Jan. 10, 1933. L. A. GEBHARD 1,893,666

TEMPERATURE CONTROL SYSTEM FOR ELECTROMECHANICAL OSCILLATORS

Filed May 20, 1930 4 Sheets-Sheet 1

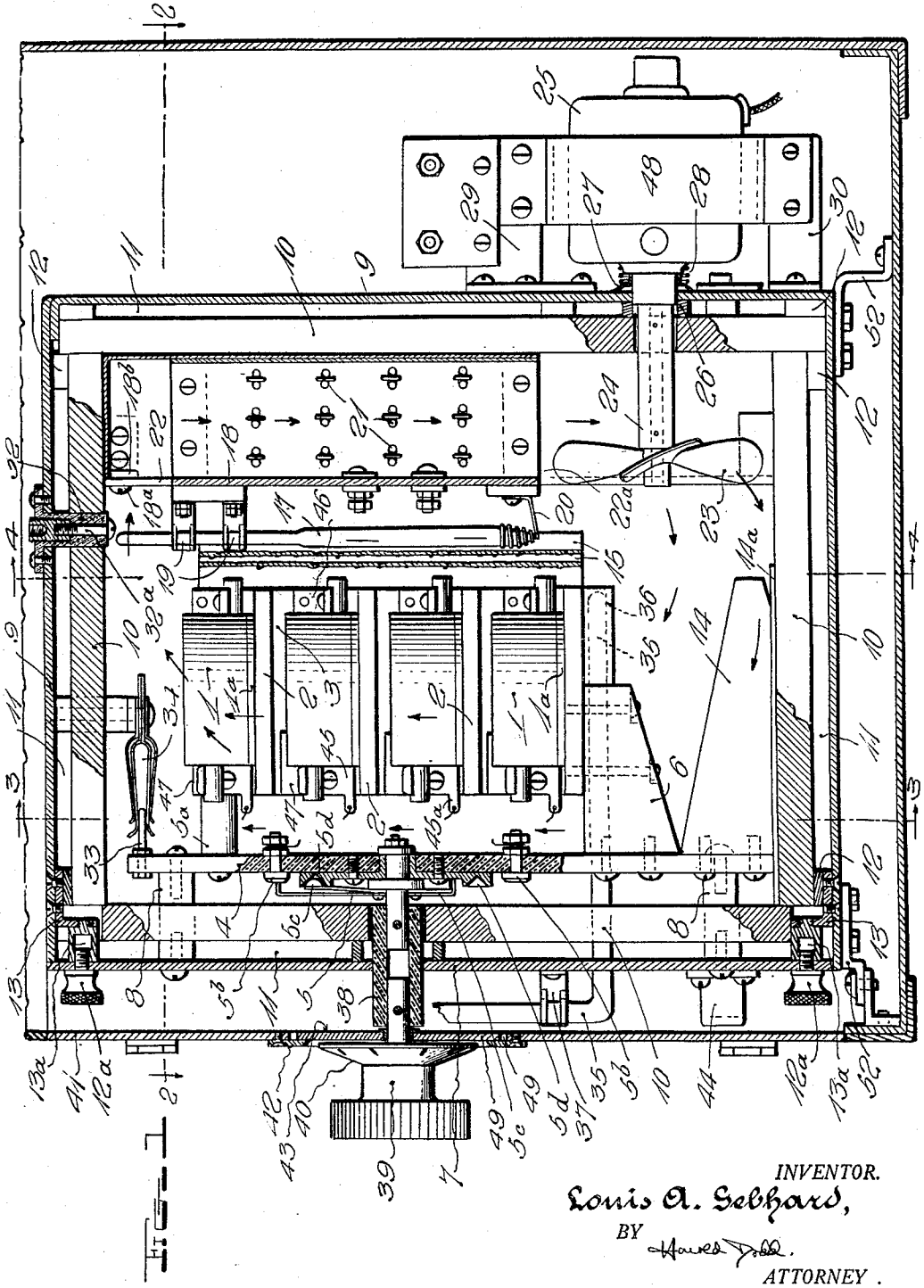

Fig. 1

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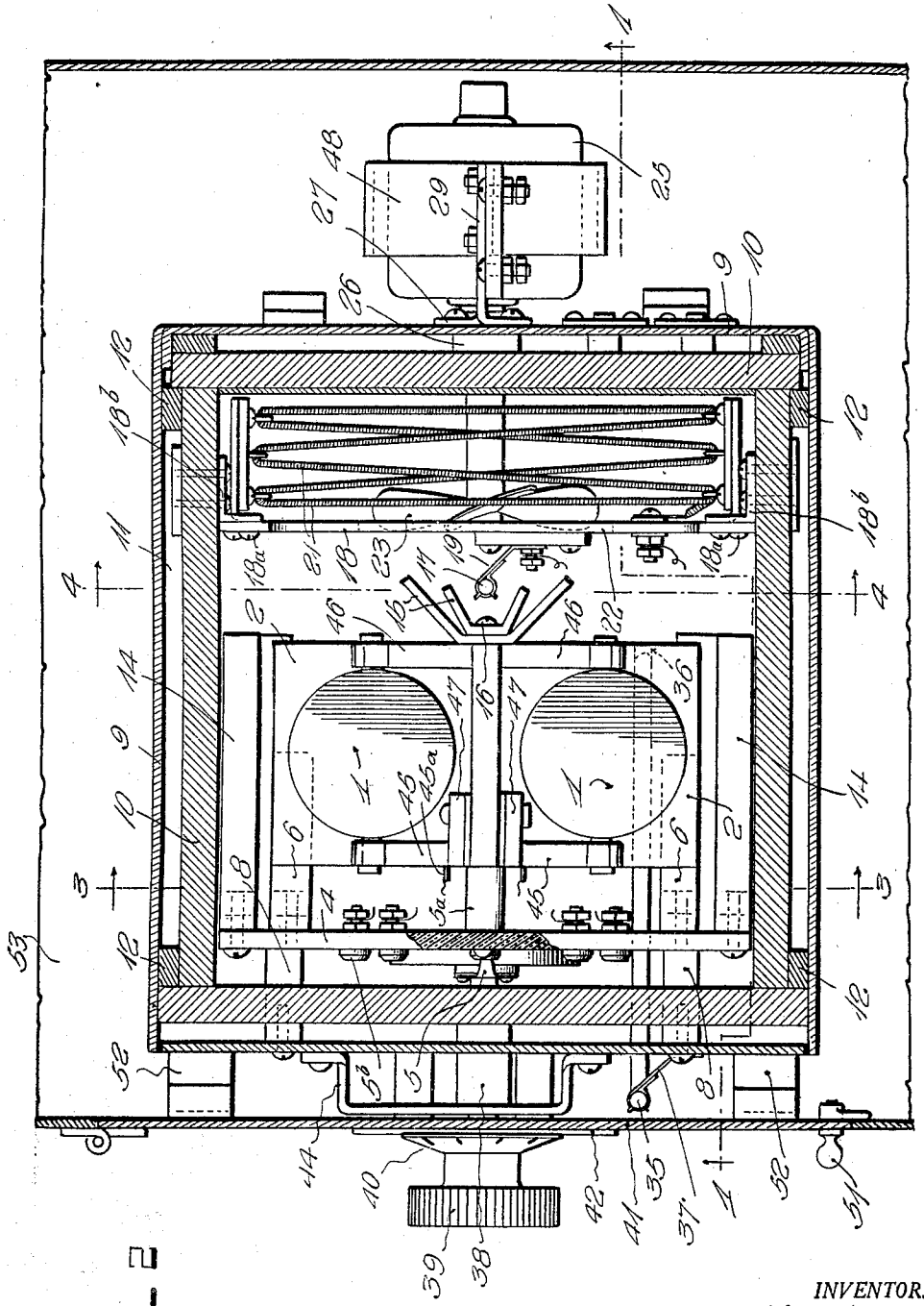

