 during telegraphic keying. This arrangement, therefore, meets a requirement of the Federal Communications Commission that when telegraph signals are trans-

mitted on the 8-megacycle band the pure carrier wave alone shall be keyed on and off.

Tube VI is preferably of the so-called beam power amplifier type. Its control grid is connected to one terminal of the secondary winding on a transformer T1. The other terminal 46 of this transformer secondary is connected to a contact on a telegraph key S2 and also to a contact 45 of a cam-operated switching device K2 which is used for automatic SOS signalling. When the oscillator V3 is to be modulated by this SOS keying device K2 feedback potentials are fed from a point 42 between resistors R2 and R3 in the power supply circuit of the tube VI through a capacitor C19, switch blade A of the master switch S3, through contact 45 of switch K2, thence to the secondary terminal 46 on the transformer T1, through the secondary winding of this transformer and to the control grid of tube V1. The same feedback potential may be so applied to the grid of tube V1 when operating on the 500 kc. carrier wave while applying signals thereto by means of the manually operated telegraph key S2. In this case switch blade A is moved to its contact 47 and the feedback potentials traverse the upper contacts of the telegraph key S2, whence they are applied to the grid of tube V1 through the secondary of transformer T1 as previously described.

During times when the telegraph key is to be used for telegraphic signalling on the 8-megacycle carrier wave, the master switch S3 is moved to one side in which blade A contacts a dead segment 48. The feedback circuit for the modulated tube V1 is, therefore, opened and this tube ceases to oscillate. Keying is now accomplished by the use of the lower contacts of the telegraph key S2. These contacts are in circuit with the winding of relay K1. This relay is normally energized in order to set its contacts 52 and 55 against their companionate front contacts, as when the equipment is used for reception. During reception both of the oscillators V2 and V3 of the transmitter are inactive, since their anode circuits are open.

During transmission the pure carrier wave of 8-megacycle frequency may be radiated under control of the manually operable telegraph key S2 by depressing this key and opening the circuit of its lower contacts. Relay K1 responds to keying by releasing so as to close the anode circuit for the oscillator tube V2 through relay contact 52 and its back contact. The antenna circuit is also closed by relay contact 55 resting against its back contact. When outgoing signals are applied to the antenna 56 the circuit for the latter may be traced from the coupling capacitor C18 through relay contact 55 and through the loading coil L8 to the antenna itself. Relay K1 is of the quick acting type which is capable of following the manual control of the telegraph key.

The primary winding of transformer T1 is included in a microphone circuit which may be traced from ground through the microphone unit in a hand-set 49, through a push-to-talk switch S1, through the primary winding of transformer T1 and thence to ground through resistor R13. This resistor carries a direct current which flows from ground to the cathodes of tubes V1 and V4. The potential drop across resistor R13 serves as a D. C. source for the carbon microphone in the hand-set 49. Capacitor C17 is in shunt with resistor R13.

The anode of tube V1 is fed with positive potential from the high voltage source 50. The anode circuit when closed by the release of relay K1 includes relay contact 52 which makes with its back contact and feeds current through a choke T3 to the anode in tube V1, and also through a resistor R1 to the screen grid in this tube. Resistor R1 is shunted by a capacitor C1. The output from the tube V1 is coupled to the anode and screen grid of a power amplifier tube V4, the circuit being inclusive of resistor R10.

Anode potential for the tube V4 is supplied through relay contact 52, through choke T3, through choke L4 and thence through resistor R11. Screen grid potential for tube V4 is also supplied through the same circuit exclusive of elements L4 and R11, but including resistor R10. Capacitor C14 operates conventionally to couple the screen grid to ground.

The filament circuits of the tubes V1, V2, V3 and V4 are not shown but are preferably connected in parallel between the positive and negative terminals of the 6-volt source 51. The two sources 50 and 51 of direct current voltage are preferably generated by hand cranking of a common generator shaft which is geared up from the speed of the crank by means of a gear train 53.

