

July 30, 1935.

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2,009,447

MEANS FOR PRODUCING AN AUTOMATIC WARNING SIGNAL

Filed May 29, 1931

4 Sheets-Sheet 1

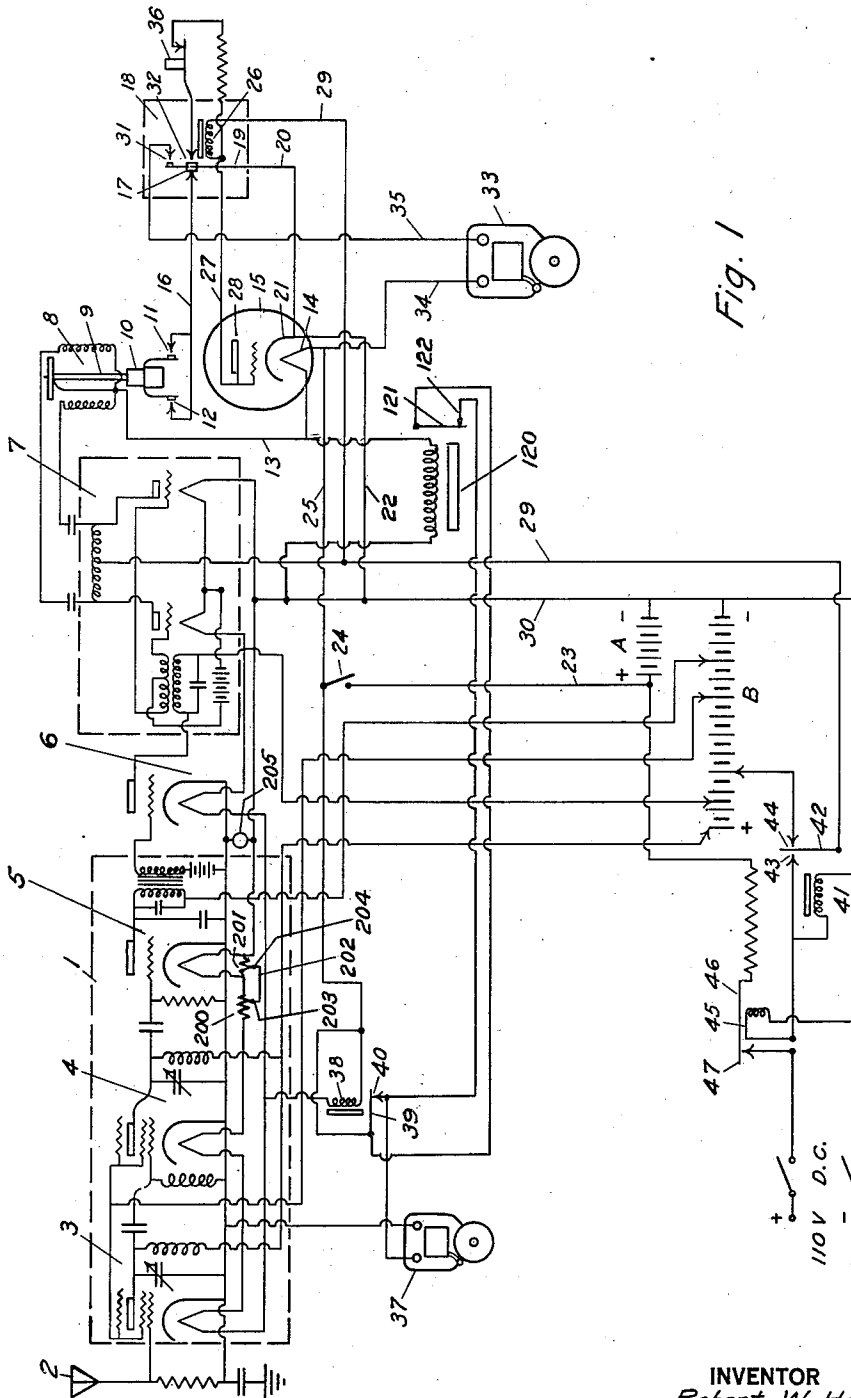


Fig. 1

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Fig. 5.

