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H. H. IDE

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VARIABLE CONDENSER

Filed Feb. 4, 1925

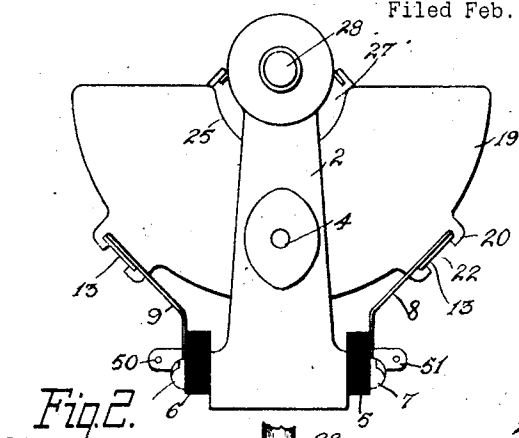


Fig. 2.

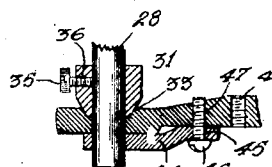


Fig. 6.

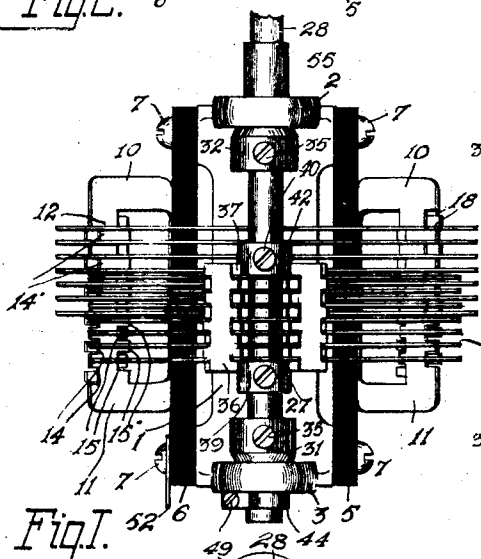


Fig. 1.

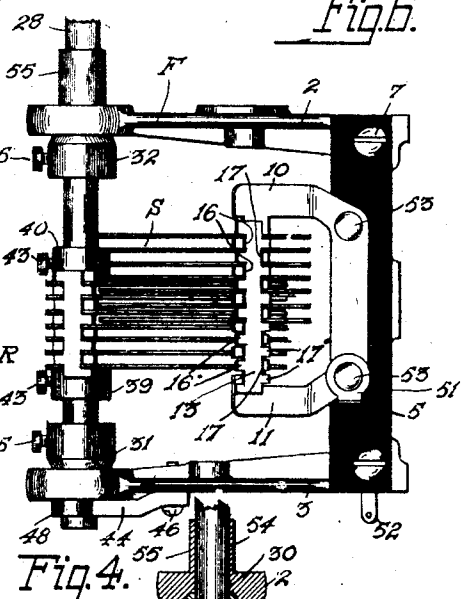


Fig. 4.

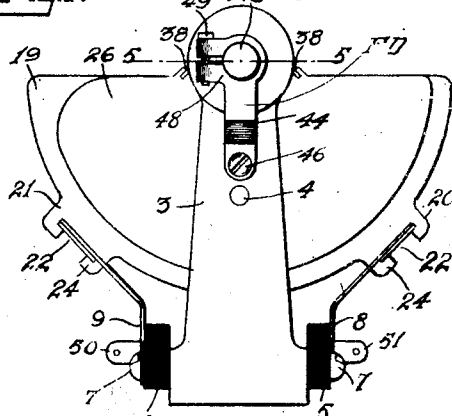


Fig. 3.

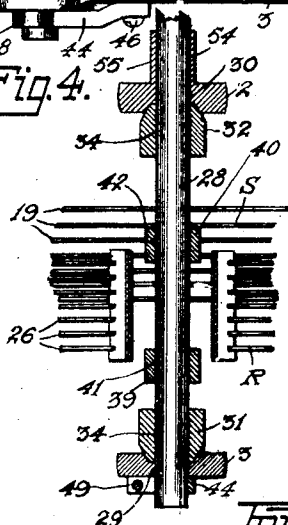


Fig. 5.

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## UNITED STATES PATENT OFFICE.

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## VARIABLE CONDENSER.

