Feb. 14, 1928. **1,658,953**

L. S. THÈREMIN

SIGNALING APPARATUS

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Fig. 1.

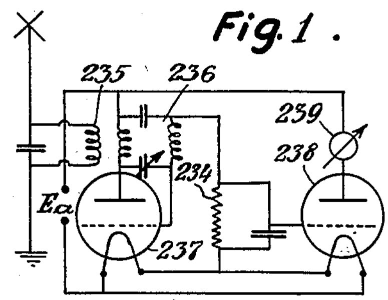

Fig. 11.

Fig. 12.

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Fig. 13.

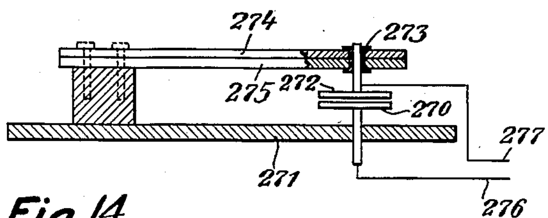

Fig. 14

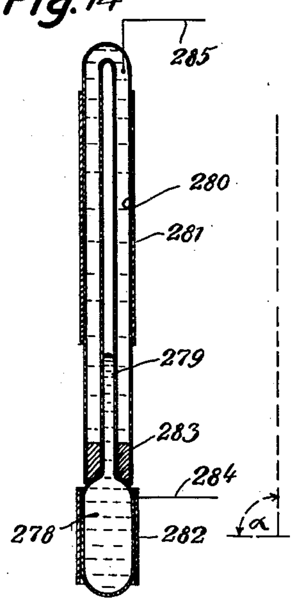

Fig. 15.

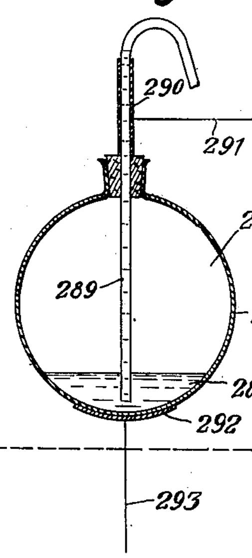

Fig. 2.