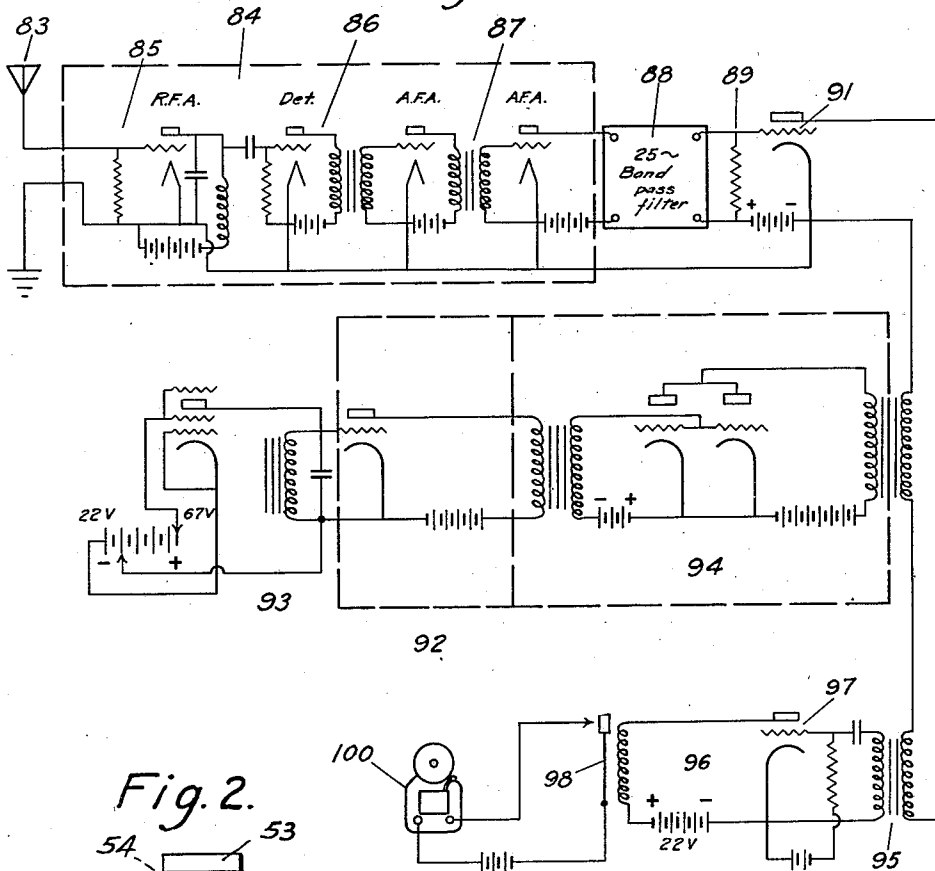


Fig. 2.

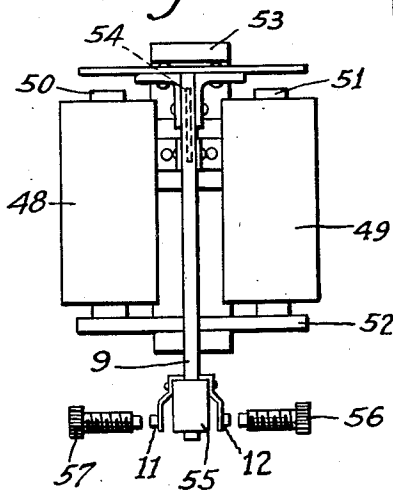
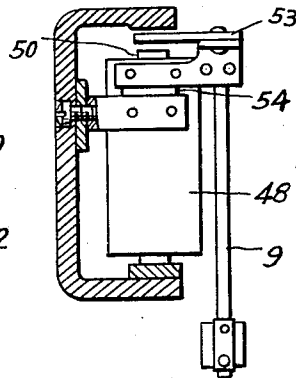


Fig. 3.