FIG. 2

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FIG. 3

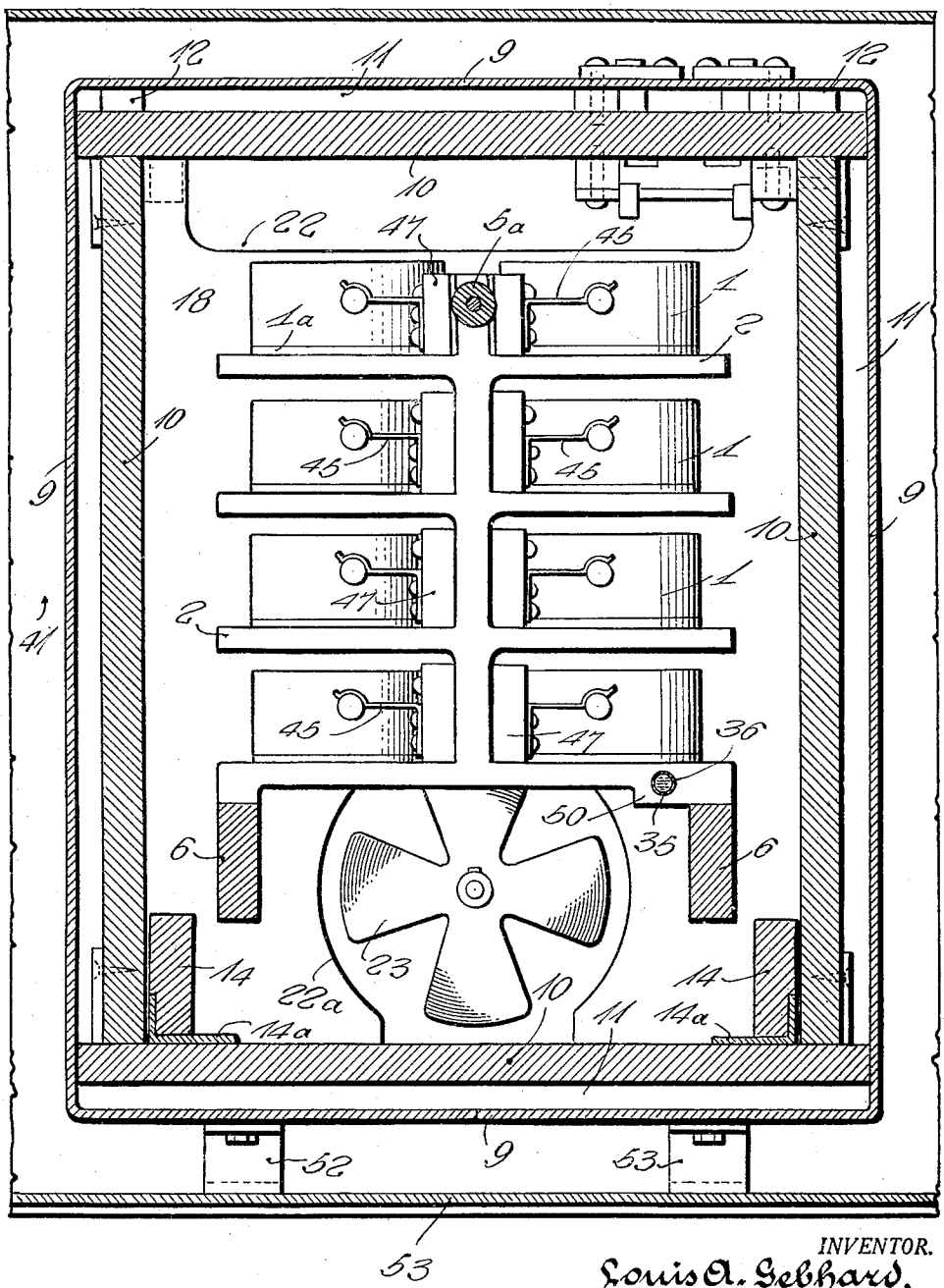

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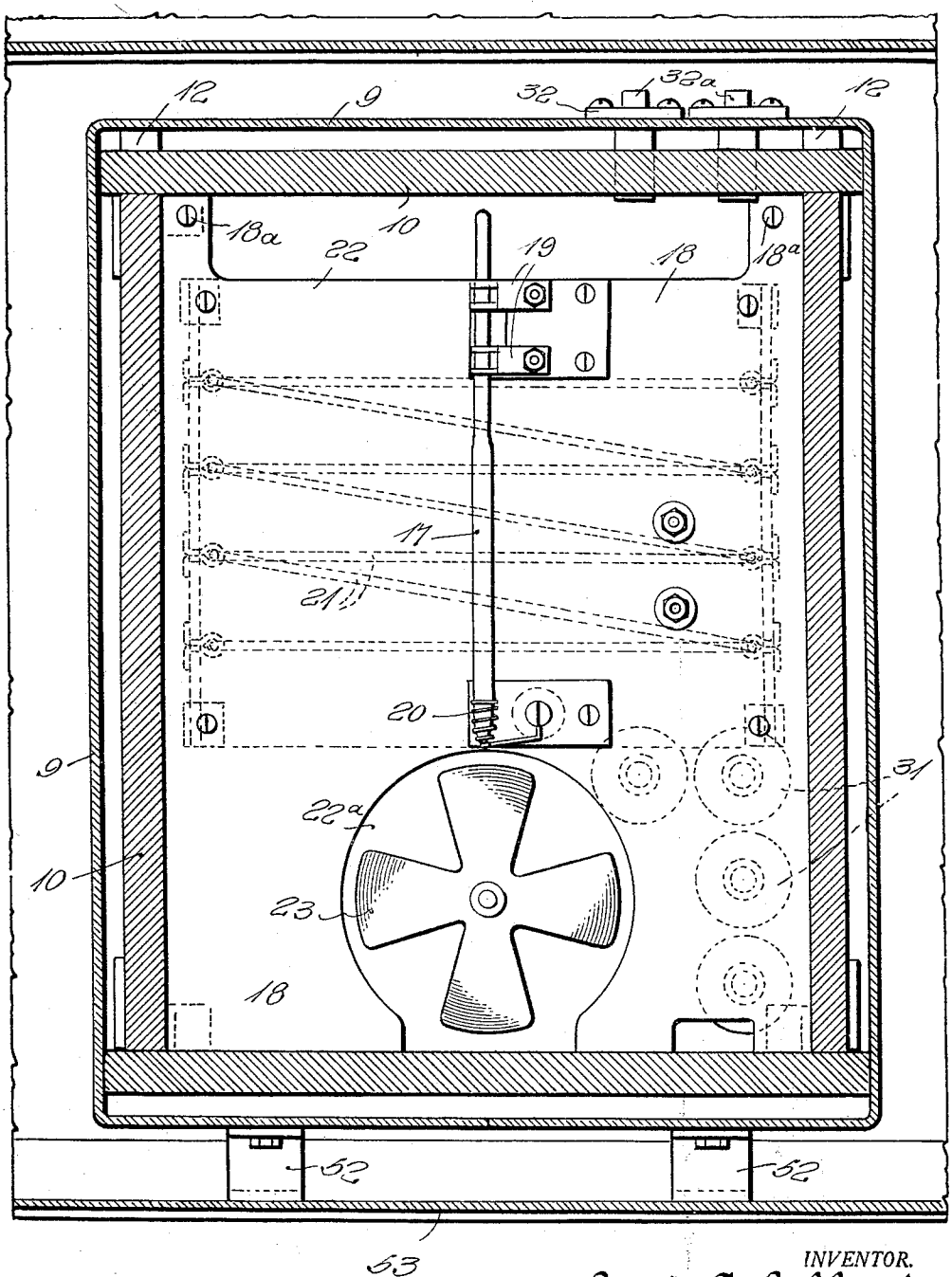
Fig. 4



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UNITED STATES PATENT OFFICE

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TEMPERATURE CONTROL SYSTEM FOR ELECTROMECHANICAL OSCILLATORS

Application filed May 20, 1930. Serial No. 454,169.

My invention relates broadly to constant frequency control apparatus and more particularly to an apparatus for maintaining a multiplicity of electromechanical oscillators under constant conditions.

One of the objects of my invention is to provide a construction of cabinet apparatus in which a multiplicity of electromechanical oscillators may be maintained under constant conditions for the frequency control of signaling systems.

Another object of my invention is to provide a construction of mounting for a multiplicity of electromechanical oscillators in which facilities are provided for the replacement of any one of the electromechanical oscillators and the maintenance of all of the oscillators under constant conditions for the accurate fixing of frequency in a signaling system.

Still another object of my invention is to provide a construction of cabinet for the mounting of a multiplicity of electromechanical oscillators in a manner in which the oscillators may be maintained at constant temperature for the accurate fixing of frequency in a signaling system.

A further object of my invention is to provide a construction of mounting for a frequency control apparatus wherein a multiplicity of electromechanical oscillators may be simultaneously inserted in or withdrawn from a temperature control cabinet structure within which the electromechanical oscillators are subjected to constant conditions for the frequency control of signaling circuits.

A still further object of my invention is to provide a construction of heat conductive support for a multiplicity of electromechanical oscillator mountings, the support having such characteristics that temperature conditions may be equalized at each of the electromechanical oscillator mountings for the accurate fixing of frequency in the circuits of a signaling system.