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My invention relates to condensers and has to do more particularly with variable condensers with an air dielectric, such as are now in general use in radio sets; and is of the type in which the rotary plate element is operatively located in position relative to the fixed plates or stator element so that the capacity of the condenser may be varied in the desired manner. An object of my invention is the provision of an improved variable condenser which is provided with novel features of construction which produce a condenser of simple construction and at the same time provides an improved condenser which is most efficient in its operation and is of the low loss type.

A feature of my invention is the means provided and the manner in which I support and space the plates of the rotor element to form a unit structure and, also, the plates of the fixed or stator element to form a unit structure.

Another feature of my invention is the provision of simple and dependable frictional means for maintaining the rotor element in its adjusted position relative to the fixed or stator element of my condenser.

A further feature of my invention is the provision of means whereby the capacity of the condenser may be varied by longitudinally sliding the rotor element on its supporting shaft.

The above features, as well as others, will be more clearly and specifically pointed out in the ensuing specification and appended claims, and for clearer understanding of the same reference may be had to the accompanying drawing, in which like reference characters in the several views denote like parts and in which:

Fig. 1 is an elevation of the condenser of my invention;

Fig. 2 is a top view of Fig. 1;

Fig. 3 is a bottom view of Fig. 1;

Fig. 4 is a right side view of Fig. 1;

Fig. 5 is a sectional view along the line 5-5 in Fig. 3;

Fig. 6 is a fragmentary sectional view of the frictional means for holding the rotor element in its adjusted position in relation to the stator element.

The variable condenser of my invention comprises in general a U-shaped frame F, a stator element S, a rotor element R opera-

tively associated with the stator element S, and a friction element FD.

Referring now in detail to the different parts of my invention the frame F is made of any suitable material and consists of the base 1 and arms 2 and 3 which are integrally formed parts of the base 1 and are at opposite ends and at right angles to the said base 1. The base 1 and the arms 2 and 3 each have threaded orifices 4 to receive screws (not shown) to hold the condenser in proper relation to the panel and base board of the radio set, of which it is a part. Insulating members 5 and 6, formed of a suitable non-conducting material, are attached to the frame F by means of screws 7 which pass through suitable orifices in the members 5 and 6 and have screw-threaded engagement with orifices (not shown) in the frame F.

Secured, by any suitable means, to the insulating members 5 and 6 are supporting members 8 and 9 having integrally formed arms 10 and 11 for supporting the spacing means. The arms 10 and 11 extend upwardly and outwardly from the insulating members 5 and 6 so as to be in the proper position to support the stator element S. The arms 10 and 11 are joined by an integrally formed bridging member 12 which is used for the purpose of supporting and spacing the plates of the stator element. A metal bridging strip 13 is used in association with the bridging member 12, integrally formed with the arms 10 and 11 of the supporting members 8 and 9, for spacing and supporting the plates of the stator element, as will now be described. A plurality of notches 14 and 15 are provided in the sides of the bridging member 12, the said notches 14 and 15 being in staggered relation to each other. A plurality of notches 16 and 17 are provided in the sides of the bridging strip 13, the said notches 16 and 17 are also in staggered relationship to each other. The portions 14' and 15' of the bridging member 12 and the portions 16' and 17' of the bridging strip 13 are slightly smaller in width than the width of the notches 14 and 15, 16 and 17 in the respective bridging member and bridging strip 12 and 13 so that when the bridging members 12 and 13 are placed with their faces against each other the portions 14' and 15' of the bridging member

12 will position themselves over the notches 16 and 17 of the bridging strip 13, and the portions 16' and 17' of the bridging strip 13 will position themselves under the notches 14 and 15 of the bridging member 12. Due to the fact that the portions 14' and 15', 16' and 17' are slightly smaller in width than the width of the notches 14 and 15, 16 and 17 in the respective bridging member and bridging strip 12 and 13, a plurality of notches 18 are formed opposite each other to form the proper spacing between the stator plates.

