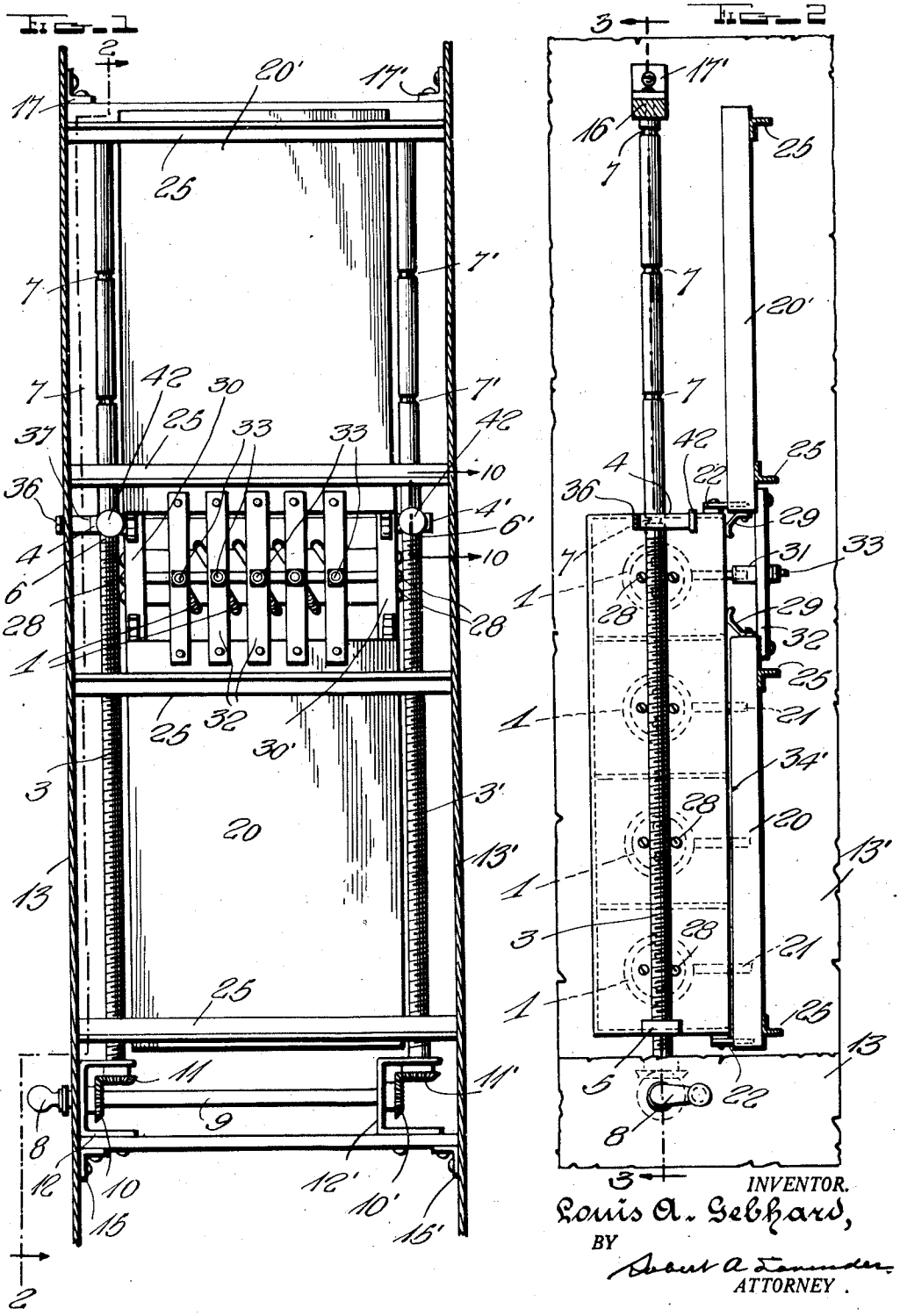
July 10, 1934. L. A. GEBHARD 1,965,590

FREQUENCY CHANGING SYSTEM

Filed Dec. 6, 1932 3 Sheets-Sheet 1

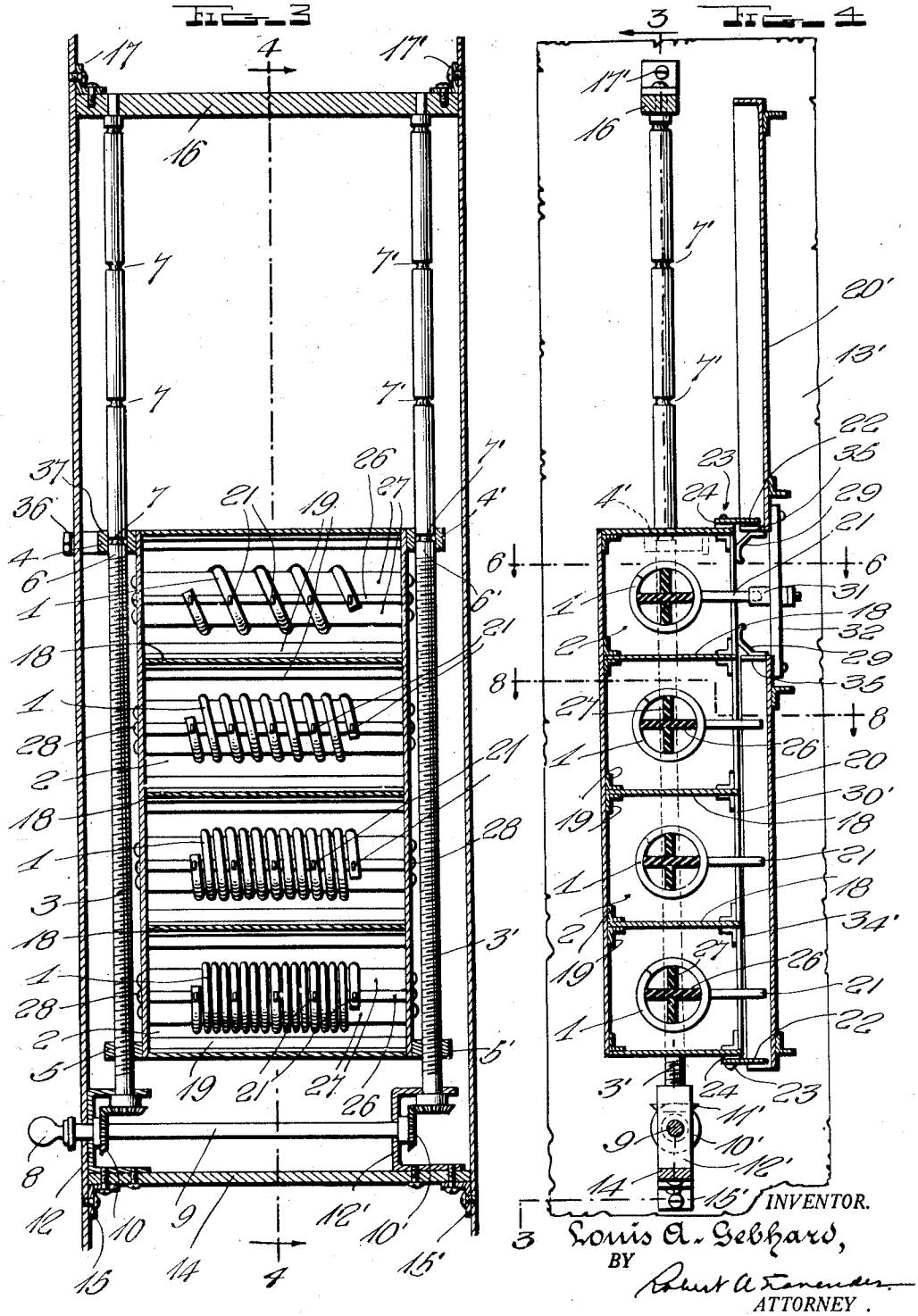


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FREQUENCY CHANGING SYSTEM

Filed Dec. 6, 1932 3 Sheets-Sheet 2



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FREQUENCY CHANGING SYSTEM

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FIG. 5

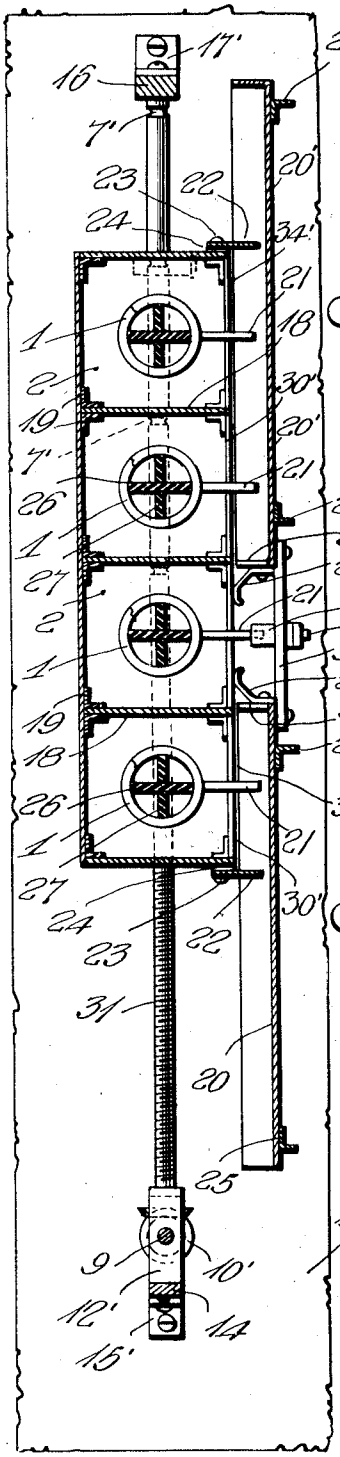


FIG. 6

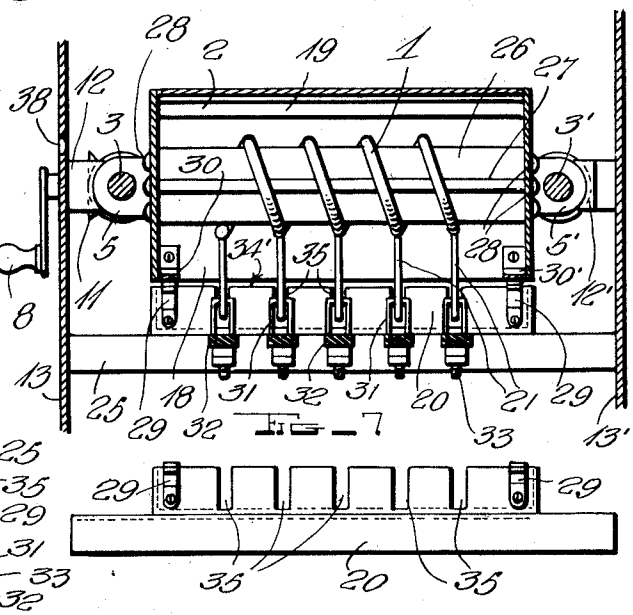


FIG. 7

FIG. 8

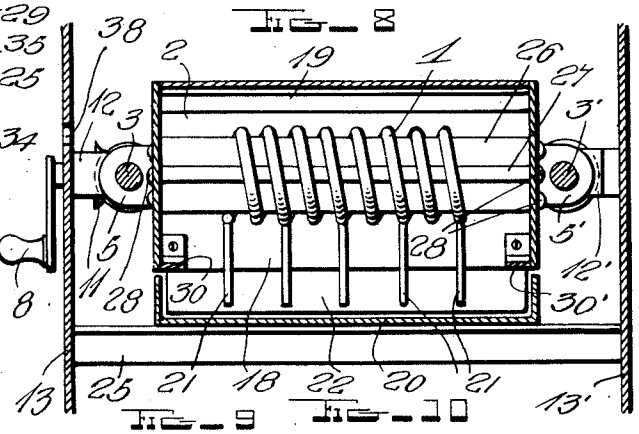


FIG. 9

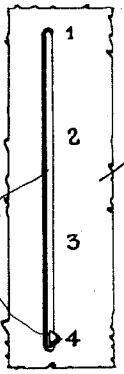
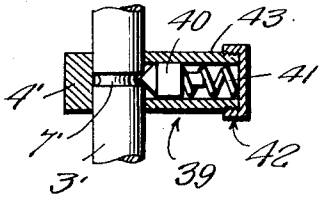


FIG. 10



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UNITED STATES PATENT OFFICE

1,965,590

FREQUENCY CHANGING SYSTEM

Louis A. Gebhard, Washington, D. C.

Application December 6, 1932, Serial No. 645,963

6 Claims. (Cl. 171—242)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

My invention relates broadly to frequency changing systems for high frequency transmitters and more particularly to a construction of frequency changing apparatus having a high degree of efficiency.