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4 Sheets-Sheet 3

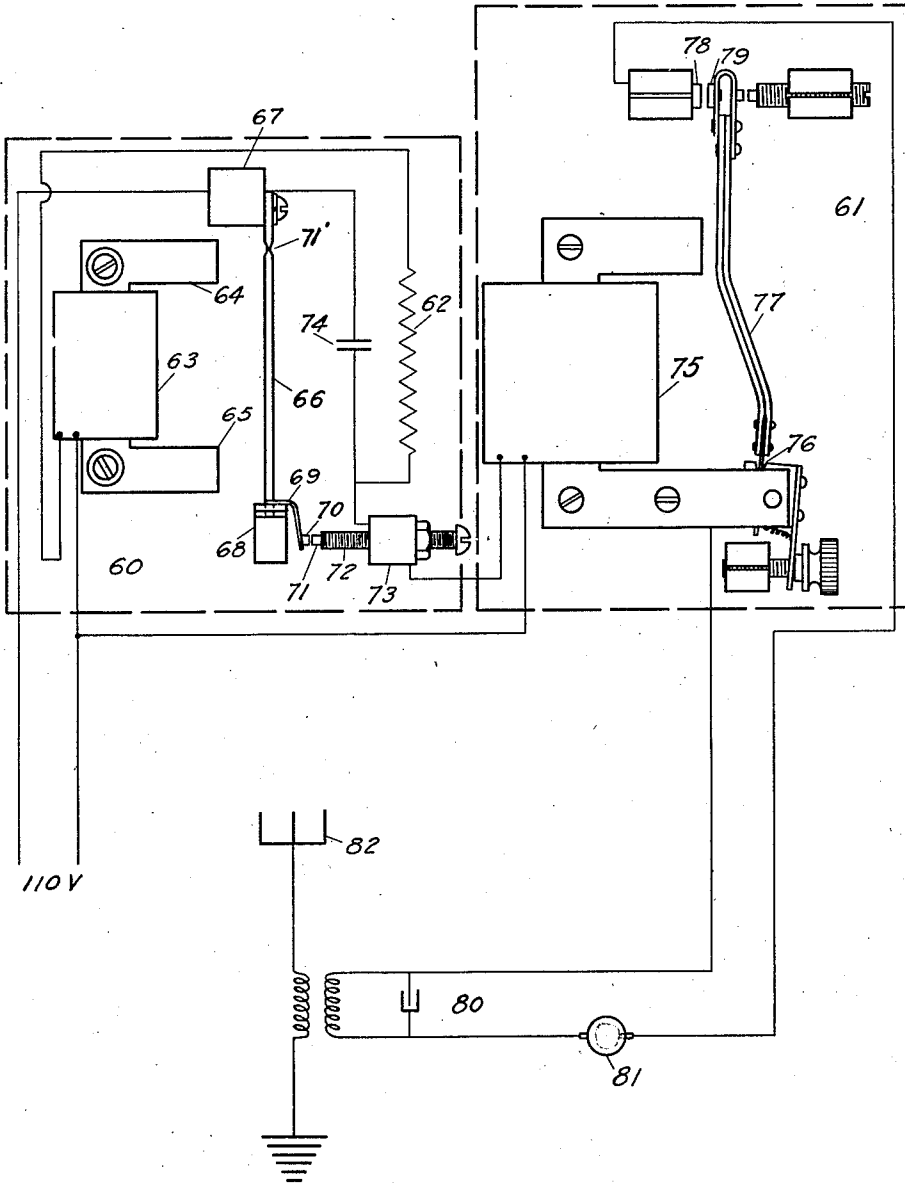


Fig. 4

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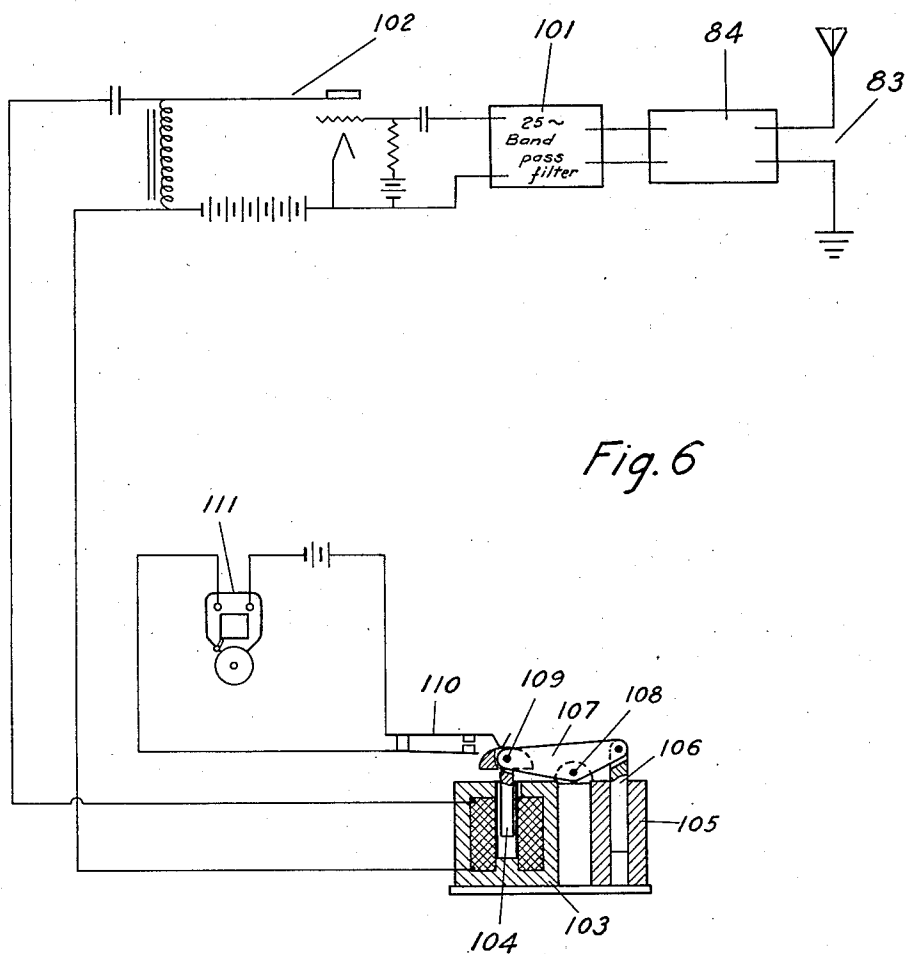


Fig. 6

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UNITED STATES PATENT OFFICE

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MEANS FOR PRODUCING AN AUTOMATIC
WARNING SIGNALRobert W. Hart, Lynn, Mass., assignor to Sub-
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Application May 29, 1931, Serial No. 540,961

3 Claims. (Cl. 250—2)

The present invention relates to a system for receiving a warning signal and more particularly to such a system in which the warning signal is transmitted by electromagnetic waves to a ship or shore station.

Warning signals have in the past been commonly used. In wireless communication at the present time the ship danger signal is given in code with the well-known letters S. O. S. A ship in danger may broadcast this signal and it is the duty of other ships in the vicinity to listen to and receive the same and if possible lend assistance. Warning signals have also been used for other purposes as, for instance, to make the position of a ship known in time of fog.

In order to make use of these warning signals, since they are transmitted at no special time, it is necessary constantly to have a wireless operator on watch to receive the same. For continuous operation it practically becomes necessary under these circumstances to have at least two operators upon a vessel which for a small crew is apt to be a rather large expense.

In order to overcome this difficulty mechanical means have been adapted and applied to give an automatic alarm when a proper warning signal is transmitted. Such alarms are in general operated in a number of ways. The signal may consist of a particular code arrangement to which on account of the mechanism in the receiving system the alarm at the receiver will respond. In devices operated in this manner the warning signal must be given quite accurately, and, further, the mechanism employed for producing the selective operation for only the warning signal is quite complex and expensive and easily gets out of order.

