

July 31, 1934.

D. WALD

1,968,108

VARIABLE CONDENSER

Filed Sept. 7, 1929

Fig. 1.

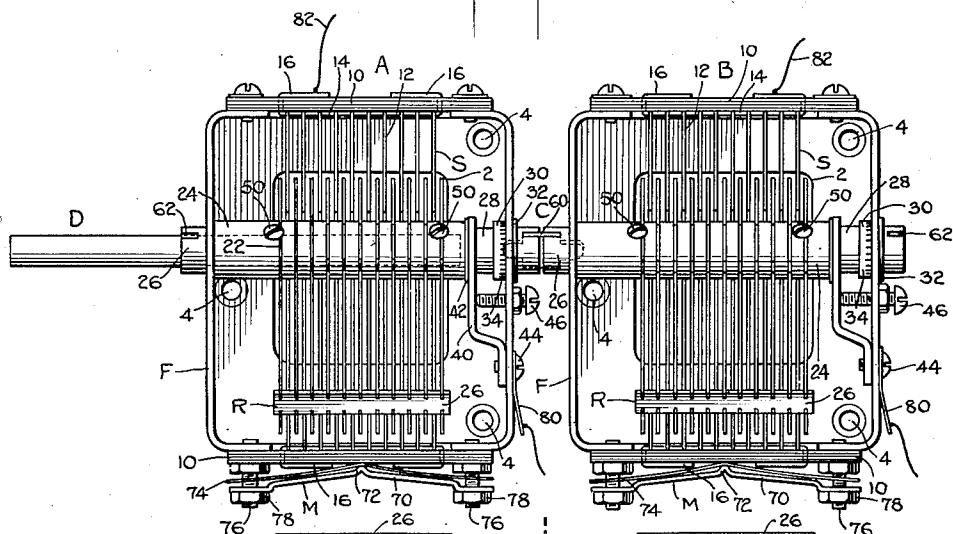


Fig. 2.

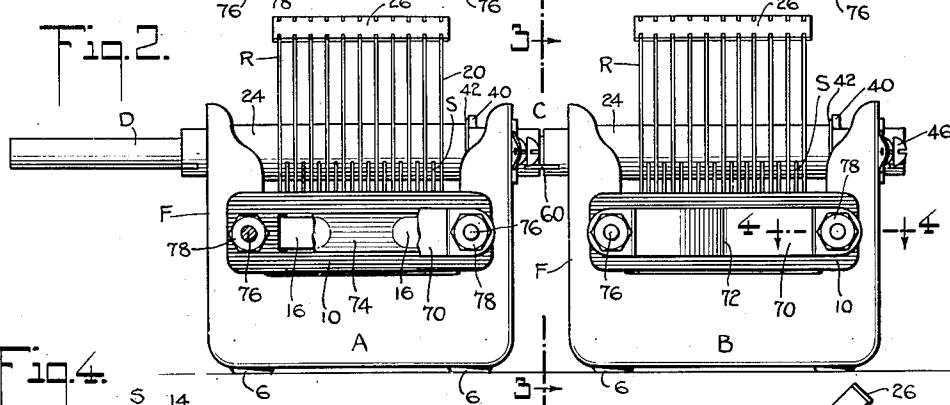


Fig. 4.

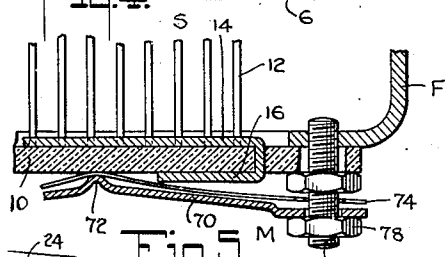


Fig. 5.

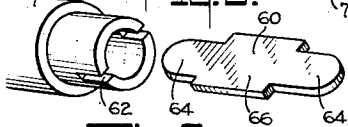


Fig. 6.