One of the objects of my invention is to provide a construction of frequency changing apparatus for high frequency signaling systems in which a high degree of efficiency of signal transmission may be maintained and wherein the construction may be rendered highly compact.

Another object of my invention is to provide a construction of frequency changing apparatus for high frequency changing systems in which a single set of switch contacts are electrically connected with the oscillation circuits of the transmitter and shielded inductance coils moved into effective electrical connection with the sets of contacts while electrostatically isolating the inductance coils, which are not in use from the inductance coil which is effective and from other parts of the signaling apparatus.

Still another object of my invention is to provide a novel form of frequency changing apparatus for high frequency signaling systems in which a multiplicity of inductance units may be mounted in electrostatically shielded compartments constituted by a frame structure which is bodily movable with respect to sets of fixed contacts in permanent connection with the oscillation circuits of the transmitter with means for shifting the electrostatically shielded compartments to bring a selected inductance unit into connection with the fixed contacts while electrostatically isolating the remaining inductance units from the inductance unit which is rendered effective.

A further object of my invention is to provide an electrostatically shielded inductance system for frequency changers wherein movement may be imparted to the entire electrostatically shielded mounting for the inductance units for rendering a selected inductance unit effective while electrostatically isolating the remaining inductance units from the effective inductance unit.

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

Figure 1 is an elevational view showing the terminal connections for the oscillatory circuits leading to the adjustable inductance system of my invention; Fig. 2 is a side elevational view of the apparatus illustrated in Fig. 1, partially broken away and shown in section on line 2—2 of Fig. 1; Fig. 3 is a longitudinal sectional view taken through the frequency changing apparatus on line 3—3 of Fig. 2; Fig. 4 is a vertical sectional view taken on line 4—4 of Fig. 3; Fig. 5 is a vertical sectional view taken through the frequency changing apparatus and illustrating the electrostatically shielded inductance system shifted to another selected position from that illustrated in Figs. 1–4; Fig. 6 is a transverse sectional view through the frequency changing apparatus on line 6—6 of Fig. 4; Fig. 7 is a plan view of the end of one of the shield plates illustrating the brushes in position for establishing electrical connection with the compartments and showing the provision for the passage of the taps therethrough; Fig. 8 is a transverse sectional view taken through one of the electrostatically shielded compartments and one of the shield plates on line 8—8 of Fig. 4; Fig. 9 is a view of the front panel of the transmitter showing the means for indicating a particular inductance unit which is selected for operation in the transmitter circuits; and Fig. 10 illustrates one of the spring actuated means which I provide for maintaining the shielded compartments in a predetermined position when a particular inductance unit is selected for operation in the transmitter circuit.

