Dec. 26, 1933. H. C. FORBES 1,940,854

REACTOR

Filed June 11, 1927 2 Sheets-Sheet 1

Fig. 1.

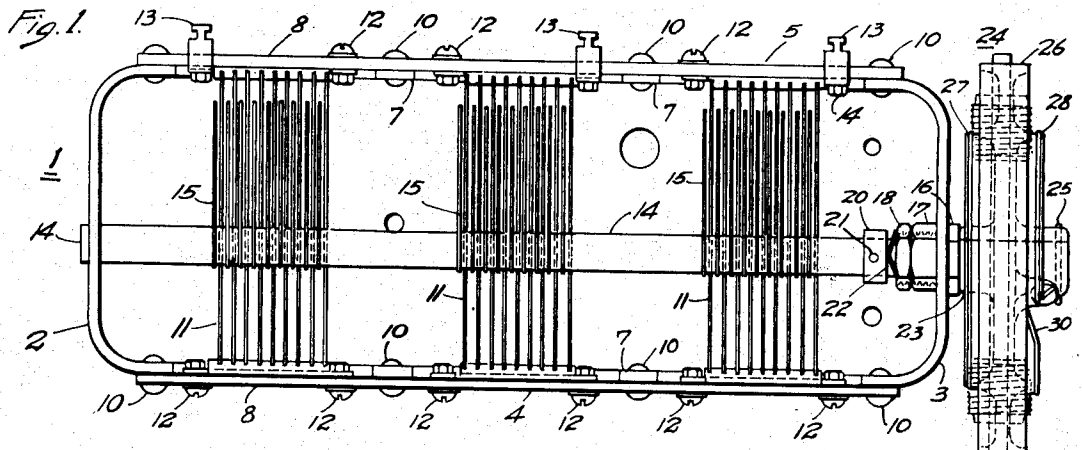


Fig. 2

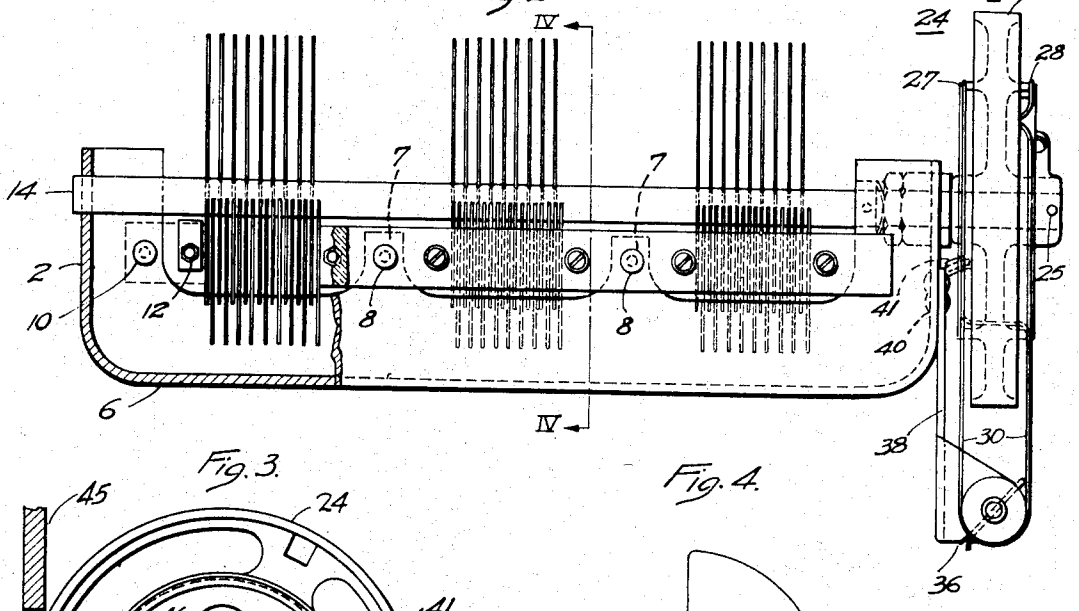


Fig. 3.

