

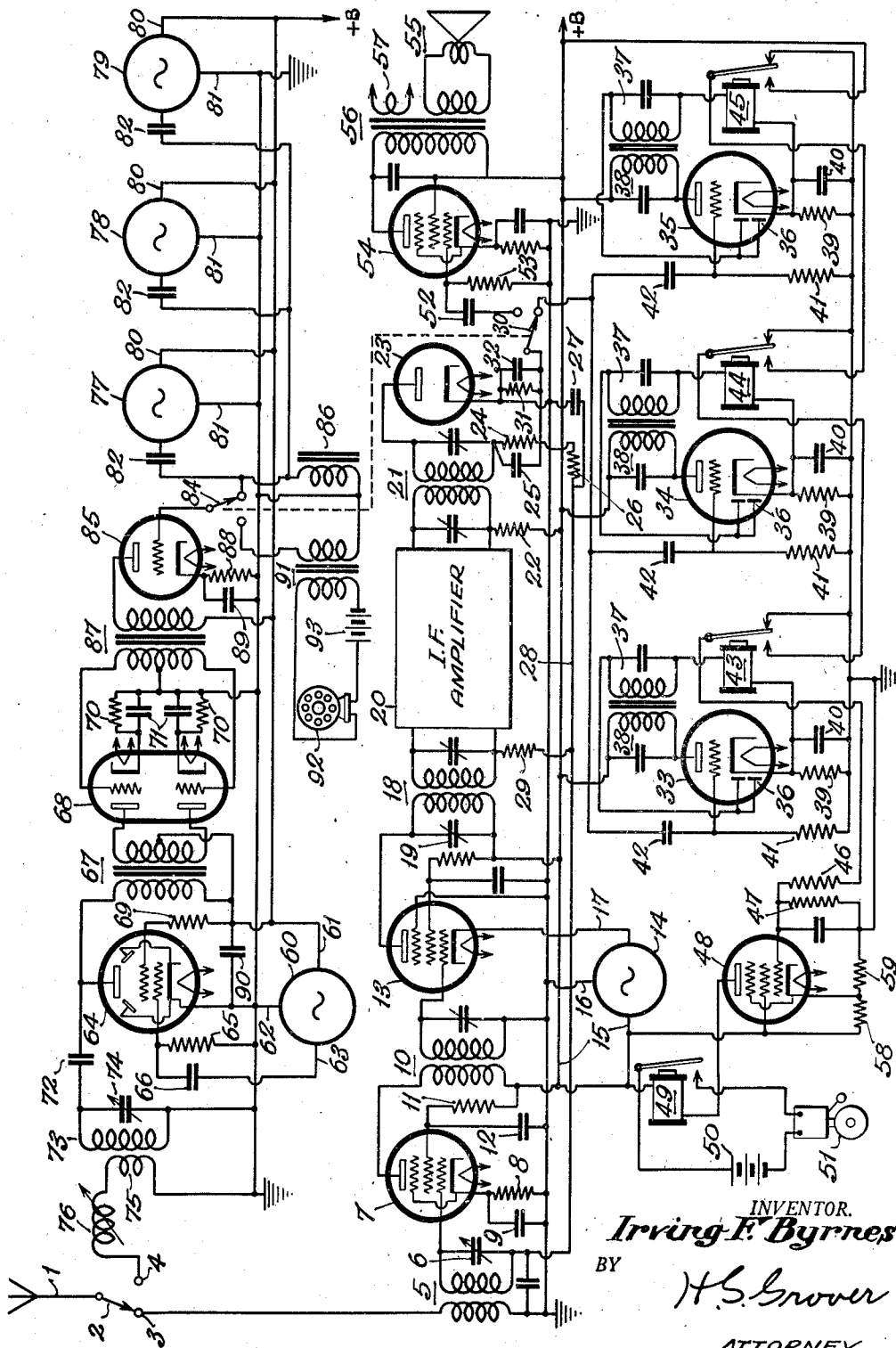
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RADIO ALARM AND TWO-WAY TELEPHONE SYSTEM

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RADIO ALARM AND TWO-WAY TELEPHONE SYSTEM

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This invention is related to automatic radio alarms and two-way telephone systems. In radio apparatus for distress signaling and for two-way telephoning, it is desirable to have a compact unit on shipboard which is adapted for transmission and reception of radio signals and which is particularly provided with means for sending and receiving distress signals.

