Sept. 4, 1928. 1,683,558

F. A. KOLSTER

VARIABLE CONDENSER

Filed April 28, 1926 2 Sheets-Sheet 1

FIG. 1.

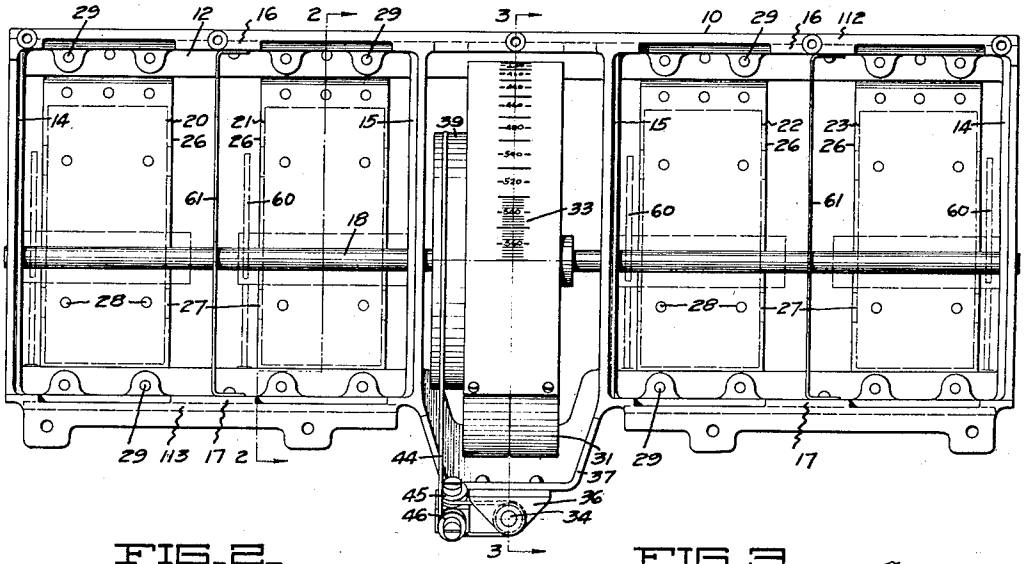

FIG. 2.

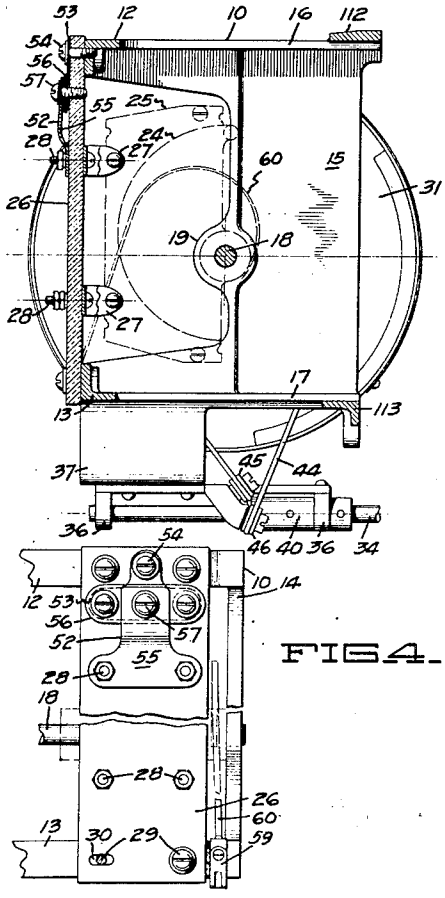

FIG. 3.

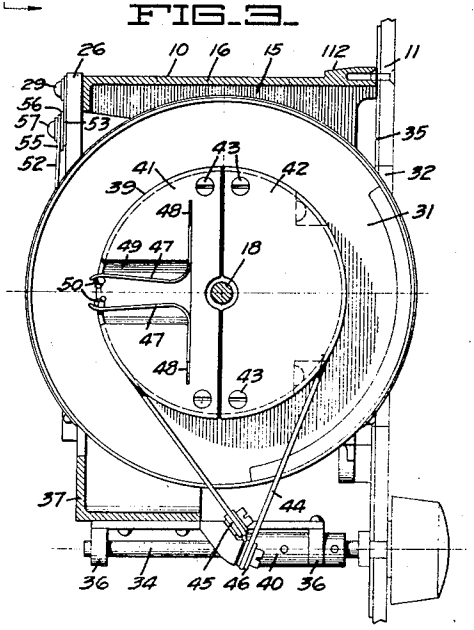

FIG. 4.