The stator element S includes a plurality of semicircular plates 19 formed of suitable material. Each plate 19 of the stator element S is formed with two sets of projecting ears 20 and 21 which are provided with recesses 22 (in the stator plates 19). To assemble the stator element S a predetermined number of plates 19, the number of plates 19 being dependent upon the rated capacity of the condenser, are placed in a suitable fixture to properly space the plates 19 and properly align the said plates 19. A pair of bridging members and bridging strips 12 and 13 are now matched together as described above to form the slots 18 which are of a width of about the thickness of the plates 19. The matched bridging members 12 and 13 are now placed in the recesses 22 in portions 20 and 21 of the aligned plates, with the body portions of the bridging members and bridging strips 12 and 13 between the notches 14 and 15, 16 and 17 of the said bridging members 12 and 13 (which are of a size to fit in the recesses 22 of the plates 19) resting in the said slots or recesses 22 and a portion of the ears 20 and 21 adjacent to the said slots extending into slots 18, the depth of the slots 22 is such as to permit the edges 24 of the plates 19 to extend a small way beyond the face of the bridging strip 13 when the bridging members 12 and 13 rest in the slots 22. Heat and a suitable flux solder is now applied to the bridging members 12 and 13 when in position in the slot 22 as just described causing the solder to flow between the bridging members 12 and 13 and in the notches 14 and 15 of bridging member 12 which serve as pockets to receive the molten solder and provide the required amount of solder to flow into the slots 18 to secure the plates 19 to the bridging members 12 and 13. When this process has been carried out with the slots 22 on the opposite side of the plates 19 the said plates 19 of the stator element S are in proper spaced relation to each other and form a unit structure that is of substantial construction and at all times maintains the respective plates 19 of the stator element S properly spaced. The plates of the stator element are formed with arcuate shaped recesses 25 for purposes as will be presently described.

Referring now to the rotor element R of my invention, it comprises a plurality of semi-circular plates 26 made of suitable material. Each of said plates 26 is provided with an extended portion 27 which is provided with an orifice for receiving the shaft 28. The shaft 28 is supported in orifices 29 and 30 in the ends of the arms 2 and 3 of the frame F by means of bearings 31 and 32. The bearings 31 and 32 are made of any suitable material and are provided with conical portions 33, as shown in Fig. 4 which fit in shallow conical countersunk portions in the arms 2 and 3 of the U-shaped frame F, the bearings 31 and 32 are provided with orifices 34 through which the shaft 29 is passed and are held secured to the shaft 29 by means of set screws 35 which have screw threaded engagement with tapped orifices 36. The bearings 31 and 32 not only provide a bearing surface for the shaft 29, but by reason of the set screw 35 in association with the conical portion 33 prevents the longitudinal movement of the shaft 29 and the consequent displacement of the rotor plates in regard to the stator plates 19. A pair of notches, similar to notches 22 in the stator plates 19, are supplied in the extension 27 of the rotor plates 26. To assemble the rotor element R a predetermined number of plates 26 are placed in a suitable fixture and a pair of bridging strips 36 and 37, similar in detail to the bridging members 12 and 13 in the stator element S, are placed in each slot 38, which slots are in alignment when placed in the fixture to permit the same to receive the bridging strips 36 and 37. The plates 26 and bridging strips 36 and 37 are now secured by means of heat and flux solder as described in connection with the assembly of the stator element S and therefore a further description is thought unnecessary. The outside edges of the two outer bridging strips are also secured to collars 39 and 40 by means of solder thus making the plates 26 and the collars 39 and 40 a unit structure. The collars 39 and 40 are provided with orifices 41 and 42 which are slightly larger than the diameter of the shaft 29 to permit the sliding of said collars 39 and 40 upon the shaft 28. The collars 39 and 40 are also provided with tapped orifices (not shown) to receive set screws 43 for the purpose of fastening the collars 39 and 40 to the shaft 28 to hold the rotor element R in its adjusted position in relation to the shaft and to permit and cause the rotor element to revolve with the shaft 28 when the said shaft 28 is revolved.

To maintain the rotor element R in any of its adjusted positions in relation to the stator element S, I provide frictional means composed of an arm 44 which has its one end provided with an orifice 45 for receiving a screw 46 having screw threaded engagement

with a tapped orifice 47 in the arm 3 of the frame F to hold the said arm 44 in place. The other end of the arm 44 is formed into an adjustable clamping member 48 and is adapted to fit over the end of the shaft 28. A screw 49 is provided which extends through an opening in one of the extending ends of the clamping member and has screw-threaded engagement with a suitably tapped orifice in the other extending end of said clamping member 48. The member 48 is so formed that its extending ends are slightly separated from each other and when the adjustable screw 49 is rotated in a certain direction the said ends are drawn toward one another to clamp the arm 44 in position on the cylindrical member or shaft 28 but not so tight that the shaft 28 cannot rotate. The extending ends of the arm 44 are flexible enough to permit this adjustment. By rotating the adjustable screw 49 any degree of frictional engagement may be obtained between the clamping end of the arm 44 and the rotatable shaft 28.

