

May 15, 1962

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3,035,251

ELECTRICAL INTELLIGENCE RECEIVER AND SIGNAL EMITTER

Filed April 6, 1959

3 Sheets-Sheet 1

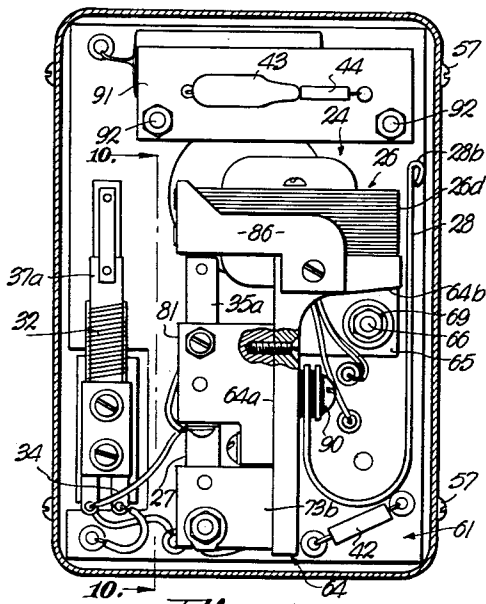


Fig. 1.

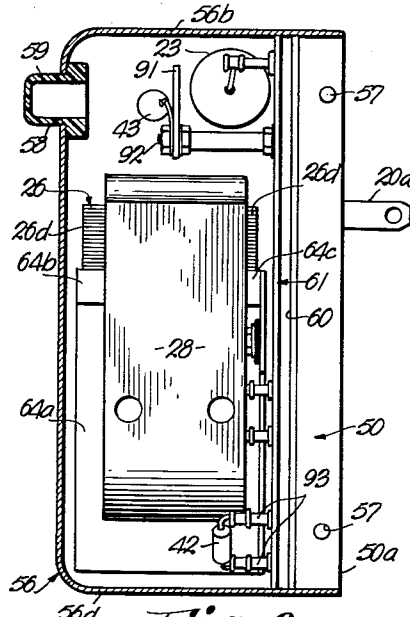


Fig. 2.

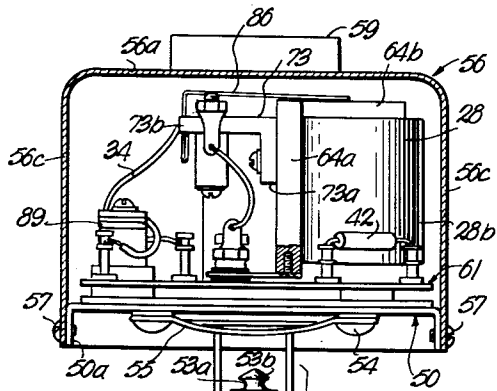


Fig. 3.

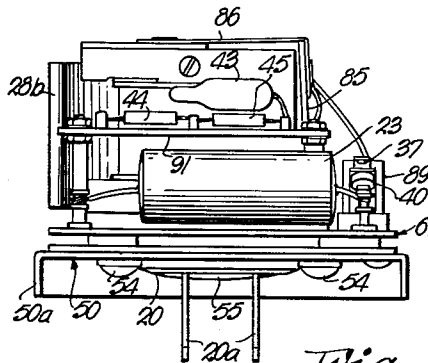


Fig. 4.

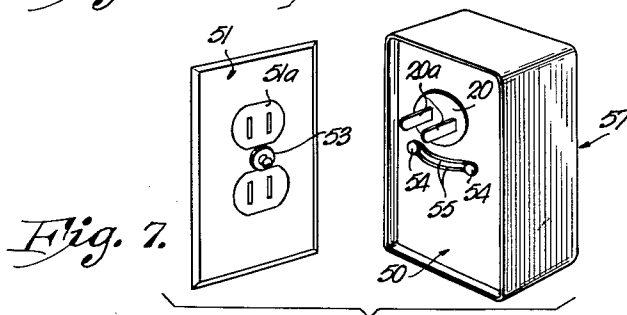


Fig. 7.

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3 Sheets-Sheet 2

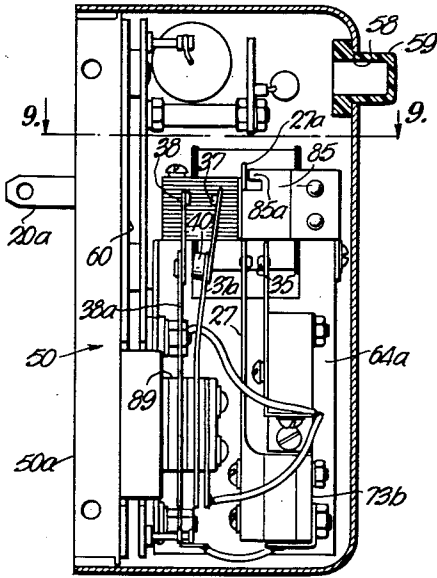


Fig. 5.