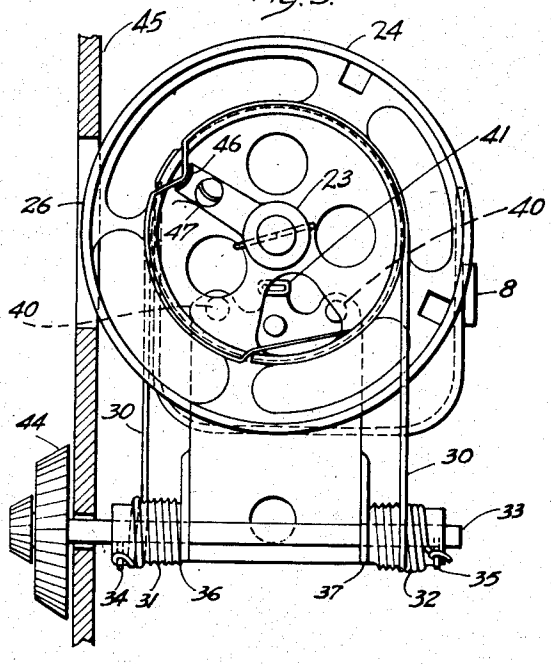
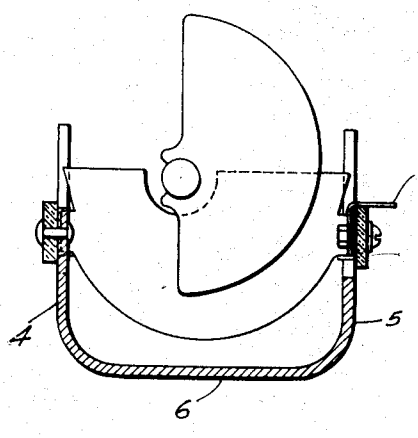


Fig. 4.



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Dec. 26, 1933. H. C. FORBES 1,940,854

REACTOR

Filed June 11, 1927 2 Sheets-Sheet 2

Fig. 5.

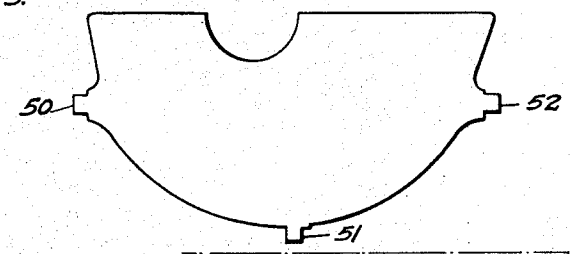


Fig. 6

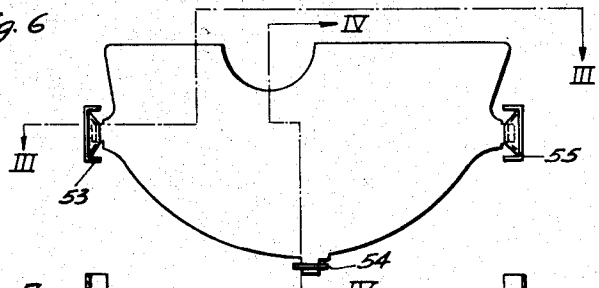


Fig. 7.

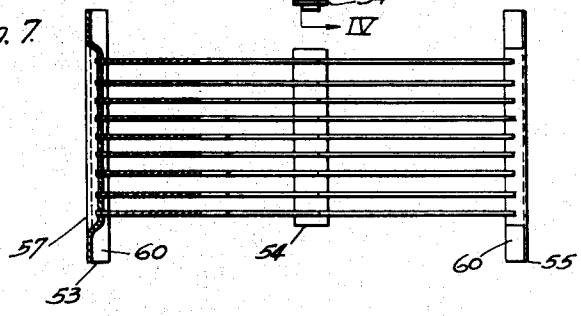


Fig. 8.

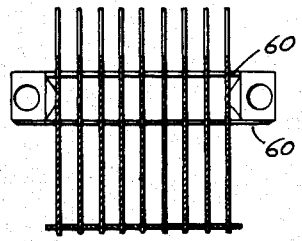


Fig. 9.

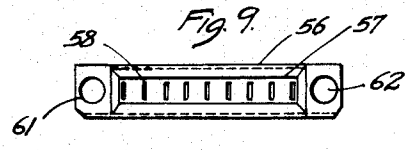


Fig. 10



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UNITED STATES PATENT OFFICE

1,940,854

REACTOR

Henry C. Forbes, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Company, a corporation of Pennsylvania

Application June 11, 1927. Serial No. 198,153

7 Claims. (Cl. 175—41.5)

My invention relates to reactors, and it has particular relation to variable condensers such as are commonly utilized in radio receiving and transmitting equipment.

One object of my invention is to provide a variable condenser that is extremely rigid in construction.