In a radio frequency transmitter in which a number of coil systems are employed to cover a large band of frequencies certain objectionable features have been encountered. In order to use the transmitter at high frequencies, the leads between the coil systems and the switching mechanism must be short and the transmitter made quite compact. This brings the coil systems quite close together. Only one of these coil systems is used at one time, the others being disconnected from the circuit. At certain frequencies of operation corresponding to the natural period of the unused coils considerable energy may be transferred from the active part of the circuit to the unused coils causing interference with the operation of the circuit and reduction in efficiency of operation. Voltages in the unused coils may become so high as to cause partial discharge from the ends of the coils. The difficulty is due to both the magnetic and electric coupling between the active coil and inactive coils. In the system of my invention I provide a movable electrostatically shielded inductance system wherein a multiplicity of inductance units of different frequency characteristics are disposed in adjacent metallic

compartments which operate to magnetically and electrostatically isolate unused inductance units from the selected inductance unit as each selective operation is performed for preventing undesired losses in the transmission system. I provide a frame structure in which there is mounted a pair of rotatably driven shafts. These shafts are simultaneously driven through a gear and crank connection. The shafts are threaded throughout part of their length and are unthreaded throughout the remainder of their length. Grooves are provided at spaced intervals in the shafts. There are means connected with the compartments for engaging the screw threads on the shafts to enable the compartments to be driven longitudinally of the shafts. There are means connected with the compartments engageable with the grooves in the shafts for providing automatic stops for the compartments at selected positions as the compartments are shifted along the shafts. Inductance units of different frequency characteristics are mounted within the compartments. Taps project through an open side wall of the compartments from each of the inductance units. There is an insulated panel mounted midway of the shafts, which panel carries contact elements extending in the path of the taps on the inductance units. Extending in opposite directions from the insulated panel and immediately adjacent the open side wall of the compartments, I provide shield plates. These shield plates are so shaped and coordinated with the end walls of the compartments that the compartments containing the unused inductance units are effectively electrostatically and magnetically shielded. Electrical connection is established between the compartments and the shield plates by means of brushes which project from the shield plates and bear upon the compartments.

My invention will be more fully understood by a detailed reference to the drawings. The coils 1 are shown mounted in compartments 2 made of suitable metal. These compartments 2 are disposed one on top of the other, the whole forming a rectangularly shaped container which is caused to move up and down by the use of members 3 and 3'. These members 3 and 3' pass through supports 4, 4', 5 and 5'. Below points 6 and 6' members 3 and 3' are threaded and engage with threads in 5 and 5'. Above the points 6 and 6' members 3 and 3' are smooth and are free to rotate and slide over members 4 and 4' except for annular grooves 7 and 7' which are provided in order that the coils may be located in their proper positions. The upward and downward motion of 2 is controlled by means of control 8 by means of which shaft 9 may be rotated. This causes the rotation of bevel gears 10, 10', 11 and 11' in turn causing rotation of members 3 and 3'. The gears are supported in bearing members 12 and 12' which are in turn supported from the front and rear panels 13 and 13' by the use of member 14 and angle members 15 and 15'. Members 3 and 3' are supported at their upper end by bearing member 16 which is in turn supported from the panels 13 and 13' by the use of angle members 17 and 17'. The coil compartments 2 are formed by long vertical members extending from the bottom to the top of the coil unit. Individual compartments are formed by the use of horizontal members 18 supported by the use of angle members 19 which make the whole unit rigid.