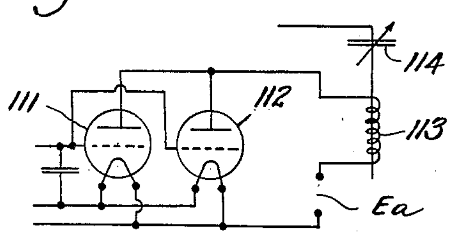

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Fig. 4

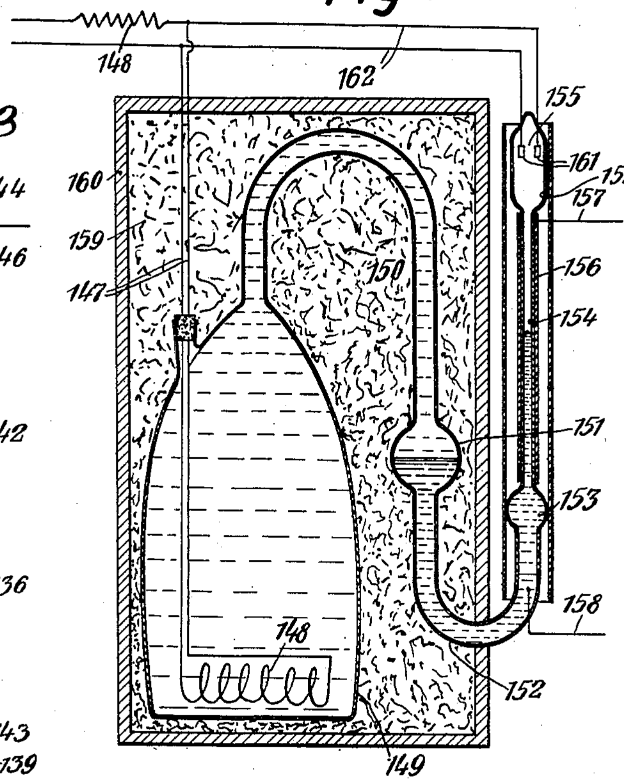

Fig. 3

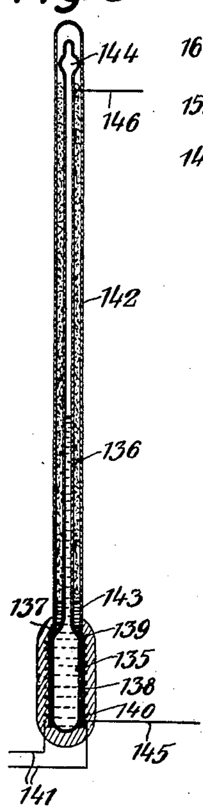

Fig. 5

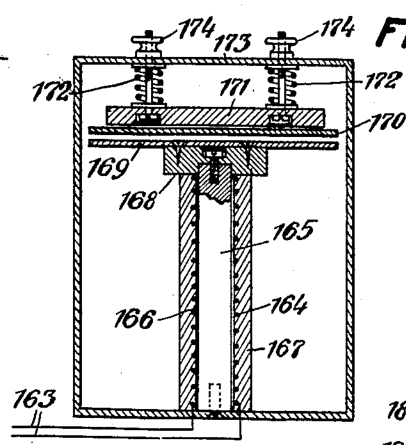

Fig. 6

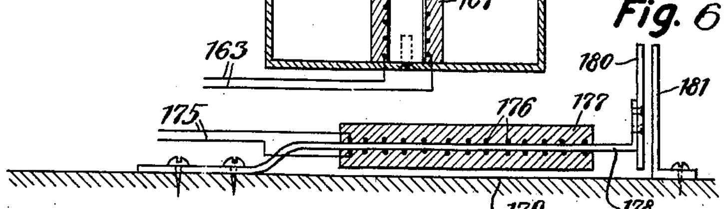

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Fig-7

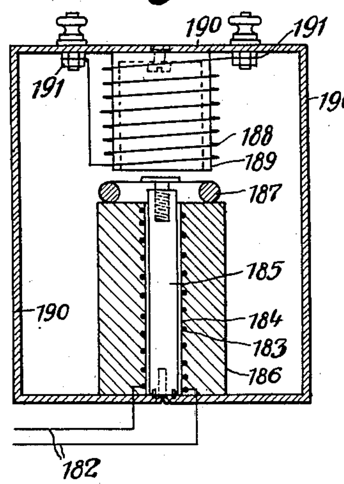

Fig. 8

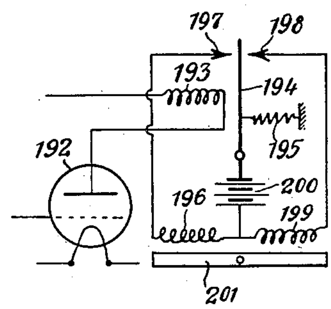

Fig. 9

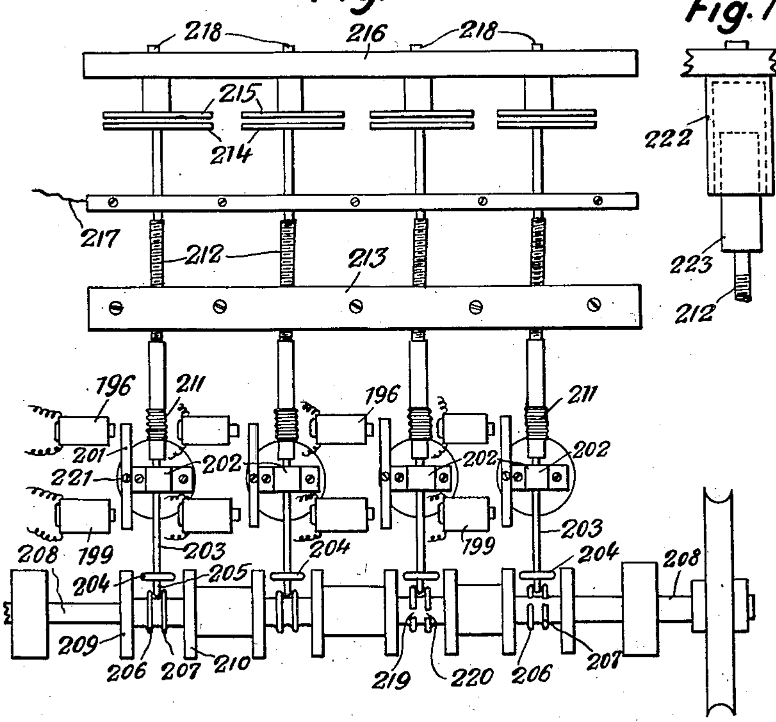

Fig. 10.

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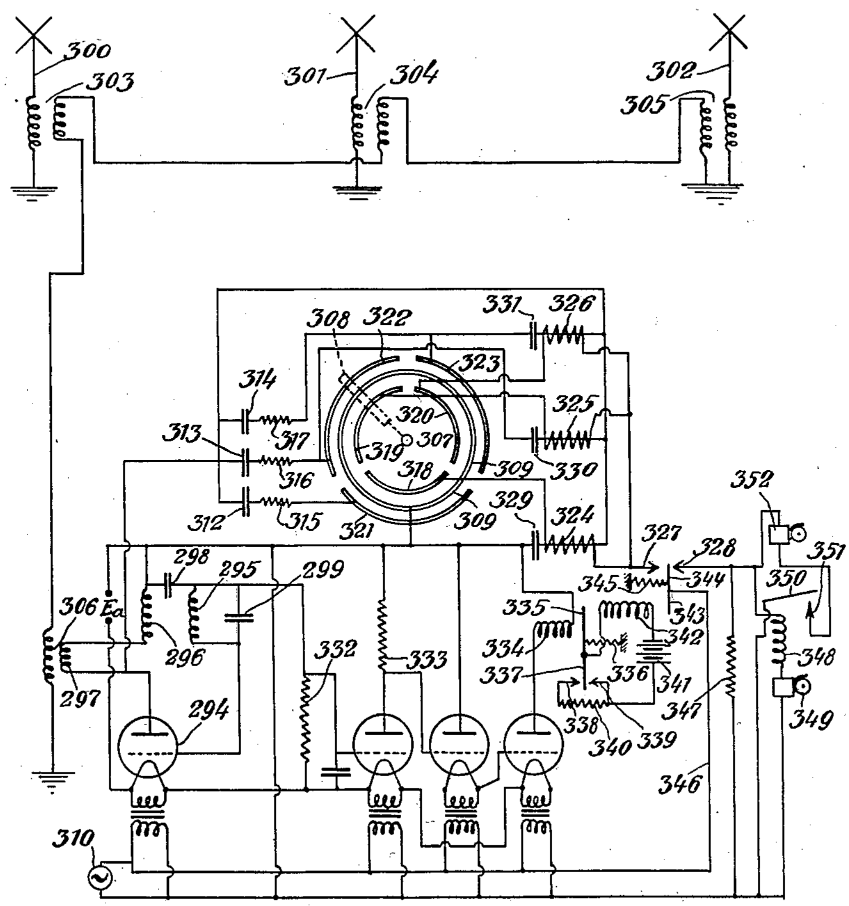
Fig. 16.



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UNITED STATES PATENT OFFICE.

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SIGNALING APPARATUS.

Application filed December 5, 1925, Serial No. 73,530, and in Germany December 11, 1924.