In marine radio communication systems as used in the past, it has been customary to characterize a distress signal by a series of dashes of definite length with intervening spaces of shorter duration. It was the common practice to transmit these signals by a hand key. The timing was done with the aid of a watch. The receiving apparatus was designed to produce a response to manually keyed signals despite considerable variations in the length of the dots and dashes.

Automatic alarm systems such as heretofore used have employed selective means operable in such manner that the alarm is only sounded after reception of several long dashes, say of approximately four seconds duration each and spaced apart by periods of one second. However, it was necessary to adjust the parameters of the selective means so that the alarm signal would not be sounded in response to static and interference. Furthermore, it was necessary to adjust the timing of the relay units in the selective means so that there would be no response to extraneous signals brought in on the same carrier wave as that of the established distress signal frequency assignment.

There are many limitations and disadvantages in the heretofore used auto-alarm system. For example, interfering radio signals or static tend to increase the length of the dashes sent out from a vessel in distress and also to "fill in" the space which must be provided between the dashes. Since the auto-alarm signal is transmitted by on-and-off keying, the carrier and the modulation are both removed during the space interval between dashes. Under these conditions the use of an automatic gain control device is not practical. This in turn requires that the sensitivity of the auto-alarm receiver be adjusted manually, causing it to be "blocked" by strong interference or static which may occur after the manual adjustment has been made.

In carrying out the instant invention, I propose to overcome the difficulties mentioned in the foregoing. To do this, I propose the adoption of an entirely new form of distress signaling. Instead of transmitting three or four long dashes spaced apart by short intervals of silence, I would

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transmit simultaneously a number of different tone frequencies which have been predetermined as a suitable combination, such as a musical chord or other mixture of tones for designating the distress signal. The carrier frequency which is assigned for distress signaling may then be modulated by this predetermined mixture of tone frequencies. At the transmitter, therefore, it is necessary to provide a plurality of low frequency oscillators with which to generate simultaneously the chosen tone frequencies of the distress signal. These frequencies are to be simultaneously impressed upon the carrier as a modulation. The auto-alarm receiver is, therefore, provided with audio frequency filters and rectifiers for converting the filtered audio frequency currents to direct current, which is then used to operate a relay system for producing an audible or visual alarm signal.

In addition to the novel features of the apparatus for sending and receiving distress signals, my invention provides means for intercommunication by marine radio telephony. A simple arrangement of switches enables the operator to connect either his microphone or tone frequency generators in circuit with the modulator of the transmitter, according to requirements. The operator also has a choice of reception on a loud speaker or on a plurality of tone frequency filters which are used under standby conditions for reception of distress signals from a remote point.

My invention will now be described in more detail, reference being made to the accompanying drawing, in which the sole figure thereof represents more or less conventionally certain apparatus, the elements of which are arranged in a novel combination.

Referring to the drawing, I show therein an antenna 1 connected to a switch blade 2 having two positions in which contacts 3 and 4 are alternatively used.

The receiver

For reception the switch 2 is set to the position shown. Incoming signal energy is, therefore, fed to the primary winding of a transformer 5. The secondary winding of transformer 5 forms the inductance of a tuned circuit, the tuning condenser of which is indicated at 6. Preferably, I provide a stage of radio frequency amplification in the pentode discharge tube 7. This tube has its first grid connected to the tuned secondary of transformer 5. The other terminal of this secondary

is connected to an automatic gain control arrangement which will be hereinafter described.

Tube 7 employs a cathode resistor 8 which is shunted by a capacitor 9. The cathode circuit is grounded. The anode circuit is connected to a suitable direct current source indicated as +B, and current is fed to the anode through the primary winding of a transformer 10. Screen grid potential is obtained from the same source +B and is fed to the screen grid through resistor 11. High frequency voltage components on the screen are bypassed to ground through capacitor 12.

The tuned secondary of transformer 10 is connected to the first grid of a converter tube 13. Local oscillations are supplied to the cathode of this tube by a suitable generator 14 which is conventionally indicated, since the details of design are unimportant. The conventional indication of the oscillator 14 shows the application of +B potential on conductor 15 and ground potential on conductor 16, oscillatory output energy being fed to the conductor 17. The converter tube 13 is also preferably provided with a screen grid and a suppressor grid, the connections for which are conventional. The anode in tube 13 is connected to the +B terminal through the primary winding of a transformer 18, this primary winding being tuned by means of a capacitor 19.

Output energy from the converter tube 13 is fed across transformer 18 to the input circuit of an intermediate frequency amplifier 20. This amplifier may have any desired number of stages of amplification according to practical requirements.