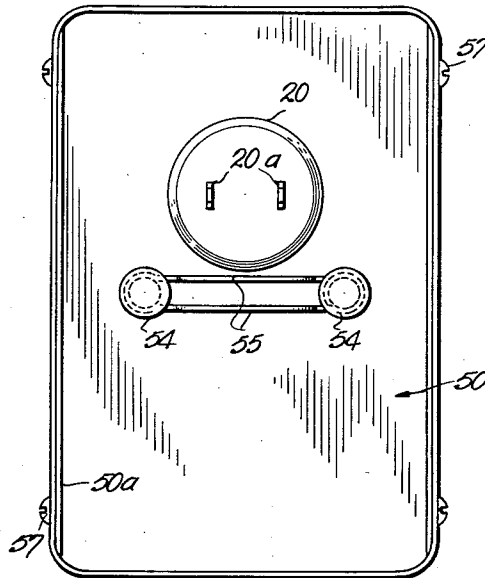
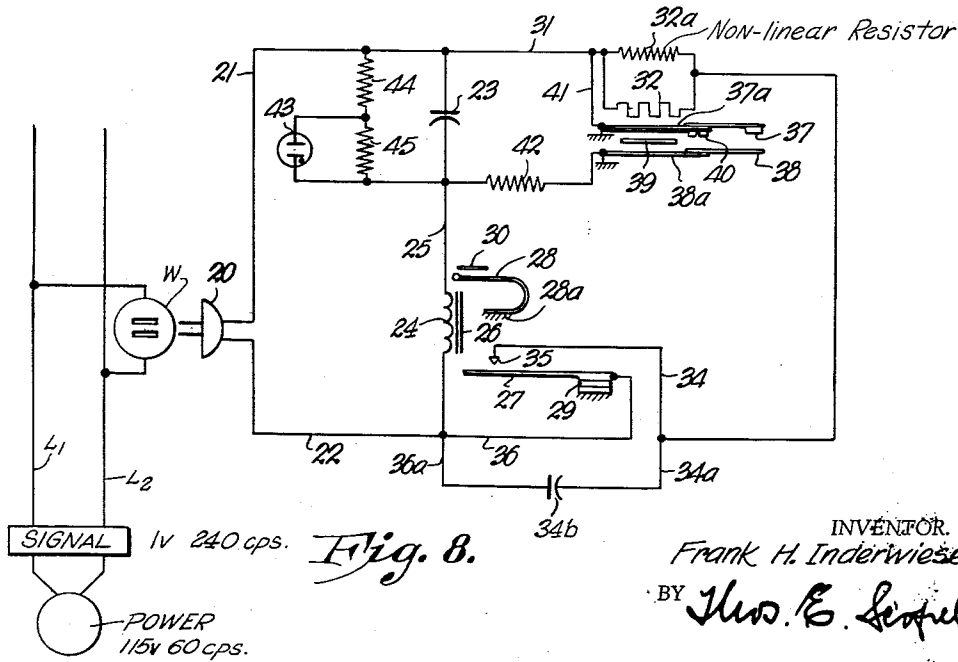


Fig. 6.



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3 Sheets-Sheet 3

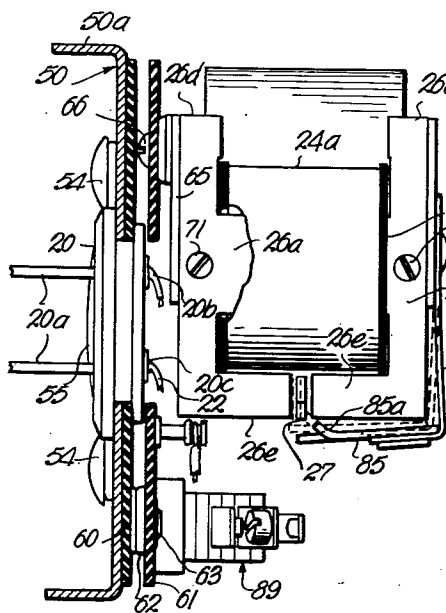


Fig. 9.

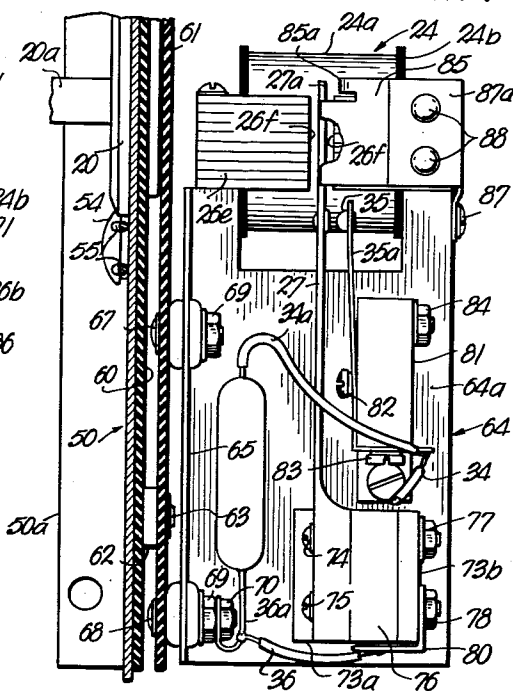


Fig. 10.

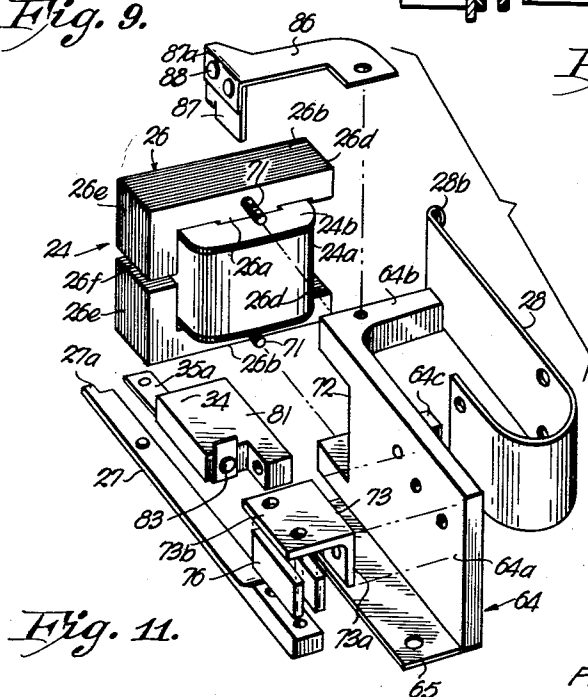


Fig. 11.

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3,035,251

ELECTRICAL INTELLIGENCE RECEIVER AND SIGNAL EMITTER

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Filed Apr. 6, 1959, Ser. No. 804,523
17 Claims. (Cl. 340—171)

This invention deals generally with the reception and use of intelligence communicated by means of electrical circuits or networks, and refers more particularly to an intelligence receiver which maintains continuous surveillance over a complex alternating current circuit or network, and produces a desired effect only when an electrical signal of specific character and frequency is applied to the circuit or network.

Broadly, the invention is directed toward the provision of a unique intelligence receiver of the type which can be connected as a part of an existing circuit or network and which will operate to discriminate between alternating currents of differing frequencies in the circuit and sense the presence of a preselected signal frequency therein. The receiver includes not only means for sensing the signal frequency, but also means whereby the presence of the signal frequency produces a change in the original condition of the receiver and causes a second signal to be emitted by the receiver. The principal application I perceive for the invention is its use as an alarm or warning unit which is capable of operation in connection with existing transmission lines and networks (e.g. those employed by public and private utilities for the distribution of electric power), and which, upon the application of a particular signal frequency thereto at some central location, will produce an alarm in the vicinity of the unit itself.