This invention relates to signaling and alarm devices and aims to provide a novel method of and means for generating sound or producing visual signals for alarm purposes. It embodies an electro-magnetic system of high-frequency oscillation potential operable by the approach thereto of an object, such for example as a person entering a room when the apparatus is applied in a burglar alarm system, a train approaching a signal block when applied in a railroad signaling system, etc. An apparatus embodying the invention may also be controlled by other factors, such as an increase of temperature when adapted in a fire alarm system, or by some other factor when appropriately applied to operate upon the happening of an anticipated disturbance or event.

In other words, movement of an object or other variable factor in predeterminable relation to an apparatus embodying the invention causes a variation in the self-inductance or capacity of the oscillating system thereof, which in turn brings about a variation in the frequency of oscillation of the system and such frequency variation causes operation of the sound producer or signaling means.

An object of the invention is to provide an apparatus of the specified type, the operation of which will not be affected by the variables to which related apparatus have generally been subject and to this end is designed to respond not to variations of frequency but to an abnormal rate of such variation, and to operate only when such rate exceeds or fails to attain a certain value, as opposed to the normal rates of variation caused by certain conditions hereinafter described.

Apparatus of the general type to which this invention relates have heretofore been operated by frequency variations and not by the rate at which such variations occur. Such apparatus has been objectionable because it will not operate properly without continual supervision and regulation. This fact is due to the influence of several factors which become so great in a comparatively short time as to interfere with the operation of the apparatus.

The defective conditions in such apparatus are either inherent therein and result from factors which influence the oscillations of the electro-ionic oscillator preferably employed, such for example as the heating, the plate potential, the vacuum, the electron emission, etc., or are due to extraneous causes, such as atmospheric influences, temperature, the varying percentage of moisture in the walls or structures along or in which the wires of the system are disposed, or to other similar causes. The influence of these variables is so great that it cannot be compensated by the means ordinarily provided.

On the other hand, in an apparatus embodying this invention, the influence of such factors is eliminated by making the apparatus responsive to the rate of variation of the frequency, rather than to the variation of frequency. The influence of the aforementioned variable factors is compensated by an appliance which may be termed a regulator which is operated at a certain speed, and the apparatus will respond only if the rate of variation of the frequency due to the approach of an object or other controlling factor is abnormal and exceeds that speed.

By such means, the apparatus is rendered independent of the variations of frequency which are due to said variable factors, does not require continual supervision and regulation, and will operate in a reliable and satisfactory manner.

The apparatus may be so designed as to respond under any desired conditions, for instance, if applied to a building in a burglar-alarm system, it may be made to respond and signal an alarm as a burglar creeps within distance to influence the system even before entering the premises, because his body, upon approaching in proximity to the system, will cause vibrations to be set up therein at a rate of frequency variation far greater than the rate of variation due to said variable factors. Similarly, if applied in a fire-alarm system, the apparatus may be made to respond only to abnormal variations or sudden rise of temperature in the room wherein it is arranged, even if the actual temperature increase is relatively small.

The regulator, which may be designed for any speed and magnitude of compensating action, will gradually and automatically vary its self-inductance or capacity and consequently the characteristics of the oscillating circuit in such a manner as to obtain the desired result.

In the drawings, several forms of apparatus embodying the invention and operable according to the method embodying the same are illustrated diagrammatically by way of example.

In said drawings,

Fig. 1 is a diagram illustrating the underlying principle of the invention;

Fig. 2 is a diagram of a regulator;

Figs. 3 to 7 illustrate various heat-operated regulators;

Fig. 8 is a diagram of an arrangement wherein regulators according to Fig. 9 are employed;

Fig. 9 illustrates a mechanically operated regulator;

Fig. 10 illustrates a modification of the regulator shown in Fig. 9;

Figs. 11 to 15 illustrate various fire-alarm systems embodying the invention; and

Fig. 16 illustrates a complete installation comprising a central and three local protection stations.

In Figs. 1, 2 and 16, E^a represents a high-voltage battery.

For the purpose of disclosing the nature of the invention, Fig. 1 shows a system of connections in which variations of the natural period of an oscillating system 235 are caused by the variation of the capacity of an antenna or control conductor connected to it. The antenna comprises a wire or flexible lead which is supportingly extended along, around or within the area or district to be protected. Said antenna has a definite normal capacity and this capacity is affected when a person such as a burglar or any object approaches it. The antenna is accordingly hereafter referred to as a control conductor and obviously may take various forms and be arranged in various ways depending upon the use that is made of the signaling apparatus.

An electro-ionic oscillator or generator tube 237 is inductively coupled to the oscillating circuit 235. The frequency of the oscillator 237 is adjusted to about the resonance point of the oscillating circuit 235 by proportioning the constants of the associated oscillating circuit 236. When the capacity of the antenna or control conductor is varied by the approach of a foreign object, a corresponding variation of the amplitude of the oscillations of the oscillator 237 takes place resulting from and depending upon the difference between the periods of the oscillating systems 235 and 236.

The variation of the grid current in a grid-leak resistance 234 causes a variation of the potential on the grid of a second tube 238, and the plate current of the tube 238, which varies accordingly, may be measured by the measuring instrument 239. If the oscillating systems 235 and 236 are so tuned that a retardation of the natural frequency of the circuit 235 brings about a reduction of the oscillation energy of the tube 237, an increase of the capacity of the antenna causes an increase of the plate current through the measuring instrument 239, the increase being substantially proportional to the increase in capacity. As long as the object to be detected is outside of the operating range of the antenna, no variation in the deflection of the instrument 239 will take place. The plate current increases gradually in proportion to the rate at which the object approaches the antenna, until it reaches its maximum value when the object has reached the antenna. When the foreign body or object moves slowly towards the antenna, the increase of the plate current of the tube 238 proportionally takes place slowly and gradually. When the movement occurs at a higher speed, the plate current rises at a correspondingly greater rate.