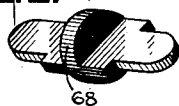
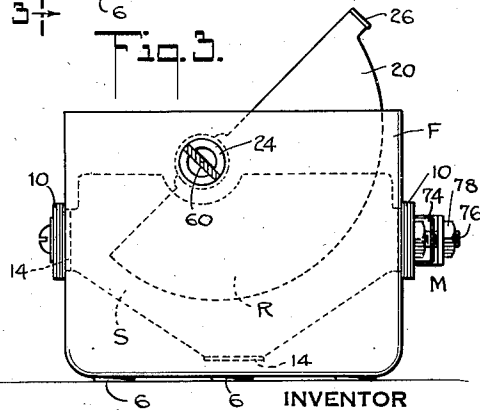


Fig. 3.



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1,968,108

VARIABLE CONDENSER

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Application September 7, 1929, Serial No. 390,951

13 Claims. (Cl. 175—41.5)

This invention relates to variable condensers and more particularly to tuned condensers such as are commonly used in radio receiving sets.

A preferred type of tuning condenser is that employing a metallic frame, which operates to shield the condenser, in which the rotor is journaled and from which the stator is electrically insulated. In fastening the stator to such a condenser it has been customary heretofore to use fastening screws or bolts which necessitated making some portions of the stator relatively heavy and which occupied space which tended to reduce the compactness of the condenser. One object of the present invention relates generally to the support of the stator within the frame, and is to provide a new, simple, economical, and very compact way to attach the stator to the frame of the condenser, which I do broadly by providing the stator with suitably shaped lugs which may bend to attach the stator to the frame. More specifically, the frame is provided with apertured longitudinally extending strips of insulation and the ends of the spacing strips of the stator are inserted in the apertures and bent to rigidly fasten the stator thereto.

Another object of my invention relates generally to the support of the rotor within the condenser frame. The rotor plates are preferably soldered within annular grooves on a condenser shaft of relatively large diameter, in order to obtain rigid support of the rotor plates. The metallic frame of the condenser being a rigid structure, somewhat of a problem is introduced when it is desired to mount the rotor within the frame. For the sake of simplicity I prefer to journal the rotor in bearings provided as near as possible by simply perforating the end plates of the condenser frame. In accordance with the present invention, the end portions of the condenser shaft are reduced in diameter to form journals, one of which is carried directly in one of the end plates of the condenser frame, while the other is carried in a bearing which is force-fitted in an enlarged aperture in the other end plate of the condenser frame. The outer diameter of the bearing is made sufficiently large to facilitate the insertion of the rotor into the frame, and the bearing is subsequently readily fitted to the frame by having its outer periphery ridged so that it may be subsequently force-fitted from the outside toward the inside of the condenser frame without appreciable difficulty.

A further object of the present invention is to provide means to adjust the end thrust and the friction of the condenser motion in order to ob-

tain smooth action, and for these purposes I provide a thrust fork which bears against one of the shoulders formed at the condenser shaft journals and I provide a set screw for adjusting the pressure of the thrust fork against this shoulder.

It is customary to employ uni-control in the radio receiving sets, and to this end to gang a plurality of condensers together. When this is done it is necessary that the minimum capacitance of the condensers be alike, and to this end I provide the condenser with a compensating condenser for adjusting the minimum capacity of the variable condenser. One of the objects of my invention relates to such a compensating condenser and resides in the provision of such a compensating condenser which will be accurately adjustable, simple, and economical in construction, and which may, if desired, be removed or restored to the condenser at will. In accordance with my invention the external surface of the lugs already mentioned as being utilized for attaching the stator to the frame is used as one of the surfaces of the compensating condenser, the other surface being provided by a simple resilient metallic strip adjustably fastened to the frame of the condenser.

Another general object of the present invention relates to the mechanical coupling of a plurality of condensers for ganging them together. One object of my invention resides in the provision of individual self-contained condenser units which may be used by themselves and which may, if desired, be ganged together, thereby making a condenser unit of wide applicability and flexibility in use. Another object of my invention is to make the individual condensers each rigid and permanently adjusted within itself and to provide coupling means between the several condensers which will permit no play or back lash and yet which will permit of a slight disalignment of the condenser shafts so that the individual condensers may be permanently mounted within separate shielded compartments, if desired, and yet operate together smoothly when coupled together. To this end I have devised a coupling arrangement which consists in slotting the ends of the tubular condenser shafts and in utilizing a key between the adjacent ends of the condensers which key fits within the slots with sufficiently close fit to prevent back lash or lost rotational motion and yet which may move slightly transversely of the condenser shafts and thereby permit of a slight disalignment thereof. In order to transmit the

driving motion to the condensers each of the tubular condenser shafts is fitted with set screws so that a driving shaft may be locked to any one of the condensers.