A principal object of the invention is to provide a signal receiving and warning emitting unit which, due to a unique combination of a single inductor with both electrical and mechanical tuning mechanisms, is capable of extremely accurate selection of the signal frequency employed and, moreover, is responsive to signal frequencies of extremely low voltage while still making available for actuation of the warning mechanism a relatively large amount of power of another frequency. By way of example, in the preferred embodiment of the invention I have provided for a unit which operates in conjunction with the usual 115 volts 60 cycle alternating current power systems prevalent in this country, and which will produce the audible warning upon the reception of a 240 cycle signal at a voltage of appreciably less than 1 volt, the power for the audible warning being obtained from the fundamental 115 volt 60 cycle supply.

Still another object of the invention is to provide a unit of the character described which is particularly suited to operation in signalling systems wherein the signal frequency employed is a harmonic of the fundamental power line frequency, such a system being disclosed in the copending application of Arthur Laudel, Jr., Serial No. 695,613, filed November 12, 1957, now Patent Number 2,906,897, issued September 29, 1959.

A still further object of the invention is to provide a signal receiving and warning emitting unit for connection with existing power networks and in which the impedance of the electrical circuitry within the unit is held at a low value despite the extremely accurate discrimination between frequencies which is obtained.

Yet another object of the invention is to provide a signal receiving and warning emitting unit having a single inductor which serves to operate both in the signal receiving and warning emitting phases of the operation thereof. It is a feature of the invention in this connection that the inductor forms a part of a tuned circuit tuned to the sig-

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nalling frequency and is also arranged to have applied thereto the fundamental power frequency and voltage to cause the emission of the warning. A further feature of the invention in this respect resides in the structural relationship established between the inductor and the mechanical components of the receiving and emitting mechanisms to accomplish the desired results.

A further object of the invention is to provide a compact, reliable and low cost signal receiving and warning emitting unit which is readily installable in any service outlet of a commercial power network. In its preferred form the unit is completely encased within a sturdy yet inconspicuous housing which requires only the plugging of the unit into a convenient outlet to render it operative. Means are also provided for supplementing the plug-in connection to resist accidental disconnection of the unit. In its preferred form the unit also contains visible indicator means whereby the existence of sufficient power in the line to operate the unit can be determined simply by a quick glance at the unit.

Still another object of the invention is to provide a signal sensing and warning emitting unit of the character described having means for preventing emission of the warning except on the reception at the unit of a signal of predetermined character. In the preferred embodiment this means comprises a time delay mechanism serving the function of a simple pulse-time decoder. It will be evident that selective operation of different receivers by different signals can be accomplished by including differing decoders in those units, thus making it possible to actuate a given unit or group of units without disturbing others. The decoder also serves the function of preventing operation of the units responsive to unintended transients which normally occur in power networks.

A further object of the invention is to provide a signal sensing and warning emitting unit of the character described wherein the emitted warning does not depend for its continued existence upon the continuation of the signal frequency beyond the period which triggers the warning mechanism into operation and which includes means for controlling and determining the character of the emitted warning. It is a feature of the invention that the quality of the emitted warning is independent of the strength of the signal.

Other and further objects of the invention include the provision of a unit of the character described which will operate effectively at a wide range of line voltages of the fundamental frequency; which will have full sensitivity and operate reliably regardless of which way the connecting plug is connected to the power receptacle; which will not interfere with proper operation of other receivers on the same line; which will produce a high decibel, distinctive and penetrating audible warning; which automatically resets itself following use; which will operate effectively over a wide ambient temperature range; and which has a long and useful life.

Additional objects and features of the invention together with the features of novelty appurtenant thereto will appear in the course of the following description.

In the accompanying drawings, which form a part of the specification and are to be read in conjunction therewith, and in which like reference numerals indicate like parts in the various views;

FIG. 1 is a front plan view of a typical receiver and warning emitting unit embodying the features of the invention, the front of the cover of the casing broken away to expose the internal structure of the unit;

FIG. 2 is a side elevation of the unit taken from the right hand side of FIG. 1, the near side wall of the cover of the casing broken away to expose the internal structure of the unit;

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FIG. 3 is an end elevation of the unit taken from the lower end of FIG. 1, the near end wall of the cover broken away to expose the internal structure;

FIG. 4 is an end elevation of the unit taken from the upper end of FIG. 1, the cover of the casing having been removed in its entirety;

FIG. 5 is a side elevation taken from the left hand side of FIG. 1, the near wall of the cover of the casing broken away to expose the internal structure;

FIG. 6 is a rear plan view of the unit;

FIG. 7 is a perspective view on a reduced scale illustrating the relationship of the unit with a conventional wall outlet prior to connection of the unit with the outlet;

FIG. 8 is a schematic diagram of the electrical circuitry of the unit;

FIG. 9 is an enlarged sectional view taken along the line 9—9 of FIG. 5 in the direction of the arrows;

FIG. 10 is an enlarged sectional view taken generally along the line 10—10 of FIG. 1 in the direction of the arrows, parts being broken away for purposes of illustration; and

FIG. 11 is a perspective view of the inductor and the components of the unit acted upon by the flux of the inductor, the various components and parts shown in exploded relation.

Referring now to the drawings, the electrical circuitry and general manner of operation of a unit incorporating the features of the invention will be described in connection with the schematic diagram constituting FIG. 8. In this figure reference numeral 20 indicates a conventional two prong plug designed for coupling with a convenient wall outlet W of a power supply network L1, L2 such as is usually present in any inhabited building. Leading from the plug are a pair of conductors 21 and 22 to which we will assume a line voltage of 115 volts 60 cycle alternating current is supplied through the plug from the basic supply network. The system includes a capacitor 23 and an inductor 24 forming part of an electrically tuned circuit tuned to the signal frequency. For purposes of illustration the signal frequency will be assumed to be the fourth harmonic (240 c.p.s.) of the fundamental power frequency. I have found suitable values for the capacitor and inductor to be a capacitance of 0.41 microfarads (plus or minus 5%) and an inductance of 0.885 henries. As will be observed, the capacitor and inductor are connected in series with conductor 25, the latter extending across conductors 21 and 22. As will later be made clear, the inductor is in the usual coil form and includes a core 26 of magnetic material.