Fig. 2 is a diagrammatical representation of the connections of the regulators; i. e., the devices which compensate for the normal plate current variations. The amplifier tubes 111 and 112, which correspond to the tube 238 in Fig. 1, are connected to a heating winding 113 instead of a measuring instrument 239. Said winding 113 is shown disposed around an expansible metal core connected to a condenser 114. Said metal core expands under the action of the heat emanating from the heating winding 113 to move the plates of the condenser closer together, whereby the capacity of the condenser is increased. If the condenser 114 is appropriately connected in the circuit of the oscillator tube 237, it will vary the capacity of the oscillator circuit in such a manner as to compensate for the variation which has occurred in the antenna system if this variation occurs slowly.

The regulator requires time to bring about a capacity variation to produce the desired compensating effect and this time depends upon its construction. By co-operation of the regulator with a relay described hereinafter, a signal will be given only in the event of a relatively sudden capacity variation due to the rapid approach of a foreign body towards the antenna, while if the capacity variation is sufficiently slow, the regulator is able to compensate for the variation and prevent the production of a warning signal.

Before giving a detailed description of a complete installation, the construction of various forms of regulators will first be described with reference to Figs. 3 to 7 of the drawings. In these regulators, the controlling current causes a slow variation of the values of capacity or self-inductance introduced into the oscillating circuit.

Referring first to Fig. 3, a regulator is shown embodying a heating coil 139 which is supported on the larger portion of a two-diameter glass tube 135, 136 containing mercury. A thin metallic cylinder 137 is shown surrounding the larger portion 135 of the tube, while a layer of mica 138 surrounds said cylinder. The coil 139 is disposed on the mica layer and is in turn surrounded by heat-insulation 140. The coil 139 corresponds to the coil 113 of Fig. 2, and is connected in circuit through conductors 141.

The narrow portion 136 of the tube is surrounded by a glass tube 142 which is substantially filled with mercury. Where the tube 142 rests on the larger portion 135 of the first tube, an insulator 143 is inserted between the tube portions 136 and 142 so that the mercury in the member 135 will not influence that within the tube 142. An extension 144 is provided at the upper end of the tube 136 to prevent bursting in case of overheating. A conductor 145 is connected with the metallic cylinder 137, and a second conductor 146 is connected to the mercury in the tube 142.

When current flows through the heating coil 139, the mercury in the portion 135 expands and rises in the narrow tube 136. The mercury in the member 135 and the metal cylinder 137 constitute the layers of conducting elements of a fixed condenser which is connected in series with a variable condenser, one element of which is the mercury column in the tube 136, and another is the mercury column in the tube 142. The capacity of the variable condenser varies with the level of the mercury in the tube 136. This form of regulator comprises a combination of a fixed and a variable condenser which are connected in series, and the capacity of the variable condenser is varied in substantially the same manner as that of the condenser 114 of Fig. 2.

It will be apparent that this regulator is particularly suitable for temperatures considerably greater than ambient temperatures.

Fig. 4 illustrates another form of regulating device wherein a heating coil 148, within a glass vessel 149 filled with xylol or another liquid having a high temperature co-efficient of expansion, is adapted to be connected in circuit by means of the conductors 147. A tube 150 connects the upper end of the vessel with a globe 151, the upper and greater portion of which is occupied by the xylol or other liquid, while its lower portion contains mercury supplied through a tube 152 connecting said globe 151 with a second globe 153, the latter having an upwardly extended tube 154 provided with an enlarged portion 155 at its top. Said glass tube 154 is coated with a metal layer 156 which is connected with a conductor 157. A conductor 158 is connected with the body of mercury in the tube 152.

According to the last described construction, when current flows through the heating coil 148, the xylol or other fluid expands and forces the mercury up in the tube 154, so that the capacity of the condenser formed by the mercury column in the tube 154 and the metal layer 156 is varied.

Preferably, the vessel 149 is arranged in a casing 160 filled with heat-insulating material 159. The rate of the capacity variation may be determined by varying the heating conditions and the heat insulation. The space above the mercury in the extention 155 is evacuated or filled with inert gas.

To short-circuit the heating coil 148 in case of excessive heating, two plates 161 may be arranged in the extension 155 and connected with the conductors 147 by conductors 162.

To provide the desired capacity, said device requires heating to temperatures in excess of the normal temperatures of the room in which the device is placed, i. e., in this device, like that of Fig. 3, temperatures considerably greater than ambient temperatures are preferably employed.

Fig. 5 shows a form of regulating device operated by the thermal expansion of a solid 165 which forms the core of a heating coil 164. Current is supplied to the coil 164 by conductors 163. An insulating layer of mica or the like surrounds the core at 166. Heat insulating material 167 is employed around the outside of the coil 164. A block 168 of fibre or the like, is secured to the top of the rod 165 and a condenser plate 169 is secured to said block. Said plate 169 opposes another plate 170 carried by a fibre supporting plate 171 which is suspended by springs 172 from a metal frame or container 173. Said frame or container which is rectangular in cross-section, supports the core 165 on its lower portion and is not thermally insulated. Thumb-nuts 174 are provided for adjusting and centering the condenser plate 170. When the core 165 expands, the distance between the condenser plates is reduced and the capacity of the condenser is increased.

As the core 165 is thermally insulated while the frame or container 173 is not, the temperature difference between said frame and core will be at maximum. This regulator operates in accordance with the temperature difference between the core 165 and the frame 173 and compared with the liquid regulators previously described, has the advantage that the effect of fluctuations in the ambient air temperatures is eliminated.

The regulator may be so arranged that both its condenser plates 169, 170 are under the influence of the heating coil 166 and are moved towards each other when current flows through the coil.

For installations where temperature fluctuations may be disregarded, the regulator may be modified as shown in Fig. 6, wherein 175 are conductors supplying current to a heating coil 176 surrounded by insulating material 177. An expansible core 178 for the heating coil carries an insulated condenser plate 180 adapted to co-operate with a fixed condenser plate 181 secured to a base plate 179 to which the opposite end of the core 178 is also secured.