- 5 To the accomplishment of the foregoing and such other objects as will hereinafter appear, my invention consists in the elements and their relation one to the other as hereinafter are more particularly described in the specification and
10 sought to be defined in the claims. The specification is accompanied by drawing in which:

Fig. 1 is a plan view of a pair of ganged condensers embodying the features of my invention;

- 15 Fig. 2 is an elevation thereof;

Fig. 3 is a section taken in the plane of the line 3—3 in Fig. 2;

Fig. 4 is a section taken in the plane of the line 4—4 in Fig. 2;

- 20 Fig. 5 is an enlarged perspective view of the end of a condenser shaft and a coupling key therefor; and

Fig. 6 is a perspective view of insulation coupling key.

- 25 Referring to the drawing, the complete arrangement comprises a first self-contained condenser unit A, a second and similar self-contained condenser unit B, coupling means C therebetween, and a drive shaft D for imparting motion
30 to the condensers A and B. Each of the self-contained condenser units comprises a rigid drawn steel frame F within the end plates of which there is journaled a rotor R and to which there is rigidly fastened a stator S, and ad-
35 justably mounted a minimum capacity compensating condenser M.

- Considering the condenser structure more in detail it will be observed that the condenser
40 frame F is pressed into shape from sheet metal and preferably rather heavy sheet steel, and also is trough or channel shaped in every dimension and therefore is exceedingly rigid in structure. A large portion of the base is cut away
45 as at 2 to conserve metal and to lighten the condenser and the remaining metal is provided with apertures 4 by means of which the condenser frame may be mounted on any suitable foundation. The metal is preferably depressed at these
50 holes to form protuberances 6 and these are preferably three in number in order to permit the condenser to seat itself rigidly upon the surface to which it is fastened.

- The sides of the frame carry longitudinally extending strips of insulation 10 which are fast-
55 ened by screws to the frame. This insulation may be fibre or other suitable rigid insulation. The stator S consists of a plurality of parallel plates 12 which are fixed to and properly spaced and held in parallel relation by spacing strips
60 14. In accordance with the present invention these spacing strips may be relatively light, say slightly thicker than the condenser plates themselves, and the ends thereof are suitably shaped and bent to form fastening lugs 16 which are
65 inserted in apertures preferably taking the form of transverse slots in the insulation strips 10, thereby locking the stator to the insulation strips in an exceedingly compact and economical manner, without necessitating the use of fastening
70 screws or bolts of any kind.

- The rotor R consists of movable plates 20 which are soldered in proper parallel relation within annular grooves 22 of a relatively large diameter rotor shaft 24, the large diameter of the rotor
75 shaft serving to lend rigidity to the shaft and to

the support of the movable plates 20. The large radius end of the movable plates may be tied together with a spacing strip 26. The end parts of the condenser shaft 24 are reduced to form the journals 26 and 28. Journal 26 is carried
80 directly in an aperture in the end plate of the frame F, while journal 28 is carried in a bearing 30 which is force-fitted into an enlarged aperture in the corresponding end plate of the
85 frame F. In this manner the assembled rotor may readily be inserted into the condenser frame for it is merely necessary to first insert the journal 28 within the enlarged opening in the frame, thereafter to move the rotor in the other direction
90 until the journal 26 is fitted within its bearing, and finally to force-fit the bearing 30 to the frame F over the end of the journal 28, moving it from the outside toward the inside of the frame until stopped by a flange 32 thereon. The outer
95 periphery of the bearing 30 is preferably provided with corrugations or ridges 34, thereby making it comparatively easy to insert the bearing into place and at the same time increasing the strength of the resulting force-fit.