INVENTOR
Frederick A. Kolster.
BY White & Frost.
his ATTORNEYS

Sept. 4, 1928.

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F. A. KOLSTER

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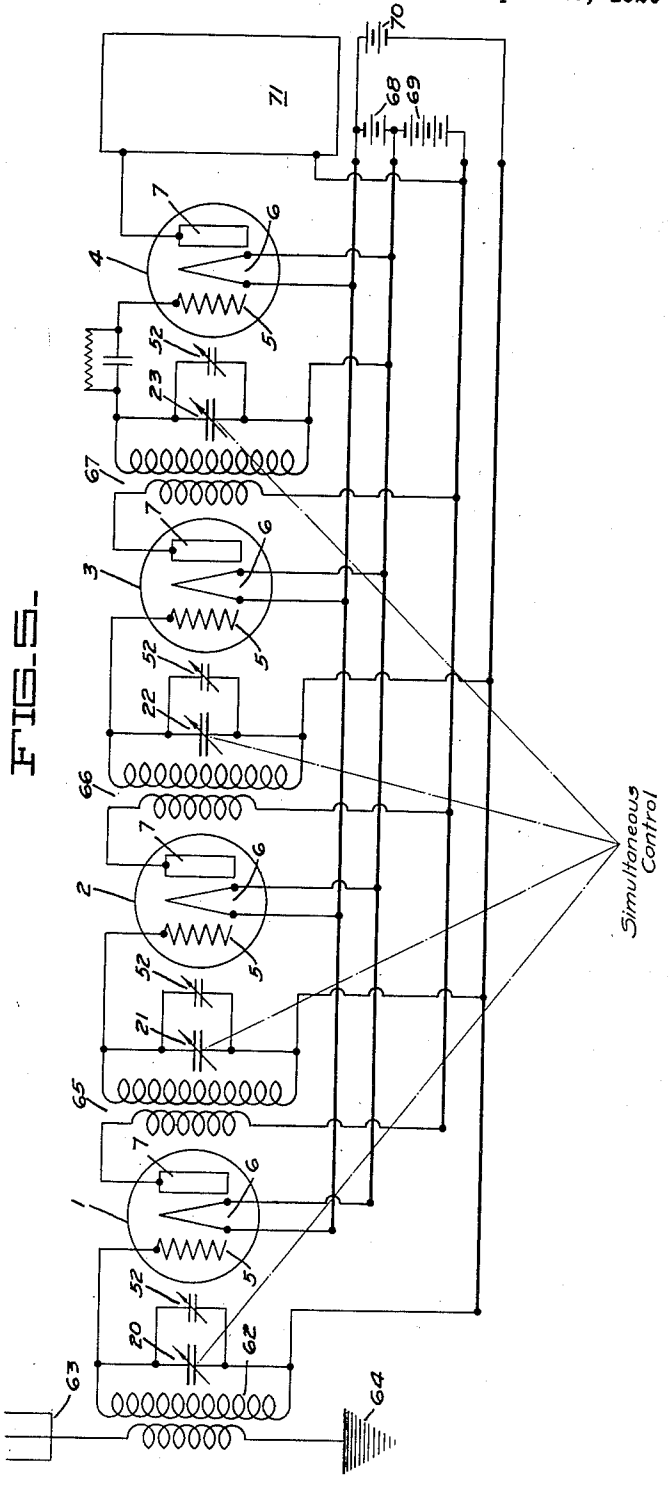

INVENTOR
Frederick A. Kolster.
BY White & Frost
his ATTORNEYS.

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UNITED STATES PATENT OFFICE.

FREDERICK A. KOLSTER, OF PALO ALTO, CALIFORNIA.

VARIABLE CONDENSER.

Application filed April 28, 1926. Serial No. 105,050.

This invention relates generally to a variable tuning device adapted to be used in conjunction with radio apparatus.