A variable self-inductance may be used instead of a condenser and such a device is shown in Fig. 7. The conductors 182 supply current to a heating coil 183 disposed on a core 185 from which it is insulated by a layer 184 of mica. Thermal insulating material 186 is provided for the coil 183. A ring 187 is secured to the upper end of the core and co-operates with an inductance coil 188 on a core 189 shown co-axial with the core 185. The core 189 is supported on a frame or container 190 carrying binding posts 191 connected to the ends of the inductance coil 188. When the core 185 expands, the distance of the ring 187 from the coil 188 is reduced, thereby varying the inductance of the latter.

A mechanical regulating device is illustrated diagrammatically in Fig. 8. This view is a continuation or modification of that shown in Fig. 1, and the tube 192 of an amplifier corresponds to the tube 238 of Fig. 1, or to the tubes 111, 112 of Fig. 2. In this instance, the tube 192 is the last stage of an amplifier system. A magnet coil 193 is connected with the tube 192, and replaces the measuring instrument 239 of Fig. 1 or the heating coil 113 of Fig. 2. The armature 194 is controlled by said coil and by a return spring 195 secured to the former. When full current traverses the coil 193, said armature is attracted and connects a magnet coil 196 to a battery 200 by making the contact at 197, while if a weak or no current traverses the coil 193, the spring 195 will move the same to close a circuit through the contact 198 and connect the battery to a magnet coil 199. The coils 196 and 199 control a duplex armature lever 201. For intermediate values of current, the attraction of the coil 193 and the force of the spring 195 are balanced and both contacts 197 and 198 are open.

Fig. 9 illustrates a regulating device for four signaling stations embodying the device shown in Fig. 8. Four sets of magnet coils 196 and 199 are provided, each set acting on an armature 201 fulcrumed at 221 and connected with vertical shafts 203. A shaft 208 is shown adapted to rotate in synchronism with a distributor which will be described hereinafter. A friction wheel 204 is secured on the lower end of each shaft 203 adapted to co-operate with friction plates 209 and 210 on the shaft 208. The end portion 205 of each shaft 203 is normally disposed between a pair of ribs 206 and 207 on said shaft having opposed gaps 219 and 220. While the said end portions of the shafts 203 lie between the ribs 206 and 207, the armatures 201 are rendered incapable of tilting said shafts by means of brackets 202, and the friction wheels 204 will be held away from the plates 209 and 210. However, when said ends lie intermediate the opposed gaps 219, 220 of said ribs, the magnet coils 196 or 199, as the case may be, are operative to tilt their armatures 201 one way or the other, causing the wheels 204 to engage one of the plates 209, 210.

Each shaft 203 is shown connected with a shaft 212 by a flexible coupling 211. Said shafts 212 are extended through a bracket 213 in threaded engagement therewith, and each of said shafts carries a condenser plate 214 co-operating with a fixed plate 215 carried on a frame 216. Conductors 217 and 218 are connected with the plates 214 and 215, respectively. The shaft 208 is driven by a clockwork or an electric motor. It will be understood that the plates 214 will recede from, or move toward the plates 215 depending upon which of the plates 209 and 210 the wheels 204 are moved into frictional contact.

The opposed gaps or aligned openings 219, 220 in the guide members or ribs 206 and 207 readily permit the lower ends of the shafts 203 to move towards the outside of the latter and bring the wheels 204 in frictional contact with one or the other of the discs 209 and 210 to impart rotation to the shafts 212 of the condensers in the manner described. The shaft 208 is rotated synchronously with the distributor 308 of Fig. 16 as will be described hereinafter.

In this way the condenser plate 214 is made to approach the stationary condenser plate 215 when the shaft 208 is rotated in one direction and to recede therefrom when the shaft is rotated in the opposite direction. The gaps or openings 219 and 220 in the guides or ribs 206 and 207 permit the shaft 203 to swing from one operative position to the other when the distributor lever 308 of Fig. 16 makes a complete revolution, during which the extended guide end 205 of the lever 203 will lie intermediate said gaps only when said lever arrives at the beginning of the contact period for the associated regulating device of the system. Swinging movement of the lever 203 is then controlled by the corresponding magnet 199 or 196, and the friction wheel 204 thereon is held frictionally against the disc 209 or 210 for a complete revolution of the shaft 208 and said lever 308.

In this way the capacity of the condenser is automatically increased, reduced or kept constant according to the intensity of the plate current of the tube 192 of Fig. 8.

In Fig. 10, the condenser plates are slightly modified, the fixed plate 222 (corresponding with the plate 215 of Fig. 9) being a hollow cylinder, and the movable cylinder 223 (corresponding with the movable plate 214 of Fig. 9) being disposed inside the member 222. This form of condenser may be used in connection with the regulator shown in Fig. 9.

In conjunction with the above described apparatus, automatic fire-alarm devices may be employed, the same being directly connected with the control conductor. These fire-alarm devices are based particularly upon the speed of temperature rise caused by a fire. If the temperature increase occurs slowly, as in the normal increase of temperature in a room due to ordinary causes, no signal will be given in consequence of the operation of the frequency regulator hereinbefore described. On the other hand, a signal will be given in the case of a rapid temperature rise, even if it is relatively small. The apparatus is thus based upon the utilization of the variations of the condenser capacities under the action of heat.

Fig. 11 shows a simple device, which, however, becomes operative only at sufficiently high temperature. In this case the antenna consists of two conductors 264 and 265 connected by easily fusible metal 266. The metal will fuse when the temperature rises sufficiently, so that the two parts of the antenna 264 and 265 will then be disconnected.

Fig. 12 shows a similar device in which overlapping ends of parts of the antenna 267 and 268 are separated by an easily fusible dielectric 269. When said dielectric fuses upon sufficient temperature rise, an increase in the capacity of the antenna will occur owing to the resultant contact of its ends, the parts thereof thus forming, in effect a condenser, or direct contact may be made after the material 269 fuses. The device shown is simple and operates only at temperatures above a predetermined value.