Other and further objects of my invention reside in the arrangement of frequency control apparatus as set forth more fully in the specification hereinafter following by reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional view taken on line 1—1 of Fig. 2 through the cabinet structure which encloses the frequency control apparatus of my invention; Fig. 2 is a plan view of the frequency control apparatus of my invention on line 2—2 of Fig. 1; Fig. 3 is a cross-sectional view looking in the direction of line 3—3 of Figs. 1 and 2; and Fig. 4 is a cross-sectional view taken on line 4—4 of Figs. 1 and 2.

In radio transmitters employing electromechanical oscillators for frequency control it is essential that the oscillator elements be maintained under constant conditions of temperature in order to assure the proper frequency stability of the transmitting circuits. Under certain conditions in radio transmitters it is necessary to quickly shift from one frequency to another and in some instances provision must be made for operation upon a relatively large number of different frequencies. It is essential to have the oscillator elements controlled at constant temperature with provision for selectively connecting any one of the oscillator elements in the frequency control circuit.

In illustrating my invention I have shown mountings for piezo electric crystal elements which are supported within a cabinet structure in such manner that the temperature thereof may be accurately controlled. While I have shown piezo electric crystal elements used as frequency determining means it will be understood that magnetostriction devices may be employed or other forms of constant frequency controlled devices may be arranged in the mounting which I illustrate herein. If piezo electric crystals are employed these crystals may be ground to a definite working temperature which has been established in the practice of the United States Navy at 50° centigrade. The system of crystals, however, must be arranged so that if a crystal fails in service it may be replaced by a spare which is kept on hand. This makes it essential that all crystals be ground for the same temperature, namely 50° C. and be held accurately to this temperature. Very little temperature gradient from one crystal to another as well

as very little variation from standard temperature can be permitted.

My invention will be understood with more detail by specific reference to the drawings. The electromechanical oscillators are each disposed in mounting devices indicated at 1 which are carried upon a multiplicity of horizontally disposed metallic shelves 2. The shelves 2 extend horizontally from the vertically extending upright portion 3. The upright portion 3 and the horizontally extending shelves 2 are integrally formed in the same casting so that the thermal conductivity may be increased throughout the casting and the temperature gradient reduced. The shelves 2 are spacially related one above another for that distance which will permit the insertion or removal of the electromechanical oscillator mountings 1. Due to the cast construction of the shelves 2 with respect to the upright portion 3, this distance is fixed and made in such a manner as to enable the housing 1 to be slid endwise into position on the shelves 2 in a horizontal direction in inserting the housing on the shelves 2 or removing the housings therefrom. The casting comprising the shelves 2 and the upright portion 3 is supported behind a vertically extending insulated panel 4 by means of a pair of laterally extending brackets 6 and horizontally extending spacer members 6*a*. The insulated panel 4 carries a switch 5 movable over a row of contacts 5*b* individual to each of the electromechanical oscillators 1. The switch 5 is provided with a spring pressed member 5*c* which enters a multiplicity of detents 5*d* corresponding to the number of positions to which the switch 5 is to be moved. A spring member 5*e* projects from the switch 5 for maintaining the switch 5 in tensioned position as the same is moved over the row of contacts 5*b*. The electromechanical oscillators 1 each fit into sets of spring clip devices 45 and 46 which extend laterally from the upright portion 3. The spring clips 46 are grounded directly upon the casting constituted by horizontally extending shelves 2 and upright portion 3. The spring clips 45 are each insulated from the casting by means of insulated blocks 47 which are secured to the casting. Connections extend from the lugs 45*a* of the spring clips 45 to the rear of the individual contacts 5*b*. I provide a multiplicity of heat radiating fins 15 connected by means of screws 16 along the rear of the upright portion 3 for dissipating heat which may tend to localize in any one part of the casting consisting of shelves 2 and upright portion 3 so that the temperature throughout the support may be equalized.