Contact clips are provided for electrical connections; 50 and 51 are the contact clips for the stator element S and 52 is the contact clip for the rotor element R, the connection being through the screw 7 which enters into a tapped orifice in the base 1 of the metal frame F.

I have given a detailed construction of the different elements of my condenser and I will now describe them in operative relation to each other.

The stator element S, which is composed of the plates 19 and the spacing and supporting members 8 and 9 to form a unit structure; as has been described, is fastened by any suitable means such as rivets 53, to the insulating and supporting members 5 and 6, which are fastened to the frame F by means of the screws 7.

The rotatable shaft 28 is inserted in the orifice 54, of the integrally formed extension member 55 of the arm 2, the orifice 30 in the arm 2, the orifice 34 in the bearing 32, the orifice 42 in the collar 40, the orifices in the plates 26 of the rotor element R, the orifice 41 of the collar 39, the orifice 34 of the bearing 31, the orifice 29 in the arm 3 of the U-shaped frame F, and between the clamping extending arms 48 of the friction device FD. The set screws 35 in the bearings are tightened until the bearings 31 and 32 revolve when the shaft 28 is revolved. The bearings are inserted as far as possible into the orifices 29 and 30 in the arms 2 and 3 before they are tightened by means of the set screws 35, to prevent the longitudinal movement of the shaft 28 and to provide a bearing surface. The plates 26 and the spacing and supporting members 36 and 37 which compose a unit structure as has been described are then adjusted in the

proper position on the shaft 28 to make the condenser of the proper capacity. This is done as follows:

The plates 26 that form the rotor element are revolved about the shaft 28 until every part of each plate 26 is above every part of each plate 19 of the stator element S. The rotor element R can then be slid longitudinally along the shaft 28 without interfering or coming into contact with any parts of the stator element. The maximum capacity of the condenser is determined by the number of plates of the rotor element R that are located in the air spaces between the plates 19 of the stator element S. It can be readily understood that in a condenser of this type, which has an adjustable rotor element, that different capacities may be obtained simply by sliding the rotor element R longitudinally on the shaft 28 so that when the shaft is revolved, as will be described presently, any predetermined number of rotor plates 26 will be located between the plates 19 of the stator element S. When the proper position of the rotor element is obtained set screws 43, in the collars 39 and 40 of the unit structure rotor element R, will be screwed into the orifices provided in the collars 39 and 40 to come into contact with the shaft 28. This contact serves the double purpose of holding the rotor element R in its adjusted position to prevent longitudinal movement of the said rotor element R and also causes the rotor element R to revolve as a whole with the shaft 28 when the said shaft 28 revolves. The rotation of the plates 26 will cause the plates 26, to rise above the tops of the plates 19 of the stator element S, thus changing the area of the rotor plates 26 that are located between the plates 19 of the stator element S and consequently a change in the capacity of the condenser. All of which will be easily discerned by one familiar with the art.

In radio circuits it is desirable to have a condenser of just the size to furnish the maximum capacity necessary to tune the desired circuit. This means that the tuning is spread out over the whole 180 degrees of movement of the condenser, thus further separating the stations on the dial. I accomplish this result by having the rotor element of my condenser adjustable longitudinally so that just the necessary number of rotor plates will appear between the stator plates to provide the desired maximum capacity, when the rotor plates are entirely in between the stator plates. The dial may then be rotated to change the capacity, from the maximum set value to zero.

After the rotor element R has been properly positioned the adjusting screw 49 of the friction device FD is adjusted to clamp the extension members, of the clamping end

48 of the arm 44, tighter upon the shaft 28 to cause the shaft and parts associated with it to remain in any of its adjusted positions as has been described previously.

5 While I have described and illustrated a particular embodiment of my invention, it is to be understood that I do not wish to be limited to the exact structure as shown and described, as many changes and modifications will readily suggest themselves. Therefore, it is to be understood that I intend to cover all that which may come within the scope and spirit of the appended claims.

15 Having described my invention what I claim as new and desire to secure by Letters Patent is:

1. A device of the character described including a mounting frame, a pair of insulation strips secured to said mounting frame, a plurality of stationary plates and bridging members holding said plates in spaced relation, means integral with certain of said bridging members for securing said stationary plates to said insulation strips, a plurality of rotary plates and bridging members holding said rotary plates in spaced relation, a shaft for rotating said rotary plates, and means for adjusting said rotary plates on said shaft so that different members of said rotary plates may be inter-leaved with said stationary plates.