In my invention described below I overcome these and other objections and provide a simple, easily operated mechanism which is very rugged and will not ordinarily get out of order. For a warning signal I prefer to employ a long continued radio signal of a continuous or discontinuous wave source which is modulated by some low frequency wave. This type of signal has been employed for a warning signal and may comprise a continuous or discontinuous radio frequency wave modulated by an audio frequency tuning fork at, for instance, 25 cycles. The signal may be operated for a given period or for any period longer than the given period, that is the radio frequency wave may have imposed upon it a modulation of 25 cycles enduring for four or more seconds. The circuit which I have

devised is particularly adapted to receive this type of signal to the exclusion of all others.

A tuning fork which by continued operation over a given period of time builds up to a sufficient amplitude may be employed in the system for receiving the type of the warning signal just described for the purpose of bringing about the operation of an alarm signal which may be a visual indicator or a ringing device. While this type of apparatus has proved to be very successful in alarm devices for the receipt of warning signals of the type described above, the means employed in the present invention offers even greater reliability and freedom from interfering elements tending to create false signals and at the same time presents a system in which the tuning element of the receiving circuit need not be extremely closely tuned to the tuning element of the transmitting circuit.

In fact, even though the vibrating element in the receiving system is slightly out of tune with that in the transmitting device, the time interval in which the receiving system will operate may be kept extremely constant. Further, even though the amplitude of the vibrating element in the receiving system is never very great, it is possible to provide a consistent operation of the warning signal without any possibility of false alarms.

In the system which I have devised for receiving warning signals of this type I have separated in two different means the distinctive elements of the warning signal. A tuned vibratory system, mechanical or electrical, may be used to pick up the tuned signal. If the tuned signal should then endure for longer than a given period of time, the time-control means connected with the tuned means or circuit will operate and allow the operation of the warning signal.

In the embodiment described in connection with this specification, a mechanical vibratory relay is used tuned to the warning signal. This relay, while tuned, does not need to be tuned so sharply as a tuning fork in the corresponding position. For making the operation of the alarm dependent upon the duration of the warning signal, there is provided a thermionic valve circuit of the heater type in which the heating circuit is connected in the circuit of the tuned vibrator. In order for the thermionic valve to become operative, the cathode must be heated to a sufficient degree by the heater which is accomplished only after applying current for a given time. The vibrator intermittently makes and breaks the contact in the heater circuit of the tube and as a

result it takes a number of seconds for the tube to heat to the point of operation. In this manner if the warning signal has endured for the desired time, the circuit becomes operative and an alarm is sounded.

The separation of the time element and the tuning element is very useful and important in the present system and by this means even though the tuned element at the receiving station should not be exactly tuned to the modulated wave at the transmitting station, it would still be possible to bring about a consistent operation of the warning signal. In such cases there is a possibility that the tuning fork or reed at the receiving station may vary a small percentage in tuning and still not affect the faithful operation of the system, since its operation of the system does not depend upon the building up of the amplitude of the vibrating member of the tuned system, but depends upon a separate and independent element as will appear from the description in the specification.

In the drawings Figure 1 shows a circuit arrangement of the receiving system, and Figure 2 shows a detail of the mechanically tuned vibrator, Figure 3 shows partly in section another view of the vibrator of Figure 2, Figure 4 shows the transmitter modulating device and Figures 5 and 6 show modifications of the receiver system. In Figure 1 the signal, such as described above, is received in the radio frequency receiver and amplifier shown within the dashed lines 1 from the antenna 2. The radio frequency receiving circuit has at least two radio frequency tuners or amplifiers, the first of which, as indicated by 3, is tuned quite broadly to the radio frequency of the warning signal to be received. This is, of course, the frequency of the carrier wave and may in ordinary work be 300 or 600 meters. The second radio frequency circuit 4 is tuned somewhat more sharply than the first circuit 3 and to a slightly different frequency than that of the first circuit. The first circuit 3 may be tuned, let us say, to 595 meters broadly while the second circuit 4 may be tuned to 605 meters, but more sharply tuned. The radio frequency wave received and passed through the circuits 3 and 4 is rectified in the usual manner in the detector circuit 5. If the signal happens to be a continuous wave signal, the output of the detector circuit may contain an audio frequency note modulated at the pitch of the warning signal.