Journal 28 is carried inward further than journal 26 so as to accommodate a preferably open ended thrust fork 40. The forked end of the member 40 surrounds journal 28 and bears
100 against a thin steel washer 42 which, in turn, bears against the shoulder of the journal. Thrust fork 40 is fastened to the end plate of the frame F by means of a screw 44, and the pressure thereof against the rotor shaft is adjustable by means of a set screw 46.

It will be noted that the longitudinal position-
110 ing of the rotor plates is determined by the shoulder of the journal 26, and the centering of the rotor and stator plates is accomplished by adjusting the longitudinal relation of the insulation strips 10 to the frame F, the holes in the
115 insulation strips 10 being either slotted or enlarged to permit of this adjustment, as is best shown in Fig. 4.

The individual condenser units as so far described are self-contained units which may use-
120 fully be employed as such. Each of the tubular condenser shafts 24 are provided with set screws 50 by means of which the condenser shaft may be locked to any appropriate drive shaft D for imparting movement to the condenser. Obviously, if several condensers are to be ganged together and are to be kept in perfect alinement it is merely necessary to use a drive shaft D of sufficient length to extend through the desired number of condensers and to lock each of the
130 condensers to the individual condenser shafts. However, as a practical matter, I find it desirable to arrange ganged condensers in such a manner as will permit of a slight disalignment of the condenser shafts, for this frequently occurs when
135 mounting the condensers upon their foundation and particularly when the condensers are mounted within individual shielded compartments. At the same time it is essential that there be no back lash or lost motion between the condensers.
140

To fulfill the foregoing requirements I have devised the coupling means, generally designated C, which comprises merely a key 60, best shown in Fig. 5, arranged to fit in slots 62 cut in the journal ends of the condenser shafts. The key
145 60 consists of reduced end portions 64 which are rounded and sufficiently small to fit within the bore of the condenser shafts, and of an enlarged intermediate portion 66 which fits within the slots 62 in the ends of the condenser shafts. If desired,
150

the key 60 may be tapered slightly in thickness from the middle toward the ends, but whether or not this is done, the arrangement is such that the key fits the slots closely and therefore prevents lost motion or back lash and at the same time a slight transverse movement of the key is permitted which makes it possible to successfully operate the condensers even though their shafts be slightly disaligned.

Ordinarily, when condensers are ganged together the rotors are electrically connected, but in special cases a circuit may be encountered in which the rotors are not to be at like potentials. In such case it is merely necessary to substitute for the flat metallic key illustrated in Fig. 5, a key made of insulating material and provided with a spacer disc 68 such as is illustrated in Fig. 6 of the drawing. This key connects the condensers together mechanically just as before, but insulates them electrically.

When ganged condensers are employed it is obvious that as many condensers may be ganged together as desired and that the drive shaft D may be applied to which ever condenser is found most convenient. It is also obvious that for use by amateurs and experimenters the present condenser arrangement has the advantage that the ganged condensers may be disassembled and used as individual condensers whenever desired.

It is frequently desirable to adjust the minimum capacitance of a variable condenser and this is particularly true when condensers are ganged together for in such case their minimum capacitances should preferably be equal. To make this adjustment possible I provide the minimum capacity compensating condensers M. As may readily be seen from the drawing, one surface of the compensating condenser consists of the external surface of the lugs 16 which serve to attach the stator to the insulation strips 10. The other surface of the compensating condenser consists simply of a metallic strip 70 which preferably is made of resilient material and is centrally indented as at 72. The two condenser surfaces are preferably separated by a thin sheet of mica or other suitable insulation 74. The insulation 74 and the metallic strip 70 are both supported on screws 76 which are also the screws which serve to fix the insulation strip 10 to the frame F. The outer nuts 78 on the screws 76 permit of a very gradual adjustment of the capacitance of the compensating condenser M and the indentation of the strip 72 makes it possible to adjust the capacitance of either end of the compensating condenser independently, thereby making the adjustment still more effective. It will be evident that the compensating condenser constructed in accordance with my invention is an exceedingly simple and economical device, and to a very considerable extent utilizes parts already necessitated by the condenser structure, and dispenses with special electrical connections between the rotor and stator and the compensating condenser surfaces. It is also apparent that if desired compensating condensers may be mounted on both sides of the condenser instead of merely on one side, though I find that the latter arrangement gives ample capacity variation and is preferable. It further will be apparent that if desired the entire compensating condenser may readily be removed by simply releasing the nuts 78 and removing the metallic strip 70 and the insulation strip 74, and that it may equally readily be replaced when desired.