Adjacent the inductor 24 and in position to be influenced by the alternating flux induced therein during certain phases of operation are two vibratable elements 27 and 28. The element 27 will be termed the reed of the unit and element 28 the clapper. The reed is a strip of good quality steel or other magnetic and electrically conductive material anchored at one end and having its free end in the field of the inductor. The reed is so designed that its critical or resonant frequency of mechanical vibration is equal to the signal frequency to be applied to the network (in the examples here under consideration 240 cycles per second). In other words, the critical frequency of the reed is the same as the frequency to which the electrical circuit 21, 23, 24, 25, and 22 is tuned. In order to coincide the vibration of the reed with the frequency of the electrical signal to which it is responsive, and to make it readily responsive thereto, the reed is polarized, preferably by means of a permanent magnet 29 which can be included as a part of the reed anchor. By placing the magnet at the anchor, the magnet is removed from the demagnetizing influence of the strong alternating flux occurring in the inductor during the alarm operation later to be described.

As to the clapper 28, it, too, is constructed of steel or other magnetic material. It also is anchored at one end as at 28a and has its free end in position to be acted on

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by the magnetic field of the inductor. In the preferred embodiment the clapper is given a critical frequency equal to twice the fundamental power frequency, which in the case being described is 120 cycles per second. The free end of the clapper is positioned adjacent a sounding member 30, which it vibrates against to produce the audible alarm. It will be remembered, however, that under normal non-signal conditions the 60 cycle current is substantially screened from the inductor by the electrical tuning of the circuit in which it is included to the signal frequency. Care should be taken, of course, to space the clapper sufficiently away from the core as to eliminate the possibility of establishing a shunt or parallel path for the flux created by the signal current. In other words, the objective is to confine the path of the signal flux primarily through the reed 27.

The reed 27 also serves as an electrical contact element in a circuit which includes conductors 21, 31, a resistance heater 32, conductors 33 and 34, contact 35, and conductors 36 and 22. As will be evident, in this circuit current flow is controlled by the vibration of the reed 27, the current flowing only when the reed is undergoing vibration sufficient to bring it into intermittent engagement with the contact 35. To cut down sparking at the reed contact 35, a capacitor 34b is connected across from conductor 34 to conductor 22. For the specific signal here under consideration a capacitance of .01 microfarad has proved satisfactory. To control the amount of current through heater 32, a non-linear resistor 32a may be connected in parallel therewith, the resistor in this case varying inversely with the amount of current supplied.

The resistance heater 32 governs the opening and closing of a pair of contacts 37 and 38, each of which is carried by an arm 37a or 38a. The arms 37a and 38a are of conventional heat sensitive bimetallic construction, and are oriented to cause displacement of the arms in the same direction under changes in temperature thus to maintain a uniform spacing between the contacts 37 and 38 despite variations in the ambient atmospheric temperatures. However, it will be observed that the upper arm 37a is positioned to be operated upon directly by the heat from the heater 32. Preferably a heat shield 39 (which may be of mica or other material having good thermal insulating properties) is placed between the two thermal elements to minimize the effect of the heater on arm 38a. It will be understood, of course, that the thermal element 37a is so oriented that the application of heat thereto by the heater will cause distortion of arm 37a to cause contact 37 to move toward contact 39 and engage it to bring about an electrical connection therebetween.

To assist in obtaining a positive closing of the contacts 37 and 38, and for a further purpose later to be described, a permanent magnet 40 is secured to the underside of the arm of contact 37. The arm of contact 38 includes a portion directly opposed to the magnet 40, constructed of magnetic material having a low reluctance, preferably soft iron. The magnet is of sufficient strength that when the distortion of thermal elements 37a has been sufficient to bring contact 37 within .050 inch of contact 37, the magnetic force will take over and completely close the contacts with a rapid snap-like action.

The magnet 40 also serves the purpose of maintaining the contacts closed during cooling of the thermal element 37a until such time as the opening force exerted by contraction of the metal is sufficient to overcome the magnetic attraction between the magnet and the magnetic material upon which it acts. More will be said of this later.

It will be observed that contacts 37 and 38, and their arms 37a and 38a, form a part of a circuit which is capable of bypassing capacitor 23 and includes conductors 21, 41, a resistance 42, the inductor 24, and conductor 22. Also included in the electrical circuitry of the pre-

ferred unit is a small neon lamp 43 which is in circuit with the voltage dividing arrangement including resistors 44 and 45. The resistors 44 and 45 have resistances so proportioned that with a given neon lamp, the lamp will be lighted only at line voltages above a certain value, in this case 90 volts. This provides a means of indicating presence of sufficient supply voltage in the supply network to cause the unit to operate effectively upon the transmission of the electrical signal for which the unit is designed and further insures that the connection through the inductor is in working order.

Turning now to the operation of the electrical system as described thus far, it will be assumed that the unit is plugged into the wall receptacle W of a 115 volt 60 cycle power network to which the signal frequency has not yet been applied. Under these circumstances the neon lamp 43 will be continuously illuminated, thus indicating the readiness of the unit for operation. Contacts 37 and 38 will be separated, as will the reed 27 from contact 35, and thus no current will be flowing through the heater 32, nor theoretically through the inductor. As a matter of actual fact, there will be a small current flow in the inductor, but for the purposes of the invention it can be ignored as it has no effect on the operation of the reed or clapper.

Assume now that there is generated in the power lines a signal of somewhat extended duration, which in this case could be a 240 cycle signal at a potential of 1 volt. As will be evident the 240 cycle current will pass through the inductor and set up an alternating flux which acts upon the reed 27 causing it to vibrate at its critical or resonant frequency. The flux caused by the 240 cycle current is insufficient to establish enough vibration in the clapper to cause it to strike its sounding element. Due to the vibration of the reed the mechanically tuned circuit, which includes the resistance heater 32, is likewise made receptive to the current flow there-through and as a result, the heater commences to act upon the bimetal element 37a. When the temperature of the bimetal element has been sufficiently raised, the contacts 37 and 38 will be closed as previously described. This causes the full line voltage and current to be applied to the inductor. Thereupon the clapper 28 will react to the alternating flux set up in the inductor by the 60 cycle current and vibrate against its sounding element 30 to provide an audible alarm signal. The resistor 42 assists in inhibiting the surge of the 60 cycle current, thus protecting the contacts 37 and 38 against being welded together at the time electrical contact is established.

It will be evident that so long as the contacts 37 and 38 remain closed, the clapper 28 will remain magnetically coupled with the inductor and continue to beat against its sounding member 30. It will likewise be evident that these contacts will remain closed so long as the reed 25 continues to vibrate, and for the additional interval required for the bimetal element 37a to cool to the extent that it will overcome magnet 40 and pull contact 37 away from contact 38. As will be later explained in detail, I have provided means for interfering with the circuit closing function of the reed immediately upon the application of the fundamental line frequency and voltage to the inductor, so that in effect, the current flow through the heater is interrupted at substantially the same time that contacts 37 and 38 are closed. This means is not, however, illustrated or depicted in FIG. 8.