In radio receiving equipment it is customary to employ a plurality of variable tuning condensers operated from a unitary or gang control for simultaneously varying the electrical properties of two or more resonant circuits. For best results these resonant circuits must be accurately tuned over a wide range of radio frequency. In manufacturing radio equipment it is difficult to maintain the electrical constants sufficiently close to make it possible to employ a gang control condenser without making individual adjustment of the separate condensers. In the past such adjustments have been made by expensive coupling devices between the shafts of the various condensers so that the rotary plates of one or more of the condensers might be set at a different angular position from the others. These prior devices were also difficult to incorporate in the ordinary panel type of radio set and electrical connections to the other instruments could not be readily made.

It is an object of this invention to devise a gang control condenser structure which may be readily adjusted to tune a radio set at maximum efficiency throughout its wave-length range.

It is a further object of this invention to devise a gang condenser which may be readily incorporated with a standard radio receiving set.

It is a further object of this invention to provide a novel form of control for a tuning device.

It is a further object of this invention to devise a gang condenser structure which will have minimum electrical losses and will be rugged in construction.

Further objects of this invention will appear from the following description in which I have set forth the preferred embodiment of my invention. It is to be understood that the scope of the invention is only to be determined by the appended claims and the state of the prior art.

Referring to the drawings:

Figure 1 is a side elevational view of the device of this invention.

Fig. 2 is a cross sectional view taken along the line 2—2 of Fig. 1.

Fig. 3 is a cross sectional view taken along the line 3—3 of Fig. 1.

Fig. 4 is a detail view showing the mounting for one of the condensers.

Fig. 5 is a circuit diagram showing the manner in which the device is connected to a standard radio receiving set.

The device includes generally a metal frame 10 which is adapted to be operatively disposed behind an instrument panel 11 of a radio set. The frame 10 is made as rigid as possible and comprises upper horizontal bars 12 and 112 and lower horizontal bars 13 and 113, these upper and lower bars being interconnected by the vertical end members 14 and the vertical intermediate members 15. Cross bars 16 and 17 serve to make the frame more rigid. Within the frame 10 there is arranged a horizontal shaft 18 which is preferably journaled in bearings 19 provided upon the vertical members or webs 14 and 15. A plurality of variable condenser structures 20, 21, 22 and 23 are operatively mounted in spaced relationship within the frame 10 so as to be simultaneously varied upon rotation of the shaft 18.

A suitable form of variable condenser structure is shown in Figs. 2 and 4 and comprises a group of spaced rotor plates 24 directly mounted upon the shaft 18. The rotor plates are adapted to interleave a group of spaced stator plates 25 which are suitably mounted upon the insulating strip 26. One suitable form of mounting comprises a bracket 27 secured to the stator plates 25 and to the insulating strip 26 by means of bolts 28. The ends of the insulating strip 26 are secured to the rear faces of the bars 12 and 13 by suitable means such as screws 29, the apertures 30 provided in the insulating strip for reception of these screws 29 being enlarged so as to permit lateral adjustment of the insulating strip.

To indicate the angular position of the shaft 18 there is provided an indicating dial or drum 31 which is mounted upon this shaft, preferably between the intermediate vertical members 15. This indicating dial is adapted to be visible through an aperture 32 in the instrument panel 11 and is provided with suitable graduations 33 on its periphery. For controlling the movement of the shaft 18 there is provided a control shaft 34 which is

rotatably mounted below the drum 31 and in alinement with the same so as to project out thru the panel 11. The mounting for the control shaft 34 includes a plurality of journal members 36 which are secured to a yoke 37 extending downwardly from the bars 13. This yoke is preferably formed as an integral part of the frame 10 and serves to bridge the space occupied by the lower portion of the drum 31.

To provide means for operatively connecting the control shaft 34 with the shaft 18 there is also mounted upon the latter shaft a pulley wheel 39 adapted to cooperate with a small pulley wheel 40 fixed to the shaft 34. The pulley wheel 39 is preferably formed of two split halves 41 and 42 as shown in Fig. 3, these halves being secured to one face of the drum 31 as by means of screws 43. Trained about the pulley wheels 39 and 40 there is a flexible belt or cord 44, a pair of idler pulleys 45 and 46 being provided to track the cord 44 upon the pulley wheels 39 and 40. A suitable form of tensioning device for the cord 44 is shown in Fig. 3 and comprises a pair of resilient fingers 47 mounted within slots 48 in the pulley wheel portion 41, the resilient ends of these fingers being disposed within a slot 49 opening into the periphery of the pulley 39. The ends 50 of the cord 44 are secured to the ends of the fingers 47 so as to be constantly urged in a direction to tension the cord. Thus upon rotation of the control shaft 34 the shaft 18 will be rotated to simultaneously vary the respective capacitances of the condensers 20 to 23 inclusive.