Electrical connection is made with the rotor

of the condenser preferably through a soldering lug 80 which is held by the screw 44 which, in turn, holds the thrust fork 40, thereby obtaining a direct electrical contact with the rotor. Further connection is made through the condenser shaft bearing and the entire frame of the condenser. Electrical connection is made with the stator of the condenser preferably by soldering to one of the lugs 16, thereby dispensing with the use of an additional soldering lug and illustrating one more advantageous function for my novel method of attaching the stator to the insulation strips of the frame. Obviously, when compensating condensers are used the stator connection is made to one of the lugs 16 on the opposite side of the condenser, as is illustrated at 82.

It will be apparent from the foregoing detailed description of one form of condenser embodying my invention that a compact and rigid condenser unit is obtained which is particularly well adapted for ganging either with aligned or slightly disaligned condenser shafts. Also, that the stator is affixed to the frame in an economical and rigid manner without necessitating the use of screws or bolts of any kind. The stator connecting means serve additionally as soldering lugs and as one of the surfaces of a compensating condenser. The rotor is of rigid construction and permanently fitted within the frame in a simple manner while the friction and thrust of the condenser is adjustable to any value desired.

It will be apparent that while I have shown and described my invention in the preferred form, many changes and modifications may be made in the structure disclosed without departing from the spirit of the invention, defined in the following claims.

I claim:

1. A variable condenser comprising a stator and a frame, said frame including a strip of insulation for the support of said stator, said stator including suitably bent lugs forming the sole means for attaching the stator directly to said insulation strip.

2. A variable condenser comprising a stator and a frame, said frame including longitudinally extending strips of insulation for the support of said stator, said stator including a plurality of plates held in parallel relation by spacing strips, the ends of said spacing strips being suitably shaped and bent to form lugs constituting the sole means for attaching said stator directly to said insulation strips.

3. A variable condenser comprising a stator and a frame, said frame including an apertured strip of insulation for supporting said stator, said stator including a plurality of plates held by a spacing strip the ends of which are suitably shaped and bent to form fastening lugs inserted through the apertures in said insulation strip and then bent over to rigidly attach the stator to the insulation strip.

4. A variable condenser comprising a rotor, a stator, and a frame, said frame including bearings for supporting said rotor and transversely slotted longitudinally extending strips of insulation for supporting said stator, said stator including a plurality of plates held in parallel relation by spacing strips, the ends of which are suitably shaped and bent to form fastening lugs inserted through the slots in said insulation strips and then bent over to rigidly attach the stator to the insulation strips without necessitating the use of fastening screws.

5. A variable condenser comprising a rotor, a stator, and a frame, said frame including bearings for supporting said rotor and transversely slotted longitudinally extending strips of insulation for supporting said stator, said stator including a plurality of plates held in parallel relation by spacing strips the ends of which are suitably shaped and bent to form fastening lugs inserted through the slots in said insulation strips and then bent over to rigidly attach the stator to the insulation strips without necessitating the use of fastening screws, the external bent over surface of the lugs serving also as soldering lugs for connecting the stator of the condenser electrically in circuit.

6. A variable condenser comprising a stator, a frame, and a minimum capacity compensating condenser, said frame including a strip of insulation for supporting said stator, said stator including suitably shaped and bent fastening lugs to attach the stator to the strip, and said compensating condenser comprising the external surface of the lugs for one condenser surface.

7. A variable condenser comprising a rotor, a stator, a frame, and a minimum capacity compensating condenser, said frame including bearings for supporting said rotor and strips of insulation for supporting said stator, said stator including a plurality of plates and suitably shaped and bent fastening lugs to attach the stator to the strips, said compensating condenser comprising the external surface of the lugs for one condenser surface, and a strip of metal adjustably fastened to the frame for the other condenser surface.