The antenna circuit is arranged to discriminate between signals applied thereto of the 8-megacycle frequency and of the 500-kilocycle frequency. In either case the output from the amplifier tube V4 traverses capacitor C13 to a junction point 54. The 8-megacycle carrier wave traverses capacitor C15, and coupling capacitor C16, thence to contact 55 of relay K1 (when de-energized) and is impressed upon the loading coil L8 and the antenna 56.

A variometer L7 is associated with the antenna circuit in such manner that it may be used to series resonate with the antenna capacities at 500 kilocycles. The variometer is continuously variable through a ratio 10:1. The rotor 57 of the variometer is mounted on a shaft which is mechanically connected through a Geneva movement to a switch shaft 59. Switch S4 is used for the purpose of completing the tuning circuit through different portions of the inductance L5 and the stator element 58 in the variometer. The variometer rotor 57 may be continuously rotated through two and one-half revolutions. Coarse tuning of the antenna circuit is, therefore, obtained by different settings of the switch S4 while fine tuning is obtained by angular orientation of the rotor coil 57 with respect to the stator coil 58 of the variometer L7.

The variometer L7 in the antenna circuit provides an adjustment for resonance on 500-kilocycles of various antenna dimensions. A tuning indicator is provided in the form of a neon lamp 12. This lamp is excited by the transmitter output power derived from a tap on the antenna variometer L7. The voltage at the tap on variometer L7 will vary somewhat according to the number of the stator turns in use. The neon indicator lamp is fed through a capacitive coupling network C43, C44 and 60 which is varied in step with the number of stator turns selected by switch S4. The position of switch S4 determines how much capacitance and inductance shall be so introduced into the circuit of the indicator lamp 12. In one position of the switch S4 capacitor C43 alone is included in the circuit. In the next position of switch S4 the capacitance C44 is introduced. In the third position of switch S4 a still further capacitance is introduced which is inherent in the proximity of two switch segments

to each other. This capacitance is, however, represented in the drawing by a broken line capacitor 60.

Another tuning indicator lamp 11 is also provided for use when operating on the 8-megacycle carrier wave. This lamp 11 possesses an inherent capacitance which is in series with the inductance of the secondary winding on a transformer L5 and provides resonance at a frequency of 8-megacycles. The primary winding of transformer L6 is tuned by parallel connection thereacross of an adjustable capacitor C19. It is, therefore, readily observable by noting the illumination of lamps 11 and 12 just how the radio equipment is tuned for transmission on the desired carrier wave.

The receiving unit

The receiving unit comprises a number of tube stages and is more or less conventional in its circuit arrangements. The first tube V5 is, however, useful at different times either as a tuned radio frequency amplifier or as a converter tube for superheterodyne reception. The second tube is not shown but is indicated by a block V6 to comprehend an amplifier which operates as an R. E. amplifier under conditions of reception within the 500 kc. band; and it also operates as an I. E. amplifier after conversion of the incoming signals to a 500 kc. frequency. The output from the amplifier V6 is translated through transformer Z3 and is then detected in a tube V7 which is preferably of the twin-diode-triode type. This tube supplies automatic volume control potentials for the tubes in the first two stages of the receiver and also amplifies the signals in its amplifier section, whence they are coupled across a capacitor C37 to the input circuit of a power amplifier tube V8. The output transformer T2 delivers signals to the earphone of the handset 49.

The master switch

The master switch S3 has six poles and they are ganged together to form a triple throw switch. Normally the switch stands with its switch blades in the central position in readiness for automatic keying of the SOS signals and the long dash signals. The switch blades when moved to the left provide for operation on the 8-megacycle carrier wave. Manual keying of code signals is accomplished by means of the key S2. In the left-hand position of the master switch two-way telephony in the 8-megacycle band is also possible, as well as reception of code signals by means of the phone in the handset 49.

By setting the master switch blades to the right the equipment is conditioned for two-way telephony on the 500 kc. carrier wave. This same switch setting also provides for manual telegraph keying by applying an interrupted tone frequency to the 500 kc. carrier wave. During code signal transmission the tone frequency is generated in tube VI in response to the depression of the key S2. But during speech transmission from the microphone in the handset 49 the tube VI acts as a modulator for impressing voice signals upon the power amplifier tube V4. The functions of the respective switch blades A, B, C, D, E and F will now be explained.