In assembling condensers such as described above it has been found that the respective minimum capacitance of the different condenser structures will vary between certain limits. In order to definitely fix this minimum capacitance each condenser structure is provided with a small adjustable condenser 52 which is mounted upon the rear face of the insulating strip 26. In the construction shown this variable condenser comprises a metallic strip 53 which is connected to a screw 54 which is threaded into the bar 12, thus being grounded to the frame. The strip 53 forms one electrode of a condenser while the spring strip 55 forms the other electrode, the lower end of this strip being connected with two of the bolts 28. The overlapping portions of the strips 53 and 55 are separated by means of a strip 56 and a screw 57 serves to press down the upper plate against the lower a more or less amount depending upon the capacitance desired.

For making connections to the rotor plates of the respective condenser structures there are provided terminal connectors 59 which are connected to the stator plates by means of a flexible ribbon or other suitable conductor 60. Connections to the insulated stator plates may be made to any one of the screws 28. Metal shields 61 may be positioned between the condensers and grounded to the frame in order to reduce intercapacitative coupling. The front bars 112 and 113 may be employed for operatively mounting the device behind the instrument panel 11, and as shown, are secured to a metal panel 35.

The manner in which the device of this invention is associated with a radio set is shown in Fig. 5. In this instance it has been shown as incorporated with a radio receiving circuit comprising radio efficiency vacuum tube amplifiers 1, 2 and 3 and a detector tube 4. These vacuum tubes may be of the usual three element type comprising a grid 5, filament or electron emission element 6 and plate 7. The grid circuit for the tube 1 is provided with an inductance 62 for coupling two antennæ 63 and ground 64. Inductive coupling devices 65, 66 and 67 are also provided for coupling together the tubes 1, 2, 3 and 4 in cascade as shown. The condenser structures 20, 21, 22 and 23 are connected respectively across the inductance 62 and the coupling devices 65, 66 and 67, so as to selectively tune the entire system to a certain frequency. It is of course obvious that the system may be energized by A and B batteries 68 and 69 respectively, while the grids of the amplifier tubes may be maintained at a negative potential by the use of a B battery 70. The output of the detector tube 4 has been shown as supplying a translator 71 which may consist of a telephone or any further system of audio frequency amplifiers. By employing the small adjustable condensers 52 in shunt with the variable condensers the minimum capacitances of the respective variable condensers may be made equal so as to facilitate maintaining the system in resonance to a single frequency throughout its frequency range.

In addition to providing a structure which is rugged and has a high electrical efficiency it may be readily assembled and adjusted to operate a receiving set at maximum efficiency. Thus if in the process of manufacture one of the coupling devices has an inductance which is lower than the other, then the position of the insulating strip 26 of its associated condenser may be adjusted by loosening the screws 29 to position the stator plates 25 so as to slightly increase its maximum capacitance. Dielectric losses are reduced to a minimum since the stator plates 25 are spaced a considerable distance from the insulating strip 26 and are merely supported from two points represented by the brackets 27.

I claim:

1. A device of the class described comprising a frame adapted to be mounted behind an instrument panel, a plurality of variable condenser structures mounted on said

frame, a horizontal shaft parallel to the panel connecting said structures, said frame including a plurality of metallic shielding plates intermediate said condenser structures on more than two sides thereof a control shaft extending normal to said former shaft, and means for operatively connecting said shafts.

2. A device of the class described comprising a frame adapted to be mounted behind an instrument panel, a horizontal shaft journaled to said frame and extending parallel to said panel, a plurality of condenser structures having rotor elements mounted on said shaft, an indicating dial mounted on said shaft between two of said condenser structures and visible thru an aperture in said panel, a control shaft extending thru said panel, and means for operatively connecting said control shaft and first named shaft.