This would particularly be true where the carrier wave was heterodyned with a local oscillator or where the heterodyned note was transmitted from the carrier station. The signal may, however, be merely the pitch of the warning signal. If the transmitter was a discontinuous wave set, as, for instance, a spark set, then the output of the detector circuit would be, as has been previously described above, an audio frequency note modulated at the pitch of the warning signal. Either type of signal may be handled in the present circuit.

The detector circuit 5 impresses its output into an audio frequency amplifier 6 which, in turn, operates the push-pull amplifier 7 controlling the warning signal operating circuit. To the output of the push-pull amplifier 7 is connected the mechanical electrically driven vibrator 8 which will be described in greater detail later. The vibrator 8 is a tuned device being tuned by the tuned rod 9 which has an adjustable mass 10 positioned at its end. The vibrator is tuned to the pitch of the

warning signal and responds within close range only to a signal of that pitch or very closely to that pitch. If the vibrator in the present case were turned to 25 cycles, it might respond somewhere from $24\frac{1}{2}$ cycles to $25\frac{1}{2}$ cycles without great change in amplitude and would under such circumstances have sufficient amplitude to alternately make and break the contacts 11 and 12 operated thereby.

The contacts 11 and 12 are connected on the one side through the wire 13 attached to the reed 9 to the heating element 14 in the thermionic valve 15. The contacts 11 and 12 on the other side are connected by means of the wire 16 to a contact 17 on the alarm-ringing relay 18. Normally the contact 17 is closed and the current passes through the relay stem 19 to the wire 20 connected to the cathode 21 of the tube 15 and to the cathode lead 22 to A— of the A battery. The lead 23 from the A+ connects to the filament switch 24 and through this to the lead 25 to the heater 14. It will be seen, therefore, that the closing of the contacts 11 and 12 by the vibration of the mechanical vibrator 8 completes a circuit through the A battery and the heater 14 of the tube and commences the heating of the tube so that it may operate.

The alarm-ringing relay 18 has an operating coil 26 which, as will be seen from Figure 1, is connected through the lead 27 to the anode 28 of the tube 15. The operating coil 26 is connected at its other end to the lead 29 which connects to the positive potential of the power supplied and returns therethrough by means of the leads 30 and 22 to the cathode 21 of the thermionic valve 15. When the cathode 21 has been sufficiently heated by the heater 14 through the intermittent operation of the vibrator 8, a current will flow through the cathode-anode circuit of the tube including the coil 26 and will break the contact 17 and make a contact on the opposite side of the armature 19 with the contacts 31 and 32. The contact made at 31 will energize the radio auto alarm 33 by connecting the same across the A battery circuit as follows: leads 34, 25, switch 24, lead 23, A battery, lead 30, lead 22, lead 20, armature 19, contact 31 and lead 35. At the same time that the contact 17 is broken and the thermionic tube 15 becomes inoperative because the heating current is broken, the contact 32 is made which completes the circuit through the coil 26 across the power supply and maintains the coil 26 energized so that the radio auto alarm will continue to ring. In order to stop the ringing of the alarm, the alarm release push button 36 may be pressed which breaks this circuit and allows the armature 19 to assume its normal operating position.

As the system must be operatively connected at all times, there is provided a filament circuit alarm 37 operated by a filament circuit relay 38 which is in series with the filament circuit supplying the heating current to the tubes of the radio frequency receiver. The heating current is supplied to the tubes of the receiving set in a series parallel connection, half of the tubes being connected in series and the two series circuits connected in parallel with the filament leads.