Switch blade A in the middle position completes a feed-back circuit from the point 42 on the output circuit of tube V1 via capacitor C19 and back through contact 45 (which rides on cam 68) and thence through the secondary winding of transformer T1 to the first grid in tube V1. While contact 45 engages its companion contact, tube V1 generates an audible tone frequency. When however, the cam 68 opens its contact 45 the automatic signalling device is enabled to transmit the 8-megacycle carrier wave without tone frequency modulation. In other words, tube V1 is caused to cease oscillating when the 8-megacycle carrier wave generator V2 is rendered operable.

Switch blade B in the middle position supplies positive high potential from the source 50 to the anodes and screen grids in tube V2 or tube V3 for generating the high frequency and the low frequency carrier waves alternately in accordance with the operation of the cam controlled switch 44. The middle segment contacted by switch blade B is directly connected to the movable contact 44 which rides over the periphery of cam 67. During half the time, therefore, transmission of the automatic SOS signals is obtained while the 8-megacycle frequency carrier wave generator V2 is operable and for the remainder of the time while the low frequency carrier wave oscillator V3 is operable. Cam controlled contact 44, therefore, switches the anode potential from one oscillator to the other, giving the two generators equal times for transmission of the SOS and long dash signals.

Switch blades C, D and F are open circuited in the middle position.

Switch blade E in the middle position completes a circuit from the positive terminal of the 6-volt source 51 through the motor 62 and thence to ground. This motor runs continuously while transmitting the automatic SOS signals by means of the keying cam 65 and its associated contacts. The contact labeled SOS is grounded and connects the negative terminal of the high voltage source 50 to ground for keying purposes. The cam 65 is cut with teeth and notches representing the marking and spacing elements of the SOS code signal. This cam is preferably geared by gear train 63 to rotate 12 times for every revolution of the shaft which is driven by a worm gear 64 or other suitable gear train. This gear ratio allows for three repetitious transmissions of the SOS signal on each of the carrier waves. Let it be assumed that the speed of the motor 62 and speed reduction provided by gear trains 63 and 64 are such that the cam 65 rotates at 12 R. P. M. and that the shaft driven by gear 64 rotates once per minute. Then during successive quarter minute periods signals will be transmitted as follows:

Period	Channel	Signal
1	500 kc.	SOS—SOS—SOS.
2	500 kc.	Long dash.
3	8 mc.	SOS—SOS—SOS.
4	8 mc.	Long dash.

Provision is, therefore, preferably made for the above schedule of transmissions by the contours of the cams 67, 68 and 66 as shown in the drawing. Cam 67 shifts the plate potential from V3 to V2 and vice versa at half minute intervals. Cam 68 applies a feedback potential to the control grid in tube V1 for tone-modulating the 500 kc. output from tube V3 during alternate half-minute periods. Cam 66 keys the output during alternate quarter-minute periods for transmission of the long dash.

It is apparent that the two alternatively operable generators V2 and V3 can deliver their respective carrier waves only when the grounded cathode of one or the other is connected to

the negative terminal of the source 50. In this manner, therefore, the keying contacts SOS and 43 are enabled to apply their control for generating the carrier waves. The control grids in each of the tubes V2 and V3 are connected through resistors R4 and R6 respectively to the negative terminal of the source 50. Tubes V2 an V3 become biased to cut-off when contacts SOS and 43 are open.

The conditions effective upon throwing the blades of the master switch S3 to the right will now be explained.

In this position transmission and reception is obtained on the 500 kc. frequency. Switch blade A resting on contact 47 completes a circuit to the upper contact of the manual key S2 and thence, when the key is depressed, to terminal 46 on the secondary of transformer T1. The upper terminal of this transformer secondary is connected to the control grid of the modular tube V1. This tube generates a modulation frequency of, say, 500 cycles to be applied to the 500 kc. carrier generated by tube V3. Mixing occurs in the power amplifier tube V4. The upper contacts of the manual key S2 complete a feedback circuit for causing the tube V1 to oscillate, as has heretofore been explained.