The output circuit of the final stage in the intermediate frequency amplifier 20 includes the primary of a transformer 21 which is tuned. This circuit also includes a voltage dropping resistor 22.

Rectification of the output from the I. F. amplifier 20 takes place in the diode tube 23. This tube detects the audio-frequency signal components for utilization in a responsive device and also furnishes gain control potentials. The A. V. C. circuit includes resistor 24, which is shunted by a capacitor 25, and resistor 26 in series with capacitor 27. The A. V. C. control voltage appears on conductor 28 and is fed to the first grid in tube 7 and also across resistor 29 to the input circuits of one or more stages of the I. F. amplifier 20.

Switch 30 has its movable contact connected through resistor 31 to the cathode of the rectifier tube 23. Resistor 31 is shunted by a bypass condenser 32. When the switch 30 is set in the position shown, low frequency signal components are applied simultaneously to the control grids in each of three discharge tubes 33, 34, and 35. The circuit parameters of these tubes are arranged to provide a filtering action such that each passes a predetermined audio frequency tone. These tubes are preferably of the duplex diode triode type which produce rectification of the amplified energy traversing the space path of the amplifier section. The diode anodes 36 are parallel connected to a tuned circuit 37. The main anode is connected to the +B terminal through a tuned circuit 38. Tuned circuits 37 and 38 are inductively intercoupled. Cathode resistors 39 are shunted by capacitors 40. These elements are grounded remotely from the cathodes. The input circuit for each of the amplifier sections in the tubes 33, 34, and 35 include grid leak resistors 41. Input energy is applied to these input circuits across capacitors 42.

Rectification components from the filtered output of the tubes 33, 34, and 35 are applied as

energizing potentials for individually operating relays 43, 44, and 45.

The armatures of the relays 43, 44, and 45 are arranged to shift a control potential between that of ground and a more positive potential derived from the +B source terminal. Resistors 46 and 47 serve as a voltage divider which, upon relay operation, may be connected between the +B source terminal and ground. The junction between resistors 46 and 47 is connected to the control grid in an amplifier tube 48. This tube is normally blocked by maintaining its control grid at ground potential while its cathode derives a somewhat more positive potential from a junction between resistors 58 and 59 which constitute a voltage divider connected between +B and ground.

The circuit through the voltage divider elements 46 and 47 is grounded at both ends whenever one or more of the relays 43, 44, and 45 remain unactuated. However, in response to the simultaneous energization of these three relays, that is, upon reception of the predetermined audio frequency components of the distress signal, a circuit may be traced from the +B terminal successively through the armatures of the energized relays and thence through resistors 46 and 47 to ground. Hence, by simultaneously actuating relays 43, 44, and 45, a positive potential is applied to the grid in tube 48 and causes this tube to be conductive.

The anode circuit of tube 48 includes the winding of a relay 49. This circuit is fed directly with +B potential through conductor 15. This same conductor supplies a suitable potential to the screen grid in tube 48.

The closing of the armature of relay 49 against its front contact supplies operating potential from a battery or other source 50 for sounding an alarm bell 51. In place of, or in addition to, the bell 51 a lamp may be provided for producing a visual indication.

When switch 30 is moved to the position other than as shown, the output from the rectifier tube 23 is directed across capacitor 52 and through resistor 53 so as to control the first grid of a pentode discharge tube 54. This tube amplifies the audio frequencies which may represent speech signals and which may, therefore, be used in a responsive device such as the loud speaker 55. The transformer 56 which is used for coupling the output circuit of tube 54 to the voice circuit of the loud speaker 55 may, if desired, contain an additional winding 57, the terminals of which may be used to transmit speech currents to one or more additional responsive devices, such as an earphone head set.

The transmitter

In order to transmit a distress signal or to transmit speech signals, the transmitter section of my two-way communication system may be used simply by throwing the switch member 2 into contact with the terminal 4. I will first describe the components of the transmitter which include the oscillator, the modulator, and the power amplifier.

The carrier wave oscillator 60 is conventionally shown. Positive potential is applied on conductor 61. Ground potential is applied on conductor 62 and the oscillatory output energy is fed through conductor 63.

The oscillator 60 delivers carrier wave energy across a blocking capacitor 66 and through resistor 65 in the input circuit of a beam power

amplifier tube 64. The output circuit of tube 64 includes the secondary winding of a transformer 67. Tube 64 contains the usual screen grid and beam focusing electrodes, the latter being carried at cathode potential. The screen grid current is drawn through resistor 69.