3. A device of the class described comprising a metal frame, a shaft journaled to said frame and grounded to the same, a plurality of condenser structures mounted on said frame, said structures each including a rotary element mounted on said shaft, and a stator element mounted on said frame, the mounting for the stator element including an insulating strip secured at its ends to said frame and forming a cantilever support for said stator intermediate one side thereof whereby the said stator plates are suspended from a single side thereof leaving the remaining sides free from connection with said frame.

4. A device of the class described comprising a metal frame, a shaft journaled to said frame and grounded to the same, a plurality of condenser structures mounted on said frame, said structures each including a rotary element mounted on said shaft, and a stator element mounted on said frame, each of said elements consisting of plate members in parallel spaced relationship, an insulating strip adjustably secured at its ends to said frame adjacent each of said rotary elements, said strip forming a cantilever support at its intermediate portion for said stator element, means whereby said strip may be adjusted laterally, in position on said frame for centering the plate members of said stator element between the plate members of said rotor element said stator element being wholly suspended from a single side thereof leaving the remaining sides free from connection with said frame.

5. A device of the class described comprising a frame having spaced upper and lower horizontal frame bars, a shaft journaled in said frame between said bars and parallel to the same, an indicating drum mounted upon said shaft intermediate the ends of the bars, a rotatable control shaft journaled beneath said indicating drum, the mounting for said control shaft being secured to said lower bars, means for operatively connecting the control shaft and said first mentioned shaft, a plurality of variable condenser structures mounted on said frame on either side of said drum, said condenser structures each including a rotor mounted on said shaft and a stator mounted on said frame.

6. A device of the class described comprising a frame having spaced upper and lower horizontal frame bars, a shaft journaled in said frame between said bars and parallel to the same, an indicating drum mounted upon said shaft intermediate the ends of the bars, a rotatable control shaft journaled beneath said indicating drum, the mounting for said control shaft including a U-shaped portion interconnecting intermediate portions of said lower frame bars, means for operatively connecting the control shaft and said first mentioned shaft, a plurality of variable condenser structures mounted on said frame on either side of said drum, said condenser structures each including a rotor mounted on said shaft and an insulated stator mounted on said frame.

7. A multiple variable condenser system comprising a chassis substantially in the form of a box-like frame divided into two portions, a rotatable shaft journaled in the ends of said chassis and passing longitudinally through both portions of said box-like frame, a plurality of insulated panel members secured to one side of said chassis, a plurality of variable condenser units each including sets of stator and rotor plates disposed in both portions of said box-like frame with the rotor plates thereof carried by said rotatable shaft, the stator plates thereof being supported from one side of said box-like frame on said insulated panel members, and means disposed between the said portions of said box-like frame for controlling the movement of said rotor plates.

8. A multiple variable condenser comprising a metal frame provided with shielding means adapted to be mounted behind an instrument panel, said frame having a plurality of compartments, a variable condenser structure disposed in each compartment, a shaft arranged parallel to the instrument panel and connecting said structure, a control shaft extending through said panel, means for operatively connecting said control shaft and said first named shaft and additional shielding means disposed parallel to said shaft and intermediate said aforementioned shielding means and adapted to shield each of said condenser structures from disturbances arising outside of said metal frame.

9. A multiple condenser structure comprising a plurality of condensers, an instrument panel, a common operating shaft for said condensers, and means for supporting the shaft in a position parallel to the plane of the panel comprising a plurality of metal

plates in some of which said shaft is journaled, whereby said condensers are electrostatically shielded from each other, and means for controlling the rotation of said shaft from the front of said panel.

10. A multiple condenser structure comprising a plurality of condensers, an instrument panel, a common operating shaft for said condensers, and means for supporting the shaft in a position parallel to the plane of the panel comprising a plurality of metal plates disposed at the ends of the condenser structure and intermediate the condensers, said shaft being journalled in the plates located at the ends of the condenser structure, whereby said condensers are electrostatically shielded from each other.

11. A multiple variable condenser structure comprising a panel, a plurality of variable condensers, an actuating shaft for operating all of said condensers simultaneously, and integrally connected means extending normally of the panel and rearwardly therefrom and engaging said shaft to maintain said shaft in a position parallel to the plane of the panel.

In testimony whereof, I have hereunto set my hand.

FREDERICK A. KOLSTER.