8. A variably condenser comprising a rotor, a stator, a frame, and a minimum capacity compensating condenser, said frame including bearings for supporting said rotor and apertured strips of insulation for supporting said stator, said stator including a plurality of plates held in parallel relation by spacing strips the ends of which are suitably shaped and bent to form fastening lugs inserted through the apertures in said insulation strips and bent over to attach the stator to the strips without necessitating the use of fastening screws, said compensating condenser comprising the external surface of the lugs for one condenser surface, a resilient strip of metal adjustably fastened to the frame for the other condenser surface, and a thin sheet of insulation therebetween.

9. A variable condenser comprising a rotor, a stator, a frame, and a minimum capacity compensating condenser, said frame including bearings for supporting said rotor and transversely slotted longitudinally extending strips of insulation for supporting said stator, said stator including a plurality of plates held in parallel relation by spacing strips the ends of which are suitably shaped and bent to form fastening lugs inserted through the slots in said insulation strips and bent over to attach the stator to the strips without necessitating the use of fastening screws, comprising the said compensating condenser external surface of the lugs for one condenser surface, a centrally indented resilient strip of metal adjustably fastened to the frame for the other condenser surface, and a thin sheet of insulation therebetween.

10. A variable condenser comprising a rotor, a stator, a frame, and a minimum capacity compensating condenser, said frame including bearings for supporting said rotor and a transversely

slotted longitudinally extending strip of insulation fixed to said frame by projecting screws, said stator including a plurality of plates held in parallel relation by a spacing strip the ends of which are suitably shaped and bent to form fastening lugs inserted through the slots in said insulation strip and bent over to attach the stator to the strip, said compensating condenser comprising the external surface of the lugs for one condenser surface, a centrally indented resilient strip of metal adjustably fastened to the frame by means of the aforesaid screws for the other condenser surface, and a thin sheet of insulation therebetween.

11. A variable condenser comprising a rigid metallic frame having end plates, a rotor consisting of rotor plates mounted on a tubular rotor shaft, said rotor shaft having end portions of reduced diameter to form journals for the rotor, one of said end plates having an aperture closely fitting one of said journals and bearing the same for rotation, the other end plate having an enlarged or oversized aperture, and a bearing force-fitted therein from the outside face of the plate, the other journal being carried in said bearing in the enlarged aperture, said aperture having a diameter sufficient to facilitate insertion of the rotor into the frame before the bearing is forced in place.

12. A variable condenser comprising a rigid metallic frame having end plates, a stator attached thereto, and insulated therefrom, a rotor consisting of rotor plates mounted on a tubular rotor shaft, said rotor shaft having end portions of reduced diameter to form journals for the rotor, one of said end plates having an aperture closely fitting one of said journals and bearing the same for rotation, the other end plate having an enlarged or over-size aperture and a bearing the outer surface of which is longitudinally ridged and force-fitted into the aperture from the outside face of the end plate, the other journal being carried in said bearing, the outer diameter of the bearing and consequently of the enlarged aperture being sufficient to facilitate insertion of the rotor into the frame before the bearing is forced into place.

13. A variable condenser comprising a rigid metallic frame having end plates, a stator attached thereto and insulated therefrom, a rotor consisting of rotor plates mounted on a tubular rotor shaft, said rotor shaft having end portions of reduced diameter to form journals for the rotor, one of said end plates having an aperture closely fitting one of said journals and bearing the same for rotation, the other end plate having an enlarged or oversize aperture, and a bearing force-fitted therein from the outside face of the plate, the other journal being carried in said bearing, the length of the latter journal and the outer diameter of the bearing and consequently of the enlarged aperture being sufficient to facilitate insertion of the rotor into the frame before the bearing is forced into place, and an open ended thrust fork for axially locating the condenser shaft in the bearings and for adjusting the friction of the condenser movement, said thrust fork being mounted on one of the end plates of the condenser and arranged to bear against the adjacent shoulder of the condenser shaft with a pressure determined by an adjustable set screw.

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