The amplified carrier wave energy of tube 64 is modulated by coupling the output circuit to a push-pull modulator tube 68. This tube is preferably of the twin triode type where the cathodes are connected to ground through individual cathode resistors 70, these resistors being shunted by capacitors 71. The anodes of tube 68 are connected respectively to the terminals of the primary winding on transformer 67. This winding has a midtap which is fed with +B potential.

Output energy from the power amplifier tube 64 is impressed across a capacitor 72 for controlling the energy in a parallel tuned circuit consisting of a transformer primary 73 and capacitor 74. The secondary winding 75 of this transformer is in circuit between ground and antenna coil 76. This coil is connected to the antenna 1 through switch point 4 and switch blade 2.

For the purpose of transmitting distress signals which are composed of a triad modulation, I preferably employ three low frequency generators 77, 78, and 79. These generators are conventionally shown. A wide choice of frequencies is available for the combination of tones to be produced by these generators. The frequencies may, therefore, be harmonically related or dissonantly related if desired. The chosen frequencies may also be within or without the band of frequencies occupied by speech waves. Anode potential is supplied through conductors 80, ground potential through conductors 81, and the output frequency is coupled across capacitors 82 to one of the stationary contacts of a switch 84. The movable contact of this switch is connected to a control grid in a triode amplifier tube 85. A choke 86 provides a high inductive impedance ground connection for the output circuits of the generators 77, 78, and 79.

Amplification of the three tone frequencies derived from the low frequency generators 77, 78, and 79 is obtained in the tube 85. This tube has an output circuit connected between the +B supply and the anode, and the useful output energy traverses the primary winding of a transformer 87. The secondary of this transformer has its terminals connected to the control grids in the twin triode amplifier tube 68. The center-tap on the secondary of transformer 87 is grounded. Tube 85 has its cathode connected through a cathode resistor 88 to ground. This resistor is shunted by capacitor 89. A bypass condenser 90 is connected in shunt with the +B source, the negative terminal of which is grounded.

For the purpose of transmitting voice signals, switch 84 is moved into connection with a circuit leading through the secondary winding of transformer 91. It is then possible to transmit signals from the microphone 92 in place of the distress signals. A unitary control of switches 84 and 30 is indicated by the broken-line connection therebetween. This arrangement, or the use of a double-pole-double-throw switch, is convenient, but not essential, when shifting the set from distress signaling to two-way telephone service, and vice versa. The microphone circuit which is fed through the primary winding of transformer 91 may be energized by means of a direct current source 93.

Recapitulation

To those skilled in the art, the various details of the circuit arrangements will be well understood without further description. It will also be understood that various modifications of the circuit details may be made without departing from the spirit of the invention. It should be noted further that the system as herein shown and described is capable of operation under varying conditions such as might ordinarily be met in ship-to-ship and ship-to-shore communication work. The operation of the system may be recapitulated as follows:

When the apparatus is to be set in a "standby" condition, the antenna switch 2 will be positioned as shown. The antenna is then connected to the receiver and any incoming signals such as a distress signal will be fed to the heterodyne receiving apparatus comprising the radio frequency amplifier stage 7, the converter stage 13, the I. F. amplifier 20, and the diode rectifier 23. Heterodyning of the incoming signals with output from local oscillator 14 is obtained in the converter tube stage 13. The I. F. frequency component of the incoming signal is then amplified in the I. F. amplifier 20 and rectification takes place in tube 23. Automatic gain control potentials are fed back through conductor 28 to the input circuits of one or more stages including those of the R. F. amplifier and of the I. F. amplifier.

The output energy from the detector stage 23 is also used by feeding the same through switch 30 when in the position shown so as to control the three filter tubes 33, 34, and 35. If a distress signal having the designated low frequency components is received, these filter amplifiers will all be controlled simultaneously so as to energize their associated relays 43, 44, and 45.

The simultaneous actuation of the relays which respond to the distress signal causes the amplifier tube 48 to be controlled and to pass current which energizes relay 49. Closing of the contacts of this relay actuates the alarm device 51.

After receiving the distress signal, the operator may move the switch 30 into the other position for reception of voice signals on the loud speaker.

If the transmitter is to be used either for sending out a distress signal or for communication by means of voice signals, switch 2 will be moved into position for connecting the output of the transmitter to the antenna 1.

Assuming that a distress signal is first to be transmitted, switch 84 will be positioned as shown. The three tone frequencies of the generators 77, 78, and 79 will be combined as control modulations for amplification in the tube stage 85 and for subsequent amplification in the twin triode tube 68. The power amplifier tube is fed with energy from the oscillator 60 by virtue of the coupling of its control grid to the output side of the oscillator 60 across capacitor 66. The transformer 67 applies modulation potentials to the output circuit of tube 64. Anode potential variations are reflected in the transfer of output energy across capacitor 72 to the antenna circuit.