If one filament should give way in this connection, the current through the filament relay immediately will be reduced to half its magnitude. The filament relay is so built that when this occurs the armature 39 will no longer be attracted by the magnet and consequently be released and make a connection at 40 completing the filament

circuit alarm across the A battery. If any one of the filaments should burn up while the set is being continuously operated or in continuous operative condition, a filament circuit alarm will be given so that the operator may replace the use-

The entire receiving circuit may be tied up with the filament circuit alarm in this fashion, and, as indicated in Figure 1, the audio frequency amplifiers may similarly be connected in the filament circuit alarm.

In order to insure further continuous operation of the set, a B battery is provided, as indicated in Figure 1, but normally this battery is not connected in circuit, the power leads 29 and 30 being supplied directly from the 110 volt D. C. mains. If for any reason the power supply should be broken, the differential relay 41 across the mains will release the relay armature 42 and connect from the left contact 43 connecting to the power mains to the right contact 44 connecting to the positive potential of the B battery. At the same time, the battery charging no voltage, release relay 45 would also release and prevent the A battery which is normally in charging condition through the lead 46 and the contact 47 connecting the positive A potential to the positive side of the mains from discharging through the power supply.

To provide further for faithful operation without the presence of false or stray signals which might under very rare conditions be obtained by a continuous discharge of very powerful static for a period of five seconds, there may be provided in the detector circuit, as shown at 5 in Figure 1, a resistance 200 connected in series in the heater leads and a second resistance 201 connected across the heater element of the detector tube. While these resistances may be permanently adjusted, it may be preferable to provide an adjustable contact element shown by the lead 202 which has one connection 203 adjustably associated with the resistance 200 and another connection 204 adjustably associated with the resistance 201.

In this manner the detector tube may have its cathode run at a low temperature, thereby limiting the strength of the signal current which could flow through the circuit and at the same time providing maximum sensitivity. In this manner a powerful signal would be cut down while a feeble signal would be amplified in the usual manner.

It may also be preferable to provide a space current meter, as shown by 205 in Figure 1, in the common cathode return lead. This space current should not fall below a given value, and if it does fall below a given value, the operator knows that the circuit is not functioning properly.

Figure 2 shows the mechanical vibrating device and comprises the two coils 48 and 49 with the poles 50 and 51. The magnetic circuit through the coils is completed by the plate 52 at the bottom of the coils. The armature 53 is pivoted by a center spring 54 and is alternately attracted by the poles 50 and 51, thus vibrating the rod 9 carrying the contacts 11 and 12. An adjustable weight 55 is provided for tuning the device to the desired frequency. Adjustment may also be obtained by means of adjusting screws 56 and 57 by means of which contacts may be made with the contacts 11 and 12 at the desired amplitude of the mechanical vibrator. The device described may be sharply tuned and prefer-

ably in the present case is tuned within one or two cycles.

Figure 4 shows a means of modulating the transmitter at the desired frequency. It has been found that a tuning fork alone is not a good method of modulating or making and breaking the carrier current. This is probably due to the fact that the contacts are made and broken at the instant when the velocity of the contacts with respect to one another is very small and an arc tends to form for this reason. The system shown in Figure 4 has the advantage of preserving the correct frequency in the use of the tuned rod or spring relay 60 and the power relay 61.

The tuned relay 60 is operated across the line through a resistance 62 and contacts 70 and 71. This tuned device comprises a U-shaped electromagnet 63 having two poles 64 and 65 and an armature 66 in the form of a strip of flexible iron or steel secured at one end to a block 67 and having at its other end a mass 68 from which a spring element 69 extends carrying the contact 70.

The armature may be tuned by adjustment of the mass 68 or by thinning the metal at 71' or by both means. Opposite the contact 70 is a contact 71 mounted on the screw 72 which may be adjustably positioned in the block 73. Across the contacts 70 and 71 is the condenser 74.