The entire unit comprising the casting and the insulated panel which serves to support the casting is mounted behind the metallic plate 7 by means of supports 8 and may be inserted into or removed from a cabinet structure constituted by metallic casing 9 having a heat insulated lining 10 as shown. The movement of the panel structure and casting into the cabinet is guided by the brackets 14 which slide along the rails 14*a* carried by the lower portion of the cabinet structure. The cabinet structure is heat insulated by means of the heat insulating lining 10 which extends wholly around the interior of the cabinet and between the panel 4 and front panel 7 as indicated. A space 11 is provided between the heat insulating lining 10 and the cabinet 9, which space is maintained as a substantially dead air heat resisting enclosure for the cabinet structure. Suitable spacing members are provided for fixing the spacial relation between the heat resisting lining 10 and the cabinet 9. I have indicated the spacer members 12 at the several corners of the cabinet structure, the members 12 being formed from suitable heat insulating material. I have found that very efficient operation of the frequency control apparatus is obtained at constant temperature by making the heat resisting lining 10 and spacer members 12 from balsa wood. In order to provide a tight connection between the front panel and the cabinet structure I provide angular members 13 at the top and bottom of the cabinet structure which carry screw threaded bushings 13*b* into which the screws 12*a* pass. The front panel 7 when secured in place by means of the adjusting screws 12*a*, serves to entirely close the front of the cabinet structure. Handle members 44 are provided for manually withdrawing or inserting the frequency control apparatus into the cabinet structure. The thermostat which controls the temperature within the cabinet structure is shown in 17, the thermostat comprising a thermometer carried at its lower end in the spring seat 20 and supported at its upper end by means of spring clips 19, which also serve as connectors through the contacts of the thermostat. The thermometer is located centrally between the fins 15 projecting from the upright portion 3 as shown in Fig. 2. The heater 21 is mounted within the cabinet structure in the rear of the panel 18. Panel 18 is removably positioned in the cabinet structure by screw members 18*a* which extend into brackets 18*b* which are secured to the heat resisting walls 10 of the cabinet structure. The panel 18 is provided at its top with a longitudinally extending slot 22 and at its base with an aperture 22*a*. The slot at the top of panel 18 permits the circulation of the convection currents through the cabinet structure while the aperture 22*a* permits the circulation of air currents through the cabinet structure under control of the fan 23. Fan 23 is driven by means of motor 25 mounted exteriorly of the cabinet structure as shown in Figs. 1 and 2. Brackets 29 and

30 extending from the outside wall 9 of the cabinet structure serve to carry the motor 25 in a laterally extending support designated at 48. The motor 25 drives the heat insulated shaft 24 which connects to fan 23. The heat insulation 24 is provided in order to prevent conduction of heat from the inside to the outside of the cabinet structure. A guide ring 26 encircles the shaft 24 and prevents the stirring up of the air in the space 11 between the layers 9 and 10. The dished washer 27 and retaining spring 28 prevent air leakage through the aperture in the heat resisting wall 10 and wall 9 of the cabinet structure through which the insulated shaft 24 extends. The brackets 29 and 30 provide a flexible suspension for the motor 25 so that vibration of the motor will not be transmitted to the cabinet structure 9 and from thence to the electromechanical oscillators 1. Electrical connections are provided to the heater 21 and thermostat 17 as shown at 31 in Fig. 4. These connections, together with the connections for the electromechanical oscillators are so arranged that a minimum amount of metal passes through the layers 9, 10 and 11 as shown for example by the insulated bushing 32 and conductive metal member 32*a* which extends therethrough.

By this arrangement very little heat is conducted from the inside to the outside of the cabinet or vice versa. That is, the effect of the ambient temperature is minimized. The air circulation is shown by the arrows. By reversing the direction of rotation of the fan 23 the direction of the air currents may be reversed if it is so desired. Connection from the switch structure 5 by which a particular electromechanical oscillator may be selected is established outside of the cabinet structure by an arrangement of jacks 34 which lead from the exterior of the cabinet structure and which receive the blocks 33 carried by the insulated panel 4. As the support for the electromechanical oscillators is moved into the cabinet structure, connection is completed between plugs 33 and jacks 34.