The resistance heater and bimetal element 37a thus cooperate to provide a sufficient time delay in closing the 60 cycle circuit to the inductor that transient currents having the preselected signal frequency, but of short duration, will not cause operation of the unit. In other words, by judicious combination of heater resistance and mechanical design of the bimetal element 37a, any time delay desired can be built into the unit. For example, if it is desired that the unit commence operation only upon reception of a signal having a duration of longer

than five seconds, the heater and thermal element will be so designed as to bring about the closing of contacts 37 and 38 if, and only if, the signal is at least that long. This effectively prevents actuation of the unit by the presence of momentary currents in the supply network having the frequency of the signal itself. This feature is of particular importance in the case of a signal frequency which is a harmonic of the fundamental power frequency since harmonic transients are ordinarily present during operation.

The combination of electrical and mechanical tuning and the employment of a single inductor for actuating both the mechanically tuned circuit and the warning emitting mechanism present decided advantages over any other arrangement of which I am aware. By utilizing the electrical-mechanical tuning, the tuned electrical circuit can be constructed to provide extremely low impedance, thus rendering the unit operable on extremely low voltage signals. Moreover, the degree of discrimination between frequencies is excellent. I have found that a signal of 240 cycles as low as 0.50 volt was fully adequate to effectively operate the unit, and further that the unit can be given an accuracy of reception of within plus or minus 0.4 cycle.

Having taken up the basic electrical circuitry of a preferred unit, I wish now to turn to a more detailed description of its manner of construction and operation as it would be employed in a unit for location within a home, office or other likely area.

In FIGS. 1 through 7, inclusive, 9 and 10, reference numeral 50 indicates the rectangular base of the casing for the unit. The base has an outturned flange 50a around its periphery. Preferably the base 50 and its flange 50a are so dimensioned as to fit over and around the protruding wall plate 51 (FIG. 7) of a conventional electrical outlet. The typical two prong plug 20 having springs 20a extends through and is secured within a corresponding aperture in base 50, and its best seen in FIG. 9. The plug includes the terminals 20b and 20c which provide connections for the conductors 21 and 22 of the electrical circuit earlier described.

It should be mentioned in passing that due to the detailed electrical circuitry earlier described, I have not attempted to illustrate in the drawings relating to the structural features of the unit the complete wiring system. The terminal posts necessary are shown and those skilled in the electrical art will immediately perceive the routine manner in which these terminals should be connected by suitable conductors.

To assist in firmly securing the unit to the wall outlet so that it will not easily be detached therefrom, the unit includes an attaching means which supplements the plug connection. In its preferred form this includes a screw 53 which is adapted to replace the usual central holding screw for the wall plate (FIGS. 3 and 7). As will be observed, screw 53 has a circumferentially grooved head 53a which stands out from the wall plate. Secured to the back of the base 50 of the unit by rivets 54 are a pair of outwardly arched resilient members 55 (which may be made of spring wire). These are spaced laterally from one another approximately the diameter of the groove in the screw head 53a. As the prongs of the electrical plug are inserted in the socket 51a the rounded tip 53b of the screw causes the wires 55 to spread apart. Once the plug is fully inserted, the wires spring back toward one another and are retained within the groove. If sufficient outward pull is exerted on the unit, the spring-like members 55 will again spread enough to permit detachment. However, the force required to spread the wires is considerably greater than that which would result in withdrawal of the plug from the socket where the supplemental attaching means is not present. Consequently, a measure of protection against accidental detachment by small children or accidental bumping, for example, is obtained.

The main body of the casing for the unit comprises a shell 56, preferably of drawn aluminum, having the front wall 56a, top wall 56b, side walls 56c, and bottom wall 56d. As will be observed, the sides, top and bottom telescopically fit over the flange 50a of the base and metal screws 57 or bolts are employed at intervals to secure the overlapping portions together and secure the base and shell together. Near its upper end the front 56a of the shell is provided with an elongate aperture 58 within which is received in a press fit a window 59 of translucent or semiopaque light conducting material. In its preferred form, the window is arcuate in cross section so that a substantial portion projects beyond the front of the shell, thus rendering the window readily visible from locations directly above or to one side of the unit.

The inside of the base 50 of the casing is faced with a suitable electrical insulation material 60 (e.g. a fiberboard). Disposed parallel with the facing 60 and spaced therefrom is a wiring board 61 which likewise may be made of fiberboard or any other suitable nonconducting material having relatively good structural stiffness. The wiring board 61 is maintained in its spaced condition from the facing 60 by resilient spacers 62 (FIG. 9) which surround rivets 63 secured respectively to the base 50 and wiring board. The necessary conductors for completing a number of electrical connections in the unit can be included in the space between the board 61 and the facing 60.

Positioned substantially centrally of the unit is the main mounting or support bracket 64 which, as best shown in FIG. 11, has generally the configuration of an L laid on its side. This bracket is preferably formed from aluminum or other light weight nonmagnetic material and presents a main leg 64a oriented generally longitudinally of the unit and two short sidewardly projecting portions 64b and 64c at the upper end completing the general L-shape. The mounting bracket 64 is secured to the base 50 through the medium of an attaching plate 65 secured (as by riveting) to the inner edge of leg 64a and extending laterally therefrom. Bolts 66, 67 and 68 extend upwardly through the wiring board 61 and through corresponding apertures in plate 65 and nuts 69 are tightened down thereon above the plate to provide a firm attachment. Resilient washers are interposed between the plate and board 61 and between the plate and nuts 69 to provide a shock absorbing mounting for the bracket.

It will be further observed that the bolt 68 is sufficiently long to receive another nut 70 and serves as a terminal post extending into the wiring space below the wiring board.

The inductor 24 of the unit is supported at the upper end of bracket 64 and includes the usual electrical coil 24a which in this case is wound upon a hollow plastic bobbin 24b. The magnetic core 26 of the inductor is of the laminated plate type and is generally of a block H configuration. The continuous middle bar 26a of the core extends through the inductor coil and the side legs 26b are parallel. At one end the legs 26b have coplanar pole faces 26d while at the other end they are provided with inturned portions 26e terminating in opposed pole faces 26f spaced from one another to provide an air gap. The inductor is secured firmly to bracket 64 by means of machine screws 71 which extend through the respective parallel legs of the magnetic core and are received in correspondingly tapped apertures in the adjoining end faces of the bracket. It will be observed that a recess 72 is formed in the end of the bracket to accommodate the coil 24a, preferably in a relatively close fit.