Another object of my invention is to provide a variable condenser that is substantially unaffected by the rough handling to which an assembled radio set is subjected during shipment.

Another object of my invention is to provide a frame, or support, for a "gang" condenser, that is, a condenser having more than one variable component connected to the same shaft, which will remain rigid under all conditions of handling, shipment and usage.

Another object of my invention is to provide a condenser-supporting frame that will be free from unbalanced stresses when complete, and which consequently will not tend to distort during long continued use.

Another object of my invention is to provide a condenser-supporting frame that may be cheaply manufactured, and one that requires only a few machining operations.

Another and more specific object of my invention is to provide an improved form of stator-plate assembly particularly suitable for use in a condenser of the type referred to above.

By far the greatest number of variable condensers utilized in radio transmitting and receiving sets at the present time comprise a plurality of stationary plates, known as the "stator", and a plurality of movable plates, known as the "rotor". The rotor is usually mounted on a shaft extending through bearings carried by end plates, the end plates being held together by a plurality of metallic tie-rods. In condensers of the "low-loss" type, such as disclosed on page 119 of the 1918 edition of Bureau of Standards circular No. 74, the end plates are metallic, and the stator-plates are supported therefrom by a plurality of insulating elements, preferably of quartz or the like. In other, and earlier, condensers the end plates were constructed of a material such as bakelite, and the stator plates were supported therefrom by the tie-rods themselves, insulation between the rotor and stator being provided by the end plates.

With the advent of radio receiving sets employing a plurality of tuned circuits, it has become desirable to adjust the frequency of all of such circuits by a single control device, and to this end the rotors of two or more condensers have been assembled on a single shaft, and arranged in operative relation to the corresponding stators. Such condensers are known in the art as "gang" condensers, and are usually so constructed that the rotor and the frame may be grounded in order to minimize the capacity effect of the operator's hand.

A gang condenser constructed according to the teaching of the prior art, provided with end plates held together by a plurality of tie-rods, does not permanently remain in adjustment. Torsional and other stresses tend to destroy the parallelism of the end plates, and, consequently, the correct spacing between rotor and stator plates cannot be maintained when the device is subjected to rough usage.

I have accordingly, by the present invention, done away with the end-plate and tie-rod construction, and have provided a one-piece condenser frame that is substantially unaffected by usage of the roughest sort. Specifically, my invention contemplates replacing the customary end-plates and tie-rods by an unitary supporting element shaped somewhat like a bath-tub, between the end portions of which the rotor is mounted, and along the sides of which are carried a plurality of insulating strips adapted to support the stator plates.

Among the novel features of my invention are those particularly set forth in the appended claims. The invention in its generic aspect, however, as well as further objects and advantages thereof, will best be understood by reference to the following description of a specific embodiment, taken in connection with the accompanying drawings, in which:

Figure 1 is a top plan view of a preferred embodiment of my invention;

Fig. 2 is a view in elevation;

Fig. 3 is an end elevational view, illustrating a preferred form of actuating means;

Fig. 4 is a cross-sectional view taken along a line corresponding to the line IV—IV of Fig. 2, looking toward the left;

Fig. 5 is a view of a single condenser plate;

Fig. 6 is an end elevational view of a stator-plate assembly, illustrating the manner in which such assembly is held together by a plurality of spacer elements;

Fig. 7 is a plan view of a stator-plate assembly, partly in section;

Fig. 8 is a sectional view taken along a line corresponding to the line IV—IV of Fig. 6;

Figs. 9 and 10 are views of alternative forms of spacer-elements.

Referring specifically to Figs. 1, 2 and 4, my improved condenser comprises a one-piece metallic structure 1 which is shaped somewhat like a bath tub, having end portions 2 and 3, side portions 4 and 5 and a bottom portion 6. The side portions 4 and 5 are each cut away intermediate the ends to below the level of the tops of the said ends, leaving a plurality of upstanding ears 7.

Insulating strips 8 are affixed by means of rivets 10 to the upstanding ears 7 and to the end portions 2 and 3, and extend parallel to the long axis of the structure.

A plurality of groups of stator-assemblies 11 are suspended between and supported by the insulating strips 10 by means of a plurality of small bolts 12 or analogous devices.

Each of the stator-assemblies is provided with a soldering lug 13 which is maintained in electrical contact with the stator plates by means of one of the bolts 12.

The end portion 2 of the frame is provided with an opening through which extends one end of a shaft 14 carrying a plurality of groups 15 of rotor plates, each plate being mounted in a circumferentially milled groove.