In order that the temperature of the casting comprising the horizontally extending shelves 2 and the upright portion 3 may be checked, a right angle thermometer 35 is inserted into the aperture 36 in the enlarged portion 50 of the lowest shelf 2 of the casting. The upright portion of this thermometer is arranged in back of a window in the front panel 41 of the transmitter apparatus so as to make the scale of the thermometer visible. The thermometer is supported from panel 7 by means of spring clips 37 and 37′ carried by panel 7. The rotation of switch 5 is controlled through insulated shaft 38 by means of knob 39 which projects outside of the front panel 41 of the transmitter. The knob 39 may be provided with a dial 40 thereon calibrated to indicate the particular electromechanical oscillator which is connected within the control circuit for any given position of the knob 39. The panel 41 is hinged to the frame of the transmitter and may be swung outwardly therefrom, the dial 40 and knob 39 clearing the panel 41 by reason of the aperture 49 in the panel 41. A disk 43 is positioned behind the dial 40 and serves to close the gap in the front of the panel in cooperation with the bezel ring 42. The opening of the door or hinged panel 41 enables access to be had to the screws 12*a* for the removal of the frame which carries the several electromechanical oscillators from the cabinet structure or the insertion of the frame into the cabinet structure. The closing of the hinged panel 41 and the latching thereof in closed position by means of latch 51 shown in Fig. 2 enables the entire frequency control apparatus to be mounted in the rear of the front panel structure of a radio transmitter. Bracket members 52 are provided for supporting the cabinet structure from the framework 53 of the transmitter.

The electromechanical oscillators such as piezo electric crystals in the several mountings indicated at 1 are each connected by different operating characteristics. In the case of piezo electric crystals, the crystals are each ground to different frequency characteristics and the selector switch serves to pick out the desired piezo electric crystal which is to be connected in the control circuit. Proper indications are provided on dial 40 so that the operator is informed as to which piezo electric crystal is selected for operation.

By providing the single heat conductive casting, conduction of heat currents from any one of the electromechanical oscillation is facilitated and the temperature thus equalized and maintained constant. It will be understood that when the electromechanical oscillators are in the form of piezo electric crystals that each crystal has its lower face in contact with the lower conductive heat element 1*a* of the housing 1 so that heat generated by the rapid mechanical vibration of the crystal is conducted away from the crystal conductively through the horizontally extending shelves 2. Or vice versa, heat which is impressed upon the mass formed by the metallic shelves 2 and upright portion 3 is conveyed to each piezo electric crystal element through the conductive end plate 1*a* of the housing 1. It will be realized that the relatively large mass of metal comprising the casting consisting of horizontally extending shelves 2 and upright portion 3 tends to remain at constant temperature so that maintenance of the temperature within the cabinet structure at a constant value serves to maintain the temperature throughout the mass of metal in the casting 2—3 at constant value. Any tendency of the temperature ad-

jacent one of the electromechanical oscillators to change with respect to the temperature adjacent another of the electromechanical oscillators is equalized by the conduction of heat currents through the metallic casting.

The apparatus of my invention has been found to maintain the temperature within the cabinet structure at the electromechanical oscillators very close to a fixed value with varying ambient temperatures. The temperature gradient between the different electromechanical oscillators is maintained very small by means of the heat conductive fins 15.

The apparatus of my invention has been found to be highly successful in operation for the control of a multiple number of different frequencies and while I have described my invention in a certain preferred embodiment, I desire that it be understood that modifications may be made and that no limitations upon my invention are intended other than are imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A frequency control apparatus comprising a multiplicity of electromechanical oscillators, means for supporting said oscillators comprising a metallic casting of high heat conductivity having a vertical web and a multiplicity of integrally related supporting shelves extending horizontally from sides of the web in opposed relation to each other and vertically spaced planes, electromechanical oscillator carriers resting upon said shelves and removably received thereon, means for circulating air of a constant temperature about the supporting means and carriers, and a selector switch connected with said electromechanical oscillators for rendering effective any one of the multiplicity of oscillators.

2. A multiple frequency control apparatus comprising a multiple shelf support formed from a single casting of high heat conductivity and having an upright portion, a multiplicity of integrally related shelf-like portions, projecting from opposite sides of the upright portion and spaced one above another, clamps extending from the upright portion above the shelves, electromechanical oscillator carriers resting upon said shelf-like portions, and having arms projecting from their sides and engaged by the clamps to releasably hold the carriers in place, and means for subjecting said support and carriers to circulating air currents of substantially constant temperature.

3. A multiple frequency control apparatus comprising a box like cabinet structure, a carrier removably positioned in said cabinet structure and including an upright and a plurality of shelves extending from the same, a multiplicity of frequency determining elements mounted on the shelves of said carrier, and means for subjecting said carrier and the frequency determining elements thereon to the passage of circulating air currents of substantially constant temperature, said carrier being composed of heat conductive material and adapted to equalize the temperature throughout the area thereof adjacent each of the frequency determining elements carried thereby.