The signal responsive reed 27 of the unit is mounted on and supported by bracket 64 on the same side thereof as the air gap of the inductor core. The reed, as previously mentioned, is constructed of good quality steel and has the free end thereof positioned centrally in the air gap. The other end of the reed is firmly anchored to the main leg 64a of the bracket by means of an angle

support 73 having one leg 73a flat against and secured to the bracket and the other leg 73b projecting therefrom above the reed. The reed is secured to the leg 73b of the angle support by elongate bolts 74 and 75, the latter of which is of electrically conductive material so as to serve also as a terminal post. Interposed between the reed and leg 73b of the angle is a permanent ceramic magnet 76 which may either be apertured to receive the bolts 74 and 75 therethrough, or formed of split sections disposed on opposite sides of the bolts. Nuts 77 and 78 serve to complete the connection of the reed to the angle support. The conductor 36 (FIG. 8) is electrically connected with bolt 75, and thus the reed, by means of a conventional connector 80.

As has earlier been set forth, under signal conditions the reed 27 serves as the vibrating contact in an electrical circuit which governs the operation of the alarm emitting mechanism. The fixed contact 35 of this particular circuit includes the element 35a which is supported adjacent the reed by the overhanging support 81. This support is constructed of nonconducting material (say a block of fiberboard) and is firmly secured to the main leg 64a of the main support bracket 64 in any convenient manner. The contact element 35a is preferably a copper strip bent at one end to conform to the support 81 and secured thereto by machine screws 82 and 83. The element 35a has a portion lying relatively close to one edge of the support 81 and the screw 82 extends therethrough to mechanically secure it to the support, leaving however that portion beyond the screw to flex under the control of an adjusting screw 84 threaded through the support. The end of adjusting screw 84 is adapted to engage the contact element 35a and can be utilized to control the gap between the contact 35 and the reed. Conductors 34a and 34 are electrically connected with the anchored end of the contact element 35a. The conductor 34a leads to one end of the capacitor 34b earlier mentioned in connection with FIG. 8, which is secured to bracket 64 in any suitable manner, as by adhesive, the other end of the capacitor 34b being electrically connected with the reed by conductor 36a (again see FIG. 8). The second conductor 34 at the contact element leads to the thermostatic control earlier described in connection with FIG. 8 and later to be described in more detail.

In the preferred embodiment of the invention I have, as earlier mentioned, provided means for substantially immobilizing the reed 27, and thus breaking the electrical circuit through the heater 32, at the instant that the fundamental line voltage and current is applied to the inductor 24. This has two advantages. First, it prevents excessive chattering of the reed during the alarm emitting phase of the operation and consequently prolongs the life of the unit. Secondly, it renders the duration of the alarm independent of the duration of the signal once the latter has exceeded the preset value which will cause actuation of the alarm. In other words it turns the duration of the emitted warning over to the relationship established between the cooling of the heater 32, the rate of return of the bimetal element 37a and the resistance exerted by magnet 40 against the return of the bimetal element 37a to its original condition. These relationships can be adjusted to obtain a relatively wide range of emitted signal lengths. I prefer to employ values which will produce a time delay in opening the contacts 37 and 38 following immobilization of the reed of 30 seconds.

The reed immobilizing means in the preferred embodiment comprises a magnetic latch which remains quiescent during reception of the signal frequency, but which engages the reed in response to the application of the fundamental line voltage and frequency to the inductor. The latch includes a latch element 85 constructed of magnetic material (again soft iron is preferred) which is supported adjacent but normally spaced from the inturned portions 26e of the inductor core (FIGS. 8, 9 and 10).

This element is supported in its normally spaced relation (shown in solid lines in FIG. 9) by a resilient arm 86 which functions much like a leaf spring. The arm is anchored at one end to the front edge of bracket 64 by a machine screw 87 and has an inwardly bent lip 87a at its other end to which the latching element 85 is secured as by rivets 88. In its normal unstressed condition arm 86 is spaced from the adjacent surfaces of the inductor core. It is constructed of non-magnetic material and must likewise have enough resistance to flexure as to prevent displacement of the latching element as the result of the flux set up by the low voltage signal. Its yieldability, however, must be sufficient as to permit bending when the latching element is subjected to the flux induced by the application of the line voltage and current to the inductor.

As will be observed, on that edge adjacent the air gap of the inductor the latching element is provided with an inwardly directed ear or lug 85a which is of such length that when the latching element is displaced inwardly toward the inductor to the broken line position of FIG. 9, its tip will lie in the vibratory path of the reed 27. The reed is provided with a slight extension 27a which projects beyond the air gap and the ear is so located as to engage this extension. The ear is at least long enough to prevent the reed from electrically closing the circuit through its fixed contacts 35 once the latching element is in the broken line position, and preferably long enough to depress the reed slightly away from its normal quiescent position.

Turning now to a further discussion of the alarm control mechanism and referring particularly to FIGS. 1, 5, 8 and 9, the bimetallic arms 37a and 38a of this control are supported at one end by a laminated block assembly 89 which includes laminations of insulation material which electrically separate the arms from one another. The arms carry at their free end the contacts 37 and 38, respectively. The arm 37a has wound thereon the insulated wire of the resistance heater 32. The heat shield 39, in this case a strip of mica, is interposed between arms 40 and 41 and, similarly with the arms, is supported from the block 89, being received between a pair of laminations thereof. The permanent magnet 40 of FIG. 8 is included on arm 37a, being secured thereto by any convenient means. It will be remembered, of course, that the portion of the contact 38 directly opposed to the magnet is constructed of magnetic material, preferably soft iron. Under normal non-signal conditions, contacts 37 and 38 are separated. While not shown, suitable wiring is provided to electrically connect the anchored ends of the respective elements 37a and 38a with the circuit in accordance with the teachings of FIG. 8. Reference has already been made to conductor 34 which connects one end of the resistance heater 32 with the fixed contact 35 and it will be understood that the other end of the heater wire connects with the main conductor 21 as earlier set forth.