When current is applied on the electromagnet 63, the contacts 70 and 71 are opened and closed at a period corresponding to the tuning of the element 66. This likewise opens and closes the current through the coil 75 of the relay 61. The relay 61 may be any of the ordinary types of quick acting relay but preferably is one in which the spring member 76 furnishing the movement of the contact arm 77 is very strong and the arm 77 itself is long. The contacts 78 and 79 are mounted at the end of the arm and fly back with a great velocity when the coil current is broken. The relay may be made to have this quick action by having the spring 76 of spring steel and very short and providing the contact arm 77 as a lever to obtain a higher velocity at the contact points.

The relay contacts 78 and 79 may be in the circuit of the transmitter 80 having a continuous current high frequency generator 81 of any of the well-known types radiating electromagnetic waves through the antenna 82.

In place of using a wholly mechanical tuned system, a system electrically tuned may be used. This is shown in Figure 5 where the antenna 83 picks up the radio frequency signal which is received in the receiving circuit 84 comprising a radio frequency amplifier 85, detector 86 and audio frequency amplifier 87. The audio frequency amplifier 87 is connected across a band pass filter 88 passing a small band in the neighborhood of 25 cycles or the frequency it is desired to pass.

The output 89 of the filter is connected across a thyatron or grid glow tube 91 capable of handling more power than the receiving circuit. The output of this tube is heterodyned with a local oscillator 92 which may be a dynatron generator 93 with a push-pull amplifier 94 or any other suitable generator circuit or means. The heterodyne is designed to produce a very slow beat note and this note is impressed by means of the transformer 95 or any suitable means as a resistor, for example, upon the no current relay device 96.

The tube 97 in this element has its grid biased to cut off the current flowing through the plate circuit of the tube when the voltage developed across the transformer 95 was zero because of the beat, being reduced to near zero. That is when the beat note is near zero, the current becomes almost zero value during some part of the beat cycle and at this moment the voltage generated by the transformer is zero. When this occurs the inertia weighted relay 98 which operates only near zero beat because of its design, is released and the alarm 100 operates.

In place of the circuit of Figure 5, the circuit shown in Figure 6 may be used. Here the signal is received on the antenna 83 passed through a receiver circuit 84 and a band pass filter 101 to obtain the particular warning signal note. The band pass filter works into a power or amplifying means 102 which may be a tube circuit as shown and operates a solenoid relay 103, the plunger 104 of which is delayed by the dash pot device 105 in which the plunger 106 is attached to a rocker link 107 pivoted at 108. The rocker arm at the end opposite the plunger 106 is pivoted to the solenoid at 109. When the solenoid is pulled downward, as it is by the action of the 25 cycle current, the contact 110 is made closing the alarm circuit 111.

It should also have been noted that the alarm tube heater 14 is provided with a safety device comprising a high resistance relay 120 connected in the heater circuit across the battery and the heater through which sufficient current flows at all times while the tube is in operation to maintain the contacts 121 and 122 open at all times. If the heater 14 should burn out, the current through the high resistance relay is broken and contact is made between 121 and 122

operating the alarm 37 and notifying the operator that the device is not functioning properly.

Having now described my invention I claim:

1. In a wireless receiving system for receiving a warning signal having a definite periodic interruption and of a definite length, a mechanical tuned relay connected to the output of said receiving system, a valve having cathode and anode electrodes, means intermittently heating said cathode by the operation of said relay, said means being commensurated to produce a space current after the intermittent heating has continued substantially for the signal length and means operated when the space current has been established.

2. In a wireless receiving system for receiving a warning signal having a definite periodic interruption and of a definite length, a mechanical tuned relay connected to the output of said receiving system, a valve having cathode and anode electrodes, means intermittently heating said cathode by the operation of said relay, said means being commensurated to produce a space current after the intermittent heating has continued substantially for the signal length, means operated when the space current has been established and means for manually restoring said last means to its preoperative condition.

3. In a wireless receiving system for receiving a warning signal, a valve and valve circuit having cathode and anode electrodes, means for intermittently supplying heat to said cathode to accumulate sufficient heat intensity to produce an electron flow after a definite period of intermittent heat supply and means operated by said electron flow.

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