Two stationary shields 20 and 20' are provided to shield the open side of compartments 2 together with coil contacts 21. The lower and upper ends of the end compartments 2 are provided with extension shield members 22 which close off the open ends of members 20 and 20'. Shields 22 are fastened to the ends of end compartments 2 by use of screws 23 and spacers 24. The coil units move from the extreme lower position shown to the extreme upper position. Shields 20 and 20' are supported from sides 13 and 13' by use of angle members 25. The coils 1 have different frequency characteristics. They are supported in compartments 2 by the use of insulating members 26 and 27 by means of screws 28. In order to assure complete shielding contact, members 29 are provided which electrically connect shields 20 and 20' to compartments 2. The connection is made at a point adjacent to the coils in use. The sides of compartments 2 adjacent to 20 are opened except for a short portion 30 and 30' which forms a contacting surface for brushes 29. Members 20 and 20' cover the open side of all of the unused coils, the only partially exposed coil being the one which is connected in the circuit. The taps 21 of this coil engage with connection clips 31 mounted on insulating members 32 projecting between shields 20 and 20'. As many contacts as are desired may be used. The connections to external circuits are made by the use of binding posts 33. A very small clearance space 34 to 34' is provided between shields 20, 20' and compartments 2. Clearance is just sufficient to prevent excessive friction and also to prevent leakage of electric or magnetic lines of force. In order to permit taps 21 to pass through the top of shield 20 in the bottom of shield 20', narrow slots 35 are provided in the extension shield members 22. These slots are just large enough to permit passage of the contacts but are small enough to prevent leakage of electric and magnetic lines of force. The position of the coil system is indicated by an indicator 36 which is fastened to 4 as shown at 37 in Fig. 3. Indicator 36 passes through a slot in panel 13 as shown at 38.

A locking or stop mechanism is provided as part of 4 and 4' as shown at 39. This is more clearly shown in Fig. 10 in which a pin 40 is caused to engage with grooves 7—7' in members 3 and 3' by means of spring 41. A cap 42 screws on the end of body 43 retaining the spring and pin in place. Members 3 and 3' are free to rotate or slide in members 4—4' except for the force exerted by pin 40 which may be overcome by the use of control 8 when the operator intentionally wishes to change coil systems. This lock mechanism however, prevents vibration from accidental change of the coil systems. It should be noted that in the system illustrated four coils of different frequency characteristics are illustrated. Any number of coils can be used. The number chosen was most suitable for a transmitter having a frequency period of from 4 to 20,000 kilocycles.

The oscillation circuits with which the frequency changing apparatus of my invention is employed are mounted immediately adjacent the terminal post 33 so that the connection between the oscillation circuits and the selected inductance unit and frequency changer are maintained extremely short. The unused inductance units are electrostatically and magnetically isolated from the effective inductance unit and from the adjacent oscillation circuits by virtue of the enclosure of each inductance unit centrally within a complete metallic shield so that maximum efficiency in the transmitter is obtained at the

same time that an extremely compact structure for the transmitter is afforded.

I have described my invention in one of its preferred embodiments but it will be understood by those skilled in the art that I may depart from the details shown herein and employ modifications of my invention within the scope of the appended claims. The embodiment of my invention shown herein is intended in the illustrative sense and not in the limiting sense.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalty thereon or therefor.

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

1. Frequency changing apparatus comprising a frame structure, a pair of longitudinally extending guide members rotatably journaled in said frame structure, screw threads on said guide members extending substantially one-half the length of said guide members, means for simultaneously driving said guide members, a set of electrostatically shielded compartments, means for mounting said compartments with respect to said guide members, said means including screw devices engaging the screw threads on said guide members, inductance units of different frequency characteristics mounted in said compartments, taps extending from said inductance units, a set of fixed contacts disposed in the path of said taps, and electrostatic shields extending in opposite directions with respect to said fixed contacts for effectively shielding each of the unused inductance units from each other in all positions in which said compartments may be shifted in selectively connecting the taps on a particular inductance unit with said fixed contacts.