Turning now to the alarm emitting components of the preferred unit, as we have earlier seen, the main element thereof comprises the clapper 28. The clapper is, like the reed 27, supported by the bracket 64, but on the opposite side thereof from the reed. The clapper is a generally J-shaped element bent from a flat sheet of good quality steel and provided at its free end with a rolled portion 28b. The clapper is anchored to bracket 64 at the terminus of its shorter leg by a pair of machine screws 90, fiber washers being interposed as desired to eliminate metal to metal contact and to electrically insulate the clapper from the bracket. The longer leg of the clapper extends upwardly past the pole faces 26d of the inductor core. The clapper is given sufficient width that it overlaps a substantial portion of each pole face. As earlier mentioned, the clapper is so dimensioned, constructed and mounted that its resonant frequency of mechanical vibration is preferably 120 cycles per second so that it conforms with the twice line current frequency.

In the preferred form of the invention the clapper is so disposed that the casing 56 forms the sounding board against which it acts during vibration. Referring to FIGS. 1 and 3, it will be seen that the rolled edge 28b of the clapper is positioned closely adjacent the side wall 56c of the shell. The spacing is only slightly less than the amplitude of vibration of the clapper at the resonant frequency which insures of steady operation with little dampening tendencies upon application of the 60 cycle current to the inductor. The hollow shell has an amplifying effect and results in optimum noise producing characteristics for the warning phase of operation.

As may have been noticed already, the compact construction of the inductor, main mounting bracket and reed and clapper makes it possible in a unit no larger in plan than a conventional wall outlet to leave space at the upper end of the casing for receiving other components of the system. The power indicating lamp 43 is disposed in this space, being supported on a forwardly positioned platform 91 so that it is relatively close to the window 59. The platform is of non-conducting material and is supported by elongate posts 92 anchored to the wiring board. The posts 92 should be electrically conductive as they provide a way of bringing current from the wiring board 61 to the lamp and its associated resistors 44 and 45. These resistors likewise can be included on the platform 91 as best seen in FIG. 4, along with suitable connecting terminals or posts. The platform supporting posts 91 should, of course, be covered with insulation. In a space beneath the platform 91 is located the capacitor 23 of the tuned circuit, and it likewise is provided with the necessary leads and terminals for connecting it into the electrical system.

The surge resistor 42 of the electrical system is located at the lower end of the clapper (FIGS. 1 and 2) being carried at posts 93 extending from the wiring board.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. In a receiving and signalling instrument for connection with a main alternating current circuit having a primary frequency and capable of transmitting concurrently a signal of a frequency differing from the primary frequency, the combination of a tuned circuit electrically connected with said main circuit and including an inductor, said tuned circuit being tuned to the signal frequency, a second, normally open circuit also electrically connected with said main circuit and including circuit governing means magnetically coupled with the inductor, said last mentioned means operable, upon the imposition of the signalling frequency across the inductor, to permit current to flow through said second circuit, control means conditioned by said second circuit and actuated responsive to a preselected flow of current in said second circuit to apply the full voltage of the primary frequency directly to said inductor, and signalling means magnetically coupled with said inductor and actuated responsive to the flux generated in said inductor by the voltage of the primary frequency to produce an emitted signal at the instrument.

2. In a receiving and signalling instrument for connection with a main alternating current circuit having a primary frequency and capable of transmitting concur-

rently a signal of a frequency differing from the primary frequency, the combination of a first, tuned circuit electrically connected with said main circuit, said tuned circuit tuned to the signal frequency and including an inductor, a second, normally open circuit also electrically connected with the main circuit and including therein circuit governing means magnetically coupled with the inductor when the signal frequency is being applied thereto, said last mentioned means operable, upon the presence of the signal frequency in the inductor, to permit current to flow in said second circuit, switch means conditioned by said second circuit and operable responsive to flow of current of a selected character in said second circuit to apply the full voltage of the primary frequency to said inductor, and signalling means associated with said inductor and including means actuated responsive to the flux generated therein by the voltage of the primary frequency to produce a signal at the instrument.

3. In a receiving and signalling instrument for connection with a main alternating current circuit having a primary frequency and capable of transmitting concurrently a signal of differing frequency from the primary frequency, the combination of an inductor, electrical tuning means connecting said inductor with the main circuit and operable to permit, initially, reception at the inductor of the signal frequency alone, means selectively operable to by-pass said tuning means and cause the full voltage of the primary frequency to be applied to said inductor, said means associated with said inductor and magnetically responsive to the flux generated in said inductor by the signal frequency, control means governing said last mentioned means and conditioning same for operation only upon the reception of a signal of predetermined character, and signal emitting mechanism magnetically coupled with said inductor and operable, upon the application of the voltage of the primary frequency to the inductor, to emit a second signal.

4. In a receiving and signalling instrument for connection with a main alternating current circuit having a primary frequency and capable of transmitting concurrently a signal of a frequency differing from the primary frequency, the combination of a tuned circuit including an inductor and connected with the primary circuit, said tuned circuit tuned to the signal frequency, a vibratable reed positioned with a vibratile portion thereof in the magnetic field of the inductor, said reed being resonant at the signal frequency, a second circuit connected with said primary circuit and conditioned to conduct current therethrough in response to vibration of said reed at the resonant frequency thereof, means conditioned by the flow of current in said second circuit and operable responsive thereto to cause application of the full voltage of the primary frequency to said inductor, and signal emitting means magnetically coupled with said inductor and actuated responsive to the application of the voltage of the primary frequency to the inductor to produce a signal at the instrument.

5. In a receiving and signalling instrument for connection with a main alternating current circuit having a primary frequency and capable of transmitting concurrently therewith a periodically imposed signal of a frequency differing from the primary frequency, the combination of a tuned circuit connected with said main circuit, said tuned circuit including an inductor and tuned to reception and transmission of the signal to the inductor, a second circuit also connected with the primary circuit and including therein vibratable means magnetically responsive to the flux generated in said inductor by said signal, said vibratable means so arranged in said second circuit as to permit current to flow therein only during vibration caused by the signal, control means conditioned by the flow of current in said second circuit and actuated responsive thereto to cause application of the full voltage of the primary frequency directly to said inductor, and signal emitting means magnetically coupled with said

inductor and actuated responsive to the flux generated in said inductor upon the application of the voltage of the primary frequency to produce an emitted signal at the instrument.

6. The combination as in claim 5 wherein said reed is mechanically tuned to resonancy of the primary frequency.

7. The combination as in claim 5 including time delay means associated with the control means and operable to prevent application of the full voltage of the primary frequency to the inductor if the transmitted signal is of less than preselected duration.