In the embodiment illustrated by Fig. 13, the condenser comprises opposed plates 270 and 272 separated by air, the plate 270 being fixed upon a baseplate 271 and the plate 272 being secured to the strips 274 and 275 at one end thereof by means of an insulating bushing 273. At the other end the strips 274 and 275 are supported on the baseplate 271. Said strips 274 and 275 have different co-efficients of expansion in consequence of which the capacity of the condenser formed by the plates 270 and 272 will be varied when the changes of temperature are relatively small. Current is supplied to the condenser by the conductors 276 and 277. This device responds only to sudden changes of temperature. If the temperature rises slowly, a compensation is effected by a regulating device hereinbefore described, and the signaling apparatus will not then be operated.

Fig. 14 illustrates a thermometer device for giving a signal in case of fire or the like. In this case, a glass tube 279 connects with the glass vessel 278 containing mercury and provided with a metal shell or coating 282. The tube 279 is encompassed by another tube 280 of greater diameter which likewise contains mercury and is provided with an outer metal shell or coating 281. In the lower portion of the tube 280 is placed an insulating substance 283. A conductor 284 is connected to the shell coating 282 and a conductor 285 is connected to the mercury in the tube 280. The conductors 284 and 285 may be parts of the antennæ of an installation embodying the invention. The device operates in substantially the same manner as described with reference to Fig. 3, the only difference being that the heating coil is omitted, the heating in this instance being effected by the ambient temperature.

A modification of the above described device is illustrated in Fig. 15. In this instance a glass tube 286 is shown containing a small amount of a slightly volatile electrolyte 287, the space 288 thereabove being occupied by air. A tube 289 extends downwardly through a stopper in the neck of the bulb with its lower end immersed in the electrolyte. A part of said tube exteriorly of the bulb is encompassed by a metal coating 290 to which is connected a conductor 291 which may be part of the antenna of an alarm installation. The outer end of the tube is bent downwardly as indicated. The bottom of the glass bulb is provided with a metallic cup-shield or coating 292 to which is connected a conductor 293. When the air within the enclosed space 288 is expanded under heat, the electrolyte 287 will be forced to rise in the tube 289 and bring about a variation of capacity between the condenser elements 290 and 292. The sensitiveness of this device may be varied by inclining the tube 289 at different degrees to a horizontal plane, because the electrolyte to be raised by the same degree of heat will ascend the tube more easily if the latter is inclined.

It will be readily appreciated that various other devices for effecting fire-alarms may be connected with the described signaling apparatus without departing from the scope of the invention.

Fig. 16 diagrammatically illustrates a complete system having three local stations of differing periods. In this illustration, the three local stations are represented in connection with a single central station. The three local stations comprise antennæ or control conductors 300, 301 and 302 respectively with coupling coils 303, 304, 305 associated therewith. Said coupling coils are shown connected together in series and with the coupling coil 306 of the central station apparatus which includes an oscillator tube 294. The apparatus at each local station is tuned to a definite wave length or frequency differing from the other two.

The central station apparatus is shown comprising self-inductances 295 in the grid, and 296, 297 in the anode circuit. Condensers 298 and 299 are connected to the inductances. The inductance 297 forms a coupling coil between the generator system at the central station and the local apparatus.

The system embodies a distributor 307 of a character hereinbefore mentioned with reference to the signaling systems. Said distributor comprises three series of contact strips over or in relation to which a continuously rotating contact-arm 308 is moved. The intermediate strip 309 is unbroken, but the inner and outer contact strips are subdivided into three sectors 318, 319, 320 and 321, 322, 323 respectively, corresponding with the number of local stations.

The plate of the oscillator tube 294 is connected with three parallel circuits comprising a condenser 312, 313, 314, a non-inductive resistance 315, 316, 317 and a variable condenser 329, 330, 331 respectively. Each resistance is connected to one of the three outer sectors 321, 322, 323 of the distributor. The inner sectors 318, 319, 320 are connected to a contact 327 through heating coils 324, 325, 326, respectively, of the variable condensers 329, 330, 331. These condensers are of the form shown in Figs. 3 to 7. However, said condensers may be constructed to operate mechanically as shown in Figs. 8, 9 and 10.

The rotating arm 308 connects the condensers 312, 313, 314, the resistances 315, 316, 317 and the varible condensers 329, 330, 331 successively, in parallel with the self-inductances 296, 297. The variable condensers 329, 330, 331 have such value as to give resonance with the respective antennæ. Rotation of the distributor alternately tunes the central station oscillator to waves corresponding approximately to the waves of the local stations 300, 301, 302, and if resonance is established, the energy of the oscillator is transmitted to the antennæ. This alters the current in the grid circuit of the tube 294 and causes a variation of the grid potential and of a grid-leak resistance 332. Such variation of potential is amplified by the amplifier system 333, the current of the amplifier system flowing through the winding of the electromagnetic relay 334. As the intensity of the amplifier current decreases, the variation of grid potential increases: that is, the greater becomes the difference in periodicity between the antennæ and the oscillator.

The relay 334 attracts an armature 335 to which a return spring 336 is attached, and said armature alternately closes one of the contacts 338, 339 between which is connected a non-inductive resistance 340. A battery 341 and a second electromagnetic relay 342 are in the circuit formed by the portion 337 of the armature and the two contacts 338, 339. The latter relay attracts an armature 343, the portion 344 of which is connected with a return spring 345. The portion 344 of the armature 343 may engage one of the contacts 327 and 328. A conductor 346 connects the armature 343 to the heating current source 310 of the oscillator and amplifier cathodes. A non-inductive resistance 347 is connected between the source 310 and the contact 328. A relay 348 and an alarm 349 are also connected between one terminal of the source 310 and the contact 328 in parallel with the resistance 347, the resistance serving to diminish the effect of the closing of the contact 328 upon the voltage of the source 310 and thereby upon the other devices connected to said source. When the relay 348 is energized, the armature 350 thereof closes the circuit of the alarm 352 through the contact 351.