As previously stated, the transmission of voice signals may be obtained by merely throwing the switch 84 into the left hand position, whereat the microphone 82 may be used to apply modulating potentials first to the amplifier 85 and thence to the push-pull stage of the modulator.

While it will be seen that I have described my invention as though embodied in apparatus which utilizes many well-known elements, it is nevertheless to be understood that the arrangement itself

is novel and provides improved facilities for distress signaling and for two-way communication work.

I claim:

1. In a distress signaling system, a radio receiver including a local oscillator and means for heterodyning its output with incoming radio signals, an intermediate frequency amplifier and detector connected in cascade relation to said heterodyning means, separate means for amplifying and filter-passing individual tones in a mixture of at least three low frequency components of the output from said detector, a plurality of individual relays each operable by amplified currents derived from a different one of said separate means, and an alarm device operable only upon the simultaneous operation of all of said relays.

2. In radio apparatus for distress signaling, wherein a transmitter and a receiver are provided, the improvement which provides a combination with said transmitter of a plurality of audio-frequency generators each tuned to a different frequency and all simultaneously connectable to the modulator section of said transmitter, whereby an outgoing distress signal may be characterized as a mixture of at least three predetermined and substantially equal-amplitude tone modulations of the carrier wave of said transmitter, and the combination with said receiver of a plurality of selective filter units for simultaneously passing each of the several predetermined audio frequencies of which said distress signal is composed, and, further, an alarm device including time delay means and an operating circuit closeable only in response to the reception of a distress signal which possesses the full complement of said predetermined audio frequency components and is sufficiently prolonged to outlast the operation of said time delay means.

3. In a selector for detecting the presence of certain low frequency components in a distress signal, a plurality of electronic amplifier-filter circuits each tuned to a respective one of said low frequency components, relays each energizable by output from a respective one of said amplifier-filter circuits, each relay having an armature movable between front and back contacts, an electronic device having input and output circuits, time delay elements in said input circuit, means whereby a cut-off bias is applied to said input circuit so long as any one of said relay armatures remains engaged with its back contact, means for causing said electronic device to become conductive after a predetermined delay following a circuit closure through all of said relay armatures and their front contacts in series, and an alarm device operable in response to the development of a conductive state in said electronic device.

4. The method of detecting the presence of a plurality of predetermined low frequency components in a distress signal with the aid of an electron discharge tube circuit arrangement which is subject to control by the mutual cooperation between a plurality of relays corresponding to the several low frequency components of said distress signal, said method comprising filter-passing each of said predetermined low frequency components, removing a blocking bias from the discharge tube of said circuit arrangement which is normally maintained by any one of said relays when unenergized, and producing a delayed response in said discharge tube by ren-

dering the same conductive after closure of a conductive path for an unblocking potential to be applied to said discharge tube, said path having series connections which are individually controllable by each of said relays.

5. In a distress signaling system, a radio transmitter including a carrier wave source, means for modulating said source by a wave which is constituted as a mixture of output energies from at least three parallel-connected and simultaneously operative generators, each developing a different low frequency, means for amplifying and radiating the carrier wave energy so modulated, a heterodyne receiver including means for demodulating and detecting said carrier wave energy, frequency-selective means subject to control by the detected output energy from said receiver for completing a circuit through as many points of circuit closure as the number of low frequency components in said detected output, said frequency selective means being capable of accepting substantially the same frequencies as those of said low frequency generators and no others, and an alarm device operable in response to the completion of said circuit.

6. In a distress signaling system, a radio receiver for activating an alarm device only in response to a modulated carrier wave the modulations of which are constituted as a mixture of at least three low frequency components of substantially equal amplitude, frequency selective filters for passing said frequency components after detection, a plurality of electronic devices each having the winding of a relay in its load circuit and each device being subject to control by rectified energy from a respective one of said filters, an alarm device having an electronic switch for operating the same, and relay contact means for controlling said switch, said means including series-connected points of circuit closure, each circuit closure point being controllable by a respective one of said relays, whereby said alarm device is caused to be actuated only when the full complement of said low frequency components is detected.

7. Apparatus according to claim 6 in combination with normally closed contacts on said relays, and circuit means extending through said contacts for applying a cut-off bias to the electron discharge device of said electronic switch.

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