The end portion 3 of the frame 1 is provided with an opening sufficiently large to accommodate a threaded bushing 16 which has an axial opening therethrough of a diameter just sufficiently large to accommodate the shaft 14. The bushing 16 is held in position by a nut 17, and a lock-nut 18. A collar 20 is mounted on the shaft adjacent the lock-nut 18, and is held in position by means of a pin 21. A spring-washer 22 encircles the shaft between the collar 20 and the lock-nut 18, and exerts a thrust on the shaft tending to move it toward the end portion 2.

Movement of the shaft under the influence of the spring-washer 22 is prevented by the hub 23 of an operating wheel 24, which is mounted on the end of the shaft extending beyond the bushing 16, and is held in place by a pin 25.

The manner in which the operating wheel 24 is actuated will be more clearly apparent from an inspection of Fig. 3, to which reference should now be made.

The wheel 24 comprises the hub 23, a rim portion 26 on which station call letters, or frequency indicia may be affixed, and two grooved rim portions 27 and 28 having the same diameter, and both being of less diameter than the rim portion 26.

A cord, or cable 30 passes successively around the grooved rim portions 27 and 28, the ends of the cord being wrapped around screw-threaded elements 31 and 32, respectively.

The screw-threaded elements 31 and 32 are carried on opposite ends of a short shaft 33, being held in place thereon by pins 34 and 35, to which the otherwise free ends of the cable 30 may be affixed.

The shaft 33 is mounted in openings provided in bent-out ear portions 36 and 37, which portions are integral with a depending plate 38 that is affixed to the end 3 of the frame by a plurality of bolts or rivets 40.

The upper end of the plate 38 is provided with an additional bent-out lug 41 which is covered with rubber, and cooperates with lugs 42 and 43 carried by the operating wheel to limit the rotation of the wheel in either direction.

A small knob, or dial 44, may be affixed to the end of the shaft 34 adjacent the point where the said shaft extends through an opening in a radio-set panel 45.

A slack-adjusting device, comprising a small plate 46 and a screw 47, is carried by the operating wheel, and serves to prevent the cord 30 from slipping in the grooved rims 27 and 28.

Rotary motion given to the dial 44 causes the cord 30 to wind up on one of the screw-threaded elements, and to unwind at an equivalent rate from the other screw-threaded element. The cord, inasmuch as it is prevented from slipping in the grooved rims, transmits motion to the operating wheel and causes angular motion of the rotor plates with reference to the stator plates.

Inasmuch as the underlying purpose of my invention is to provide a condenser which is more rigid than condensers of the prior art, it is necessary that the individual stator plate assemblies themselves be extremely rigid.

Referring to Fig. 5, each individual stator plate is provided with a plurality of integral lugs 50, 51 and 52. The plates are assembled in spaced relation, as shown in Fig. 3, and are held in position by a plurality of spacer elements 53, 54, and 55 having openings through which extend the lugs on each plate.

The spacer elements 53 and 55 are constructed as shown in Fig. 9, and preferably comprise a flat strip 56 in which has been embossed a cup-shaped depression 57 through the bottom of which a plurality of openings 58 are formed, the said openings being equally spaced apart and of a size just sufficiently large to accommodate the lugs 50 or 52 on the individual plates. The edges 60 of the spacer elements are turned down, giving these elements a U-shape cross-section, and the ends thereof are provided with openings 61 and 62 to accommodate the mounting screws 12.

The bottom spacer element 54 may be constructed as a plain flat strip having equally spaced openings therethrough, as shown in Fig. 10.

In the assembly of each stator plate group the requisite number of plates is held firmly in a jig which spaces them the desired distance apart. The spacer elements 53, 54, and 55 are then slipped over the lugs and a cord may be wrapped around the said elements between the condenser plates in order to hold them temporarily in position.

Melted solder is then allowed to fill the cup-shaped depressions of the spacer elements 53 and 55 successively, which, when it solidifies, unites the plates and the spacer elements into a firm, rigid structure.

The bottom spacer element is then soldered to the plates in an analogous manner, a lesser amount of solder being necessary. It is, of course, feasible, though not necessary, to utilize three spacer elements of the same character as the elements 53 and 55.

After the soldering operation is completed, the cord may be removed, or, if the plates have remained in the jig during the operation, they may be then taken from the jig with full assurance that the predetermined spacing will not later vary.

In order that rough handling shall not cause injury to the stator or rotor groups after assembly, I have made the end plates of each group of material much thicker than the material utilized for the intermediate plates.