The right hand contact associated with switch blade B supplies anode and screen grid potentials to tube V3, but only when relay K1 is de-energized so as to close its contact 52 against its associated back contact. Relay K1 may be de-energized in either of two ways. First, by depressing the manual key S2 which opens the 6-volt circuit through the relay winding. Secondly, the relay K1 may be de-energized by depression of the push-to-talk button S1. The normally closed contacts of switches S1 and S2 are in series. Current is supplied to the winding of relay K1 by the 6-volt generator 51 when switch blade E is moved to its right or left hand contact.

Switch blade F when thrown to the right completes a cathode circuit for the receiving tube V5 which is in the first stage of the receiver. When receiving a 500 kc. carrier wave tube V5 operates as an R. F. amplifier but cannot itself generate oscillations as in the case of heterodyne reception.

When the switch blades of the master switch S3 are thrown to the left conditions are made effective for transmission and reception on the 8-megacycle carrier wave as follows:

The feedback circuit for the modulator tube V1 is opened at switch blade A. No tone frequency is, therefore, generated during transmission. Furthermore, tube V1 may be used to amplify voice signals as derived from the microphone in the hand-set 49. The microphone circuit may be traced from ground through the microphone, through the primary winding of transformer T1, and thence through the cathode resistor R13 to ground.

Switch blade B in the left hand position supplies anode and screen grid potentials to the 8-megacycle oscillator tube V2.

Switch blade C in the left hand position connects the negative terminal of the high voltage source 50 to ground.

Switch blade D places ground potential on a point 61 in the antenna circuit so as to enable reception to be had by translating the received 8-megacycle carrier wave through transformer Z1, the secondary of which is tuned by capacitor C20. The 8-megacycle signals are then coupled across capacitor C26 to the third grid in the receiving tube V5 which now operates as a mixer tube.

Switch blade E (as before explained) connects the positive terminal of the 6-volt source 51 to the filaments of the receiving tubes and to the energizing circuit for relay K1.

Switch blade F in the left hand position connects the cathode of tube V5 to a tap on inductance L9, the latter being tuned by association with capacitor C22. The resonant circuit comprising inductance L9 and capacitance C22 supplies control oscillations to the first grid in tube V5 and causes heterodyning to take place for converting the incoming 8-megacycle signal to a frequency of say 500 kc. which is acceptable in the I. F. amplifier V6.

Other circuit components

The output from the 8-megacycle carrier wave oscillator V2 is applied to the first grid in the mixer tube V4 through a circuit which may be traced to include capacitor C6 and resistor R12. The 8-megacycle wave so applied is prevented from being bypassed to ground by virtue of the choke L1 which offers a high impedance to that frequency. It serves, however, as a low direct current impedance in the biasing circuit connecting the grounded negative terminal of the source 50 with the first grid in tube V4. This biasing circuit includes resistors R8 and R9.

The output from the 500 kc. oscillator V3 is applied to the first grid in the mixer tube V4 through a circuit which includes capacitor C9, inductance L1 and resistor R12. When the 500 kc. wave is fed in this manner from tube V3 the inductance L1 offers a relatively low impedance. The capacitor C6 is, however, a relatively high impedance at this carrier frequency and dissipation of the energy is thus prevented.

Capacitor C12 is an audio by-pass capacitor. Capacitor C45 tunes a section of the variometer L7 to the 8-megacycle frequency.

Anode and screen potentials for the receiver tubes V5, V6, V7 and V8 are supplied through the front contact associated with contact 52 on relay K1 when this relay is energized. The power supply circuit may be traced from the positive terminal of source 50 through the relay contacts, through resistor R25 and thence through several branches including resistor R19 and inductance Z2 leading to the anode in tube V5; through resistor R17 and a portion of the primary winding in transformer Z3 to the anode of tube V6; through resistor R27 to the main anode in tube V7 and through resistor R37 and the primary winding of transformer T2 to the anode in tube V8. Screen grid potential is applied to the screens in tube V5 through a resistor R24 which connects with the anode supply circuit of this tube.