8. In a receiving and signalling instrument for connection with a main alternating current circuit having a primary frequency and capable of transmitting concurrently therewith a signal of a frequency differing from the primary frequency, the combination of a casing, an inductor mounted within the casing and having a first pair of opposed pole faces and a second pair of substantially coplanar pole faces, a magnetic reed also supported within the casing and having a vibratile portion thereof disposed between said first pair of pole faces, another magnetic element supported within the casing and having a movable portion adjacent said second pair of faces, electrical means rendering said inductor receptive initially to said signal only, control means actuated responsive to the vibration of the said reed over a selected time interval to cause application of the full voltage of the primary frequency to the inductor, said other magnetic element constructed to move in response to the flux generated in said inductor by the voltage of said primary frequency, and means operated upon by movement of said other magnetic element whereby to produce an emitted signal at the instrument.

9. The combination as in claim 8 wherein said other magnetic element comprises a vibratable clapper, and said last mentioned means comprises a portion of the casing disposed in the path of movement of said clapper.

10. The combination as in claim 8 including a magnetic latch associated with said inductor and operable, under the influence of the flux generated by the voltage of said primary frequency, to engage said reed to prevent further vibration thereof upon application of the voltage of the primary frequency to the inductor.

11. The combination as in claim 10 wherein said latch includes a magnetic latch element and resiliently yieldable support means carrying said latch element and normally holding same out of the path of said reed.

12. The combination as in claim 8 including power indicator means associated with the instrument and connected therewith to indicate the presence in the main circuit of sufficient power for normal operation of the instrument and electrical continuity through the inductor.

13. In a receiving and signalling instrument for connection with a main alternating current circuit having a primary frequency and capable of transmitting concurrently therewith a signal of a frequency differing from the primary frequency, the combination of a casing, an inductor mounted within the casing and constructed to provide first and second magnetic circuits, a magnetic reed also supported within the casing and having a vibratile portion thereof disposed in magnetic association with said first magnetic circuit, another magnetic element supported within the casing and having a movable portion in position to be influenced by said second magnetic circuit, electrical means rendering said inductor receptive initially to said signal only, control means actuated responsive to the vibration of said reed over a selected time interval to cause application of the full voltage of the primary frequency to the inductor, said other magnetic element constructed to move in response to the flux generated in the second magnetic circuit of said inductor by the voltage of said primary frequency, and means operated upon movement of said other magnetic element whereby to produce and emit a signal at the instrument.

14. In a receiving and signalling instrument for connection with a main alternating circuit having a primary frequency and capable of transmitting concurrently a signal of a frequency differing from the primary frequency, the combination of a tuned circuit electrically connected with said main circuit and including an inductor, said tuned circuit being tuned to the signal frequency, a second, normally opened circuit also electrically connected with said main circuit and including circuit governing means magnetically coupled with said inductor, said last mentioned means operable, upon the imposition of the signalling frequency across the inductor, to permit current to flow through said second circuit, control means conditioned by said second circuit and actuated responsive to a preselected flow of current in said second circuit to apply the full voltage of the primary frequency directly to said inductor, signalling means associated with said inductor and actuated responsive to the application of the voltage of the primary frequency to the inductor to produce an emitted signal at the instrument, and further means associated with said inductor and operable responsive to the flux generated by the voltage of the primary frequency in said inductor, said further means interrupting the flow of current to said second circuit upon imposition of the full voltage of the primary frequency to said inductor.

15. In a receiving and signalling instrument for connection with a main alternating current circuit having a primary frequency and capable of transmitting concurrently a signal of a frequency differing from the primary frequency, the combination of a tuned circuit including an inductor and connected with the primary circuit, said tuned circuit tuned to the signal frequency, a vibratable reed positioned with a vibratile portion thereof in the magnetic field of the inductor, said reed being resonant at the signal frequency, a second circuit connected with said primary circuit and conditioned to conduct current therethrough in response to vibration of said reed at the resonant frequency thereof, means conditioned by the flow of current in said second circuit and operable responsive thereto to cause application of the full voltage of the primary frequency to said inductor, signal emitting means actuated responsive to the application of the primary frequency to the inductor to produce a signal at the instrument, and mechanism operable to interrupt the transmission of the full voltage of the primary frequency to the inductor after a preselected time interval has passed, thus to provide an emitted signal of fixed duration.

16. In a receiving and signalling instrument for connection with a main alternating current circuit having a primary frequency and capable of transmitting concurrently

rently a signal of a frequency differing from the primary frequency, the combination of a tuned circuit including an inductor and connected with a primary circuit, said tuned circuit tuned to the signal frequency, a vibratable reed positioned with a vibratile portion thereof in the magnetic field of the inductor, said reed being resonant at the signal frequency, a second circuit connected with said primary circuit and conditioned to conduct current therethrough in response to vibration of said reed at the resonant frequency thereof, means conditioned by the flow of current in said second circuit and operable responsive thereto to cause application of the full voltage of the primary frequency to said inductor, signal emitting means actuated responsive to the application of the primary frequency to the inductor to produce a signal at the instrument, and means associated with said reed and operable to interrupt free vibration thereof upon and in response to the application of the full voltage of the primary frequency to said inductor.

17. In a receiving and signalling instrument for connection with a main alternating current circuit having a primary frequency and capable of transmitting concurrently a signal of a frequency differing from the primary frequency, the combination of a tuned circuit including an inductor and connected with a primary circuit, said tuned circuit tuned to the signal frequency, a vibratable reed positioned with a vibratile portion thereof in the magnetic field of the inductor, said reed being resonant at the signal frequency, a second circuit connected with said primary circuit and conditioned to conduct current therethrough in response to vibration of said reed at the resonant frequency thereof, means conditioned by the flow of current in said second circuit and operable responsive thereto to cause application of the full voltage of the primary frequency to said inductor, signal emitting means actuated responsive to the application of the primary frequency to the inductor to produce a signal at the instrument, said signal emitting means comprising a vibratable clapper magnetically responsive to the flux generated in said inductor by the voltage of the primary frequency, and sound producing means acted upon by said clapper during vibration thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

2,089,665	Roberts et al. -----	Aug. 10, 1937
2,199,560	Faller -----	May 7, 1940
2,255,162	Hart -----	Sept. 9, 1941
2,394,786	Korneke -----	Feb. 12, 1946
2,569,037	Dalton -----	Sept. 25, 1951