When a person or foreign object approaches one of the antennæ, the wave length of such antenna and the current in the relay 334 will become altered. The armature of this relay closes the contact 339 when the relay is traversed by strong current, assumes an intermediate position at medium current and closes the contact 338 at weak current.

When a circuit is closed through the contact 339, the relay 342 will be traversed by maximum current. The relay 342 will be de-energized when the circuit is open and will be traversed by current weakened by the resistance 340 when the circuit is closed through the contact 338. The armature of the relay 342 will assume corresponding attracted, retracted or intermediate positions. In the attracted position, the contact 328 is closed and the relay 348 and the two alarms 349 and 352 become operative. In the retracted position, the relay 348 is not energized and contact 327 is closed. In the intermediate position, the current through the relay 342 is balanced by the spring 345 and no contact is made by the armature. In this latter case, the tuning between the antenna and the oscillator 294 is such that only a small current flows through the relay 334. When the current increases, the armature 335 assumes an intermediate position and the armature 343 of the relay 342 closes a circuit through the contact 327. In consequence, the heating coils 324, 325 and 326 are alternately heated by alternating current from the source 310. This varies the regulator capacities as described above in connection with Figs. 3–7, and the tuning between the antenna and the oscillator 294 is changed. The compensating effect of the regulators causes the current in the relay 334 to become gradually weaker until the spring 336 is operative to close the circuit of the relay 342 in series with the resistance 340, thereby opening the circuits of the heating coils 324, 325 and 326 at the contact 327.

In this manner, the normal fluctuations of antenna capacity are compensated to prevent the undesired operation of the alarm. The compensation for each antenna is effected independently by means of the distributor 307.

In case of sufficiently high resonance between an antenna and the central station oscillator, for instance in consequence of the approach of a body towards the antenna, the plate current of the amplifier 333 flowing through the relay 334 increases and the relay closes the circuit of relay 342 through the contact 339, whereupon the relay 342 energizes the alarms 349 and 352. The alarm 349 stops ringing when the regulator has detuned the circuits as described above. However, the alarm 352 remains in operation until the armature 350 of the relay 348 is reset by hand. The alarm 349 thus indicates the cause of the alarm temporarily, and the alarm 352 will continue to operate until the watchman is attracted by the signal and stops it. It will be understood that if desired, only one of the two alarms need be used.

If the variation of the capacity of an antenna takes place so slowly that no signal should be given, for instance on account of atmospheric changes, the amplifier current changes so gradually that the regulator is operative to compensate for the variation of the capacity or the plate current respectively, and the signaling devices are not then operated. If, on the other hand, the capacity variation of the antenna takes place so quickly that a signal should be given, for instance in consequence of the approach of a burglar toward one of the antenna disposed along a wall, around a window or door or otherwise, the amplifier current will rise rapidly and the alarm devices will be operated since the regulator will not then be able to compensate for the capacity variation.

If it is desired to provide an arrangement such that upon approach of a body to the antenna, resonance effect between the antenna and the oscillator will be less pronounced, it is necessary only to interchange the contacts 339 and 338 of the relay 334.

By providing a fourth contact strip on the distributor, annunciators may also be operated, which will show at a glance at what particular place the disturbance has taken place.

It is obvious that the systems of connections described and illustrated are but few of the arrangements possible for carrying out my invention. Those skilled in the art will be able to modify the different systems according to various requirements and conditions without departing from the spirit and scope of the invention, and the applicability of the invention to various purposes as also the manner of arranging and concealing the antenna leads will be readily appreciated.

Therefore, it is not intended that the invention shall be limited by the appended claims to the specific constructions, arrangements and combinations as herein described and disclosed in the drawings.

I claim:

1. A signaling apparatus comprising a circuit including a control conductor, an oscillating system connected with said circuit to induce oscillations therein, a regulator compensating for variations in frequencies occurring from normal influences upon the circuit, and indicating means responsive only to uncompensated rates of variation of the resonant frequency of said circuit occasioned by abnormal influences thereon.

2. A signaling apparatus comprising a circuit including a control conductor, an oscillating system connected with said circuit to induce oscillations therein, a regulator embodying a thermal element traversed by current from said oscillating system for compensating for variations in frequencies occurring from normal influences upon the circuit, and indicating means responsive only to uncompensated rates of variation of the resonant frequency of said circuit occasioned by abnormal influences thereon.

3. A signaling apparatus comprising a circuit including a control conductor, an oscillating system connected with said circuit to induce oscillations therein, said apparatus being subject to variations in frequency, compensating means operating at a predetermined rate for causing said circuit to be maintained at a constant frequency after each change dependent upon the variation caused in the system, and indicating means operated by a change in the system causing the frequency thereof to vary at an abnormal rate.

4. A signaling apparatus comprising a circuit including a control conductor, an oscillating system connected with said circuit to induce oscillations therein, a regulator compensating for variations in frequencies occurring from normal influences upon the circuit, and indicating means responsive only

to variations of the resonant frequency of said circuit occurring at a rate above a predetermined value.

5. A signaling apparatus comprising a circuit including a control conductor, an oscillating system connected with said circuit to induce oscillations therein, indicating means connected to said circuit, a heating coil in said system, and means including said heating coil for varying the electrical constants of the oscillating system to compensate for variations of the resonant frequency of said circuit where the rate is different from the rate to be indicated.

6. A signaling apparatus comprising a circuit including a control conductor, an oscillating system connected with said circuit to induce oscillations therein, indicating means connected to said circuit, a heating coil connected to said system, and means including said heating coil for varying the capacity of a portion of the oscillating system to compensate for normal variations in the resonant frequency of said circuit.