During reception of signals in the 8-megacycle band the energy collected by the antenna 56 is fed through the loading coil L8, relay contact 55, the primary winding of transformer Z1 and thence through switch blade D (in the left hand position) to ground. The secondary of transformer Z1 is tuned to resonance with the incoming frequency by capacitor C20. The signals are applied to the third grid of tube V5 in which they are heterodyned with oscillations generated in the resonant circuit L9—C22 which is coupled to the first grid through capacitor C24. The second and fourth grids serve as a screen and an anode in the oscillator circuit, being coupled to ground through capacitor C52. The bias on the first

grid is suitably fixed for generating oscillations by means of resistor R15. The manually adjustable ohmic impedance R22 is a volume control device in circuit between the cathode and ground.

During reception of signals in the 500 kc. band the energy is collected by the antenna 56 as above described, but is fed across capacitor C49 to the tuned circuit Z4—C41, which is coupled to the third grid in tube V5 through the low impedance secondary of transformer Z1 and capacitor C26. Resistor R30 connects the antenna circuit to ground and serves as a static drain. Tube V5 is now operative as a tuned radio frequency amplifier, a suitable cathode bias being obtained by adding the ohmic impedance of resistor R14 to that of the manual volume control R22 in circuit between the cathode and ground. Resistor R14 also serves to bias the first grid so far negative that the tube will not oscillate.

Capacitor C42 is disposed in parallel with the inductance Z2 and produces resonance at the 500 kc. frequency of input to the I. F. amplifier V6. This input is fed across capacitor C27.

The detector circuit in the receiver section may be traced from the grounded cathode in tube V7 through the rectifier anodes in this tube, thence through the secondary of transformer Z3, resistors R28, R29 and R9 to ground.

A feature of the receiver circuit arrangement is worthy of note wherein a cutoff bias is applied to all of the control grids of tubes V5, V6, V7 and V8 whenever the transmitter is operated. The cutoff bias of these tubes is derived from a potential drop through resistor R9 which is negative with respect to the grounded negative terminal of the high voltage source 50. The grid current in the power output tube V4 of the transmitter produces this potential drop through resistors R12, R3 and R9, but since resistor R9 is a component of the detector circuit the potential drop therein influences the AVC circuit of the receiver and hence the receiver tubes are biased to cut-off whenever the transmitter operates.

The rectified output from the detector portion of tube V7 is applied to the triode portion of this tube through a circuit which includes resistors R28, R29 and capacitor C36 leading to the control grid.

AVC potentials are derived from the junction between resistors R28 and R29 and are connected to the third grid in tube V5 through resistor R16; also to the control grid in tube V6 through resistor R18 and to the control grids in tubes V7 and V8 through resistors R33 and R31 respectively. Capacitor C35 is in shunt with the two resistors R29 and R9 and produces a suitable time constant effect in the AVC circuit.

It will be recognized by those skilled in the art that various modifications may be made in circuit arrangements of the system herein described, but without departing from the spirit and scope of the invention.

I claim:

1. In a radio system, transmitting equipment including alternatively operable carrier wave generators and a low frequency generator, code keying means, and a multi circuit switch for selecting a desired one of a plurality of alternative modes of cooperation between the aforementioned elements, one mode being that in which the output from said low frequency generator is keyed by said keying means, thereby to modulate the output from a predetermined one of said carrier wave generators, and another mode of cooperation being that in which said low frequency generator is disabled by said switch and the output from another of said carrier wave generators is caused to be keyed by said keying means.

2. The combination according to claim 1 wherein said low frequency generator possesses a feedback circuit and said code keying means is constituted as a manual key having contacts closeable to complete said feedback circuit, said key having other contacts operable for causing said switching means to supply operating potentions to a selected one of said carrier wave generators.