In the modification of my invention shown in the drawings, the insulating strips 8 are illustrated as extending from one end of the condenser frame to the other. Although this method of construction is preferable, it is not absolutely necessary, inasmuch as the strips themselves add

substantially nothing to the rigidity of the frame. It is, accordingly, feasible to replace the continuous strip by a plurality of short sections supported from the upstanding ear portions of the frame sides and from the end portions thereof. This modification, being believed obvious, is not illustrated.

I am aware of the fact that it has previously been proposed to construct a condenser having metallic end pieces from which the stator plates are supported on insulating elements. Such a condenser is shown on page 19 and opposite page 318 of the 1918 edition of circular #74 of the Bureau of Standards. The condenser shown in that publication, however, was not rigid. It would be impossible to construct a modern "gang" condenser in the manner illustrated. I have also found that if such a "gang" condenser is constructed in the ordinary way by utilizing a plurality of end elements bolted together by spacer devices, it is very easily disarranged by torsional stresses.

My improved condenser is extremely rigid. After having once been assembled and adjusted, the original spacing between the stator and rotor plates does not appreciably change, no matter how roughly the device may be handled. The spacing between the plates is also not appreciably affected by atmospheric changes, any elongation of the supporting frame being followed by movement of the rotor carrying shaft, since the shaft is free to move in one end of the frame but is not free to move with reference to the other end.

The supporting frame may either be die cast or may be drawn from a flat sheet of deep-drawing steel in one operation, and after drawing, the frame may be trimmed in a second operation and is then ready for punching in accordance with the requirements of the design.

In some respects the drawn frame is more desirable than one which has been die cast. Die casting introduces certain strains which are likely to later be relieved by the punching and boring operations, and cause a certain amount of distortion. The die casting is inherently expensive and must be carefully controlled, in order to avoid warping and crystalline growth which combine to cause distortion.

For these reasons, I have found it preferable to draw the frame, as above mentioned, although I consider either a drawn frame or a die cast frame as coming within the scope of my invention.

Although I have shown only a single specific embodiment of my invention, I am aware that many modifications thereof are possible. My invention is, therefore, not to be limited except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. In a variable condenser, a unitary metallic frame having substantially parallel end elements and substantially parallel sides, insulating elements carried by said sides, and a plurality of stator plates supported between said insulating elements, those portions of said frame adjacent said stator plates being cut away to reduce the capacity between said frame and plates.

2. In a variable condenser, a box-like unitary metallic supporting structure having substantially parallel ends and substantially parallel sides, insulating elements carried by said sides a plurality of groups of stator plates suspended between said insulating elements interiorly of said metallic structure, and a shaft carrying a plurality of rotor elements journalled in said end elements, the sides of said metallic structure being cut away adjacent the points where said stator plates are affixed to said insulating elements.

3. In a variable condenser, a box-like unitary metallic supporting structure having substantially parallel ends and substantially parallel sides, insulating elements carried by said sides, a plurality of groups of stator plates affixed to and carried between said insulating elements, the affixing means for said stator plates also constituting an electrical and mechanical connection between the said plates, and a shaft carrying a plurality of groups of rotor plates journaled in said ends.

4. In a variable condenser, a unitary trough-shape metallic supporting frame having end walls and side walls, insulating elements carried by said side walls, a plurality of stator plates suspended between said insulating elements interiorly of said frame, and a shaft carrying cooperating rotor plates journaled in said end walls.

5. As an article of manufacture, a trough-shape metallic condenser-element supporting frame having integral side, end and bottom portions, the side portions being so modified as to permit the mounting thereon of insulating elements adapted to support condenser-stator-plates.

6. A variable electric condenser comprising a unitary, jointless wrought metallic shell with smooth, rounded wall-connecting edges and corners and integral bottom, side and end walls, a set of stator plates and a set of rotor plates contained within the shell and supported thereby, one of said sets of plates being in electrical connection with said shell.

7. A variable electric condenser comprising a unitary, jointless wrought metallic shell with smooth, rounded wall-connecting edges and corners, and integral bottom, side and end walls, one of said walls having an opening therein, a stator unit in said shell comprising a set of stator plates, an insulating member on the exterior of said shell over said opening, a connecting element securing said stator plates to said insulating member, and a rotor unit in said shell comprising a rotor shaft journaled in said end walls and a set of rotor plates on said shaft, the rotor unit being in electrical connection with the shell.

HENRY C. FORBES.