2. Frequency changing apparatus comprising a frame structure, a pair of shaft members extending through said frame structure, said shaft members being screw threaded throughout a portion of their length, means for rotatably driving said shaft members, a plurality of electrostatically shielded compartments, means connected with said compartments and engaging the screw threads on said rotatable shafts, said compartments being open at one side thereof, inductance units of different frequency characteristics insulatingly supported within said compartments and having taps thereon projecting through the open sides of said compartments, a set of fixed contacts insulatingly supported substantially central of said frame structure and in the path of the taps on said inductance units, and shield members extending in opposite directions from a position adjacent said fixed contacts for effectively closing the open sides of said compartments as said compartments are shifted to successive positions for establishing connection between the taps on a selected inductance unit and said fixed contacts.

3. Frequency changing apparatus comprising a frame structure, a pair of shaft members extending through said frame structure, said shaft members being screw threaded throughout a portion of their length, means for rotatably driving said shaft members, a plurality of electrostatically shielded compartments, means connected with said compartments and engaging the screw threads on said rotatable shafts, said compartments being open at one side thereof, inductance units of different frequency characteristics insulatingly supported within said compartments and having taps thereon projecting through the open sides of said compartments, a set of fixed contacts insulatingly supported substantially central of said frame structure and in the path of the taps on said inductance units, shield plates disposed in a plane immediately adjacent the open sides of said compartments and extending in opposite directions from said fixed contacts, and brush members carried by said shield plates and establishing wiping electrical connection with the walls of said compartments whereby all of the inductance units which are not in use are electrostatically isolated from the selected inductance unit.

4. Frequency changing apparatus comprising a frame structure, a pair of shaft members extending through said frame structure, said shaft members being screw threaded throughout a portion of their length and having grooves disposed at spaced intervals throughout the remainder of their length, a multiplicity of electrostatically shielded compartments, means connected with said compartments and engaging the screw threads on said shafts, separate means connected with said compartments and engaging said shafts, spring devices carried by said separate means for engaging the grooves in said shafts whereby said compartments may be shifted to selected positions, inductance units of different frequency characteristics disposed in each of said compartments and having taps projecting therefrom through an open side wall of said compartments, an insulated panel mounted centrally of said frame structure, contacts carried by said insulated panel in the path of the taps projecting from said inductance units, shield plates extending in opposite directions from said insulated panel for substantially closing the open wall of said compartments as said compartments are shifted to selected positions determined by the grooves in said shafts for effecting electrical connection between a selected inductance unit and said fixed contacts.

5. Frequency changing apparatus comprising a frame structure, a pair of driving shafts extending therethrough, means for imparting rotary motion to said shafts, screw threads on said shafts, a multiplicity of electrostatically shielded compartments disposed in stacked relation, means connected with said compartments and engaging the screw threads on said shafts, inductance units of different frequency characteristics disposed in said compartments, taps on each of said inductance units projecting through an open side wall of said compartments, an insulated panel mounted centrally of said frame structure, contacts carried by said panel and projecting into the path of said inductance units, electrostatic shield plates extending in opposite directions from said insulated panel immediately adjacent the open side wall of said compartments, said shield plates having side portions coextensive with the end walls of said compartments, brush members carried by the ends of said shield plates adjacent said insulated panel and establishing electrical connection with the walls of said compartments, and plate members carried by opposite ends of said compartments and projecting toward said shield plates for maintaining an effective electrostatic shield for all of the inductance units when an electrical connection is established between the taps on a particular inductance unit and the contacts carried by said panel.

6. In an inductance changing apparatus, a frame structure, a multiplicity of electrostatically shielded compartments carried by said frame structure, inductance units of different sizes insulatingly mounted in each of said compartments, a set of contacts mounted adjacent said frame structure, sets of contacts projecting from selected points on each of said inductance units to points outside of said shielded compartments, means for producing relative movement between said electrostatically shielded compartments with the inductance units contained therein and said set of contacts for selectively connecting any one of said inductance units with said set of contacts, and means for electrostatically shielding said set of contacts from the inductance units not connected thereto.

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