3. The combination according to claim 1 wherein said code keying means is constituted as a motor-driven device having a code disk and contacts actuated thereby for transmitting a predetermined train of code signals.

4. In a radio system, transmitting equipment including alternatively operable carrier wave generators and an electronic modulator stage, subject at times to control by voice modulations, and subject at other times to on-and-off operation at a tone signal generator, a feed back circuit for said modulator stage, dual control keying means for intermittently closing said feedback circuit, thereby to cause said on-and-off operation, a normally energized relay the winding circuit of which is operable by said keying means, an operating potential source and suitable circuit connections for activating the transmitting equipment, and a master control switch having a complement of selectively closeable circuits arranged and adapted to provide different modes of operation of said transmitting equipment, wherein, according to mode (1) said keying means is motor driven and causes the two said carrier wave generators to be alternately activated, while the activation of one only of said carrier wave generators is accompanied by the activation of said tone signal generator through the intermittent closing of its feedback circuit; according to mode (2) said keying means is manually operated, thus de-energizing said relay during "marking" intervals, whereby one only of said carrier wave generators is activated, said feedback circuit being also closed by said keying means during marking intervals; according to mode (3), anode and screen grid potentials are supplied through said keying means and through said master control switch solely to the other of said carrier wave generators, while said feedback circuit for the tone signal generator is kept open, thus causing an unmodulated carrier wave to be keyed with code signals; and, according to mode (4), said electronic modulator stage is relieved of control by its feedback circuit and is subjected to control by voice modulation while either one of said carrier wave generators is activated, depending upon the selective setting of said master control switch.

5. In a radio system, transmitting equipment including two alternatively operable carrier wave generators, means for modulating the output from one or the other of said generators by voice signals, receiving equipment including a plurality of amplifier stages and a detector stage, means operable at selected times for causing the first one of said stages to function as an oscillator-converter stage, tuning means associated with said first stage and arranged to render the receiving equipment operable as a heterodyne receiver when receiving signals within one band of frequencies and as a tuned radio frequency re-

ceiver when receiving signals within a second band of frequencies, switching means for selecting a desired frequency band for two-way radio telephony through said transmitting and receiving equipment, and further switching means for conditioning the transmitting equipment to emit voice signals, while disabling the receiving equipment, or for conditioning the receiving equipment to translate incoming signals into audible sounds while disabling the transmitting equipment.

6. A two-way radio telephone system as defined in claim 5 and including a power supply unit serving both the transmitting equipment and the receiving equipment, and a normally energized relay the winding circuit of which is openable by a push-to-talk key, said relay having contacts in said further switching means whereby said power supply unit is caused to serve the transmitting equipment during periods of relay release and to serve the receiving equipment during periods of relay energization.

7. In the receiver portion of a two-way radio communication system a plurality of tube stages having an automatic gain control circuit connected to their input electrodes, a hand-set of the type which includes a microphone and an earphone, a push-to-talk switch for conditioning the transmitter of said system to emit a carrier wave modulated by voice signals which originate at said microphone, and means including a self-biasing circuit associated with at least one of the tubes in said transmitter for supplying a bias potential to said gain control circuit, whereby the receiver tube stages are blocked during the operation of said transmitter.

8. In a radio transmitter, a carrier wave generator, a modulator stage including an electron discharge tube with input and output electrodes, an output mixer stage, a key for code signaling, a microphone connectable to said modulator stage for applying voice modulations thereto, a reactive feedback circuit extending from an output electrode of said modulator stage through contacts of said key, when depressed, and thence to an input electrode of said modulator stage, said feedback circuit being operable to cause the generation of tone-frequency oscillations in said modulator stage during key depression, circuits for controlling said mixer stage by output energy from said generator and from said modulator stage, means including a grid biasing circuit for the mixer stage for obtaining a suitable grid bias to be applied to said modulator stage, and means including a cathode-to-ground resistor common to said mixer and modulator stages for feeding a direct current through said microphone, said modulator stage being automatically operable as a voice frequency amplifier except during depression of said key.

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