4. A multiple frequency control apparatus comprising a box like cabinet structure, a carrier removably positioned in said cabinet structure, said carrier including a multiple shelf-like support of material of high heat conductivity, a multiplicity of frequency determining elements carried by said support, means for subjecting said support and the frequency determining elements thereon to circulating air currents of substantially constant temperature, and selective means operative from the exterior of said cabinet structure for rendering effective any one of the frequency determining elements therein.

5. A multiple frequency control apparatus comprising a temperature controlled box like cabinet structure, a frame member slidably insertable into or removable as a whole from said cabinet structure and including an upright and a plurality of shelves extending from sides of said upright in superimposed relation one with respect to another, electromechanical oscillator holders resting upon said shelves in spaced relation to the upright and shelves above them for the passage of circulating air currents through said frame and around the electromechanical oscillator holders, said frame having high heat conductivity throughout the structure thereof for the maintenance of each of the electromechanical oscillator holders thereon at substantially constant temperature.

6. A multiple frequency control apparatus comprising a constant temperature controlled box like cabinet structure, a panel member slidably insertable into or removable from said cabinet structure, a frame supported by said panel member, said frame comprising a metallic casting having a multiplicity of laterally extending shelf-like portions projecting from a central upright portion, an electromechanical oscillator holder, each providing a housing for an oscillator, said holders being removably mounted upon said shelf-like portions and supported thereby in superimposed relation one with respect to another, means for subjecting said oscillator holders to the passage of circulating air currents of substantially constant temperature, said casting having a substantially negligible temperature gradient, and selector means carried by said panel member and operative from the exterior of said cabinet structure for rendering a selected one of said electromechanical oscillators effective.

7. A multiple frequency control apparatus comprising a temperature controlled box like cabinet structure, open at one side, a slidably removable wall member for the open side of said cabinet, structure serving as a closure when in place, a frame carried by said wall member, said frame comprising a single casting of heat material of high heat conductivity including a multiplicity of laterally extending shelf-like portions integrally connected by a vertically extending web portion, an electromechanical oscillator holder individual to each of said laterally extending shelf-like portions, said casting being disposed in the path of circulating air currents within said cabinet structure at substantially constant temperature, and electrically selective means for rendering any one of said eletromechanical oscillator mountings effective for frequency control.

8. A frequency control apparatus comprising a temperature controlled box like cabinet structure, a slidably removable end wall for said cabinet structure, a casting of high heat conductivity mounted interiorly of said removable end wall, said casting comprising a multiplicity of laterally extending heat conductive portions extending integrally from each side of a centrally disposed web portion for forming a multiplicity of shelf-like portions, a plurality of electromechanical oscillator holders adapted to be removably carried by each of the shelf-like portions of said casting, means for subjecting said casting to circulating air currents of substantially constant temperature, and selector means for rendering any one of said electromechanical oscillator mountings electrically effective.

9. A multiple frequency control apparatus comprising a temperature controlled box like cabinet structure, a wall member slidably insertable into or removable from one side of said cabinet structure, a casting of high heat conductivity supported by said wall member, said casting including a vertically extending web and a multiplicity of laterally extending integrally connected shelf-like portions projecting in opposite directions therefrom, electromechanical oscillator housings removably mounted upon each of said shelf-like portions, means for subjecting said casting and the electromechanical oscillator housings thereon to circulating air currents of substantially constant temperature, and selector means operative from the exterior of said cabinet structure for rendering any one of the electromechanical oscillator housings electrically effective.

10. Frequency control apparatus comprising a temperature controlled box like cabinet structure having one end thereof slidably separable therefrom, a frame supported by the separable end of said cabinet structure, said frame including a single casting having a vertically extending web and a multiplicity of laterally extending shelf-like portions projecting integrally from opposite sides of the vertically extending web and spaced one above another, the portions of said casting having relatively large mass for absorbing and conducting relatively large quantities of heat, electromechanical oscillator housings supported upon the laterally extending shelf-like portions of said frame in spaced relation to each other, means for subjecting said casting to the flow of circulating air currents of substantially constant temperature, and selector mechanism operative from the exterior of said cabinet structure for rendering any one of the electromechanical oscillator housings therein eletrically effective.

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