7. A signaling apparatus comprising a circuit including a control conductor, an oscillating system connected with said circuit to induce oscillations therein, indicating means associated with said circuit, a heating coil connected to said system so that its current varies in accordance with changes in frequency of the system, a condenser, and means including an expansible liquid as one element thereof associated with the heating coil for varying the capacity of a portion of the oscillating system to compensate for normal variations in the resonant frequency of said circuit.

8. A signaling apparatus comprising a circuit including a control conductor, an oscillating system connected with said circuit to induce oscillations therein, indicating means associated with said circuit, a heating coil connected to said system so that its current varies in accordance with changes in frequency of the system, a condenser embodying a vessel containing a liquid of high thermal expansion coefficient associated with said heating coil and means including said condenser for varying the capacity of a portion of the oscillating system to compensate for normal variations in the resonant frequency of said circuit.

9. A signaling apparatus comprising a circuit including a control conductor, an oscillating system connected with said circuit to induce oscillations therein, a heating coil connected to said system so that its current varies in accordance with changes in frequency of the system, a vessel containing a liquid of high thermal expansion coefficient in heat-conducing relation to said coil, a shunt around said heating coil closed by said liquid at a high temperature, a condenser connected with said vessel to be varied in capacity by the thermal expansion of said liquid and means for transmitting the variations of capacity to said system to compensate for normal variations in the resonant frequency of said circuit.

10. A signaling apparatus comprising a plurality of local stations, each having a circuit including a control conductor, said circuits having different resonant frequencies, a central station to which all of said local stations are connected, an oscillator system and a signal at said central station, means for operating said signal in accordance with the variation of the resonant frequency of each of said circuits and means for consecutively tuning said oscillator system to the normal frequency of each of the circuits at the local stations.

11. A signaling apparatus comprising a circuit including a conductor extending adjacent an area to be protected, means for detecting abnormal variations in the resonant frequency of said circuit, means for compensating for variations of frequency occurring below a predetermined rate so that the detecting means will not be affected thereby, and signal indicating means operable by said detecting means.

12. A signaling apparatus comprising a circuit including a conductor extending relatively to an area to be protected, means including an oscillator for detecting abnormal rates of variation in the resonant frequency of said circuit, means including a thermal-responsive element connected to the oscillator for compensating for variations of frequency occurring below a predetermined rate so that the detecting means will not be affected thereby, and a signal operable by said detecting means.

13. A signaling apparatus comprising a circuit including a conductor extending relatively to an area to be protected, means including an electrical oscillator for detecting abnormal rates of variation in the resonant frequency of said circuit, means for compensating for variations of frequency occurring below a predetermined rate so that the detecting means will not be affected thereby, said compensating means embodying a retarded controlling device for varying the frequency of oscillation of said oscillator, and a signal operable by said detecting means.

14. The method of operating a signal in a system of the class described, characterized by generating electrical oscillations, varying the frequency of such oscillations, compensating for the variations of frequency of the oscillations occurring below a predetermined rate to counteract the effects of natural disturbances and operating a signal when the variation in frequency occurs above said predetermined rate.

15. The herein described method of operat-

ing a signal in system of the class described, characterized by setting up electrical vibrations in the system, changing the character of said vibrations upon the approach of an object thereto, to produce a signal upon such change and restoring the system to normal at a definite rate whereby the signal will be operated only upon disturbances occurring above a predetermined rate.

16. The method of operating a continuously operative signaling system embodying an oscillator which is subject to relatively slow natural disturbances characterized by gradually restoring said oscillator to its normal frequency upon any departure of the same from the normal frequency whereby the signaling system is not affected by such natural disturbances and operating a signal upon a predetermined rapid deviation from the normal frequency.

17. The method of operating a signal in a signaling system embodying an oscillator characterized by generating oscillations in the system, continuously and gradually compensating the system for changes in the frequency of the oscillations resulting from inherent or natural causes and actuating a signal upon a sudden relatively large change in the frequency of the oscillations.

18. A continuously operative alarm system comprising an alarm, a control conductor, an electrical oscillator, means including the conductor for controlling the oscillatory current from the oscillator, means for maintaining the oscillator at normal frequency despite the effects of atmospheric disturbances and the like and means for operating the alarm upon an abnormal change in frequency of the oscillator.

19. A signaling apparatus comprising a plurality of local stations, each having a circuit including a control conductor, said circuits having different resonant frequencies, a central station to which all of said local stations are connected, an oscillating system and a signal at the central station, means for consecutively tuning said oscillating system to the normal frequency of each of the tuned circuits at the local stations and means for operating said signal upon a relatively large change in the resonant frequency of any of the tuned circuits at the local stations.

20. The method of operating a continuously operative signaling system embodying an oscillator which is subject to relatively slow natural disturbances characterized by gradually restoring said oscillator to its normal frequency upon any departure of the same from the normal frequency whereby the signaling system is not affected by such natural disturbances and operating a signal upon a relatively rapid change of frequency of the oscillator.

21. The method of operating a signal in a signaling system embodying an oscillator characterized by generating oscillations in the system, continuously and gradually compensating the system for changes in the frequency of the oscillations resulting from inherent or natural causes and actuating a signal upon a sudden relatively large change in the frequency of the oscillations.

22. A continuously operative alarm system comprising an alarm, a control conductor, an electrical oscillator, means including the conductor for controlling the oscillatory current from the oscillator, means for maintaining the oscillator at normal frequency despite the effects of atmospheric disturbances and the like and means for operating the alarm upon an abnormal change in frequency of the oscillator.

23. A signaling apparatus comprising a plurality of local stations, each having a circuit including a control conductor, said circuits having different resonant frequencies, a central station to which all of said local stations are connected, an oscillating system and a signal at the central station, means for consecutively tuning said oscillatting system to the normal frequency of each of the tuned circuits at the local stations and means for operating said signal upon a relatively large change in the resonant frequency of any of the tuned circuits at the local stations.

In testimony whereof, I have signed my name to this specification.

LEO SSERGEJEWITSCH THÈREMIN.