2. A device of the character described including a mounting frame, a pair of insulation strips secured to said mounting frame, a plurality of stationary plates and bridging members holding said plates in spaced relation, means integral with certain of said bridging members for securing said stationary plates to said insulation strips, a plurality of rotary plates and bridging members holding said rotary plates in spaced relation, a shaft for rotating said rotary plates, said rotary plates constituting a unit and being adjustable longitudinally on said shaft with respect to said stationary plates.

3. A condenser provided with a mounting frame and a pair of insulation strips secured thereto, a rotatable shaft extending through the free ends of said frame, a stationary element comprising a plurality of plates and members for holding said plates in spaced relation to form said stationary element, certain of said members providing means for securing said stationary element to said frame, a rotary element comprising a plurality of plates and bridging members for holding said plates in spaced relation to form said rotary element, said rotary element being adjustable on said shaft to provide a number of maximum capacities, said rotary element being also adjustable from a substantially zero capacity to said different maximum capacities.

4. A condenser of the character described

including a U-shaped frame, stationary plates and bridging members for spacing said plates, means integrally formed with certain of said bridging members attached to insulation strips secured to the intermediate portion of said frame, a rotary shaft extending through the free ends of said frame, and a rotary unit adjustable longitudinally on said shaft.

5. A condenser of the character described including a stationary element and a rotary element, said stationary element comprising a plurality of plates, bridging members for holding said plates together, said rotary element likewise comprising a plurality of plates, bridging members for holding said rotor plates together, a U-shaped frame, means integrally formed with certain of first said bridged members for attaching said stationary element to said frame, a shaft for said rotary element, and means for longitudinally adjusting said rotary element on said shaft so that different numbers of said rotary plates may be inter-leaved with said stationary plates.

6. A device of the character described including a U-shaped mounting frame, a rotary shaft extending through the free end of said frame, a rotor element comprising a plurality of plates supported upon said shaft and adjustable longitudinally thereon, bearings for said shaft in said frame, adjustable members on said shaft contacting said bearings, and a split member attached to said frame and substantially surrounding said shaft, forming positioning means therefor.

7. A device of the character described including a U-shaped mounting frame, a shaft extending through the free ends of said frame, a rotor element comprising a plurality of plates supported upon said shaft and adjustable longitudinally thereon, bearings for said shaft in said frame, adjustable members on said shaft contacting said bearings to prevent longitudinal movement of said shaft, and a member attached to said frame substantially encircling said shaft and being adjustable to regulate the friction between said member and said shaft.

8. A device of the character described including a U-shaped mounting frame, a shaft extending through the free ends of said frame, conical bearings for said shaft in said frame, conical members adjustably secured on said shaft contacting said conical bearings in said frame to prevent longitudinal movement of said shaft, and a friction member attached to said frame encircling said shaft, said member having a split portion and being adjustable to regulate the degree of friction between said shaft and said member.

9. A device of the character described in claim 2, having a frictional element en-

circling the rotary shaft of said rotary element and being adjustable to provide the desired friction between said shaft and said member.

5 10. A device of the character described including a U-shaped frame, a stator element comprising a plurality of plates, bridge members holding said plates in spaced relation, certain of said bridge members being provided with integrally formed  
10 brackets for securing said stator element to said frame, a rotor element comprising a plurality of plates and bridging members for holding said plates in spaced relation,  
15 a shaft for rotatably supporting said rotor element, and means on said rotor element for permitting said rotor element to be adjusted longitudinally on said shaft relative to said stationary element.

20 11. A device of the character described including a U-shaped frame, a stator element comprising a plurality of plates, bridge members for holding said plates in spaced relation, certain of said bridge  
25 members being provided with integrally formed brackets, a rotor element comprising a plurality of plates and bridging members for holding said rotor plates in spaced relation, a shaft for rotatably supporting said rotor element, bearings in the  
30 free ends of said U-shaped frame, and members on said shaft contacting said bearings in said U-shaped frame to prevent longitudinal movement of said shaft, and means  
35 on said rotor element for permitting said rotor element to be adjusted longitudinally on said shaft relative to said stator element.

12. A device of the character described including a U-shaped frame, a stator element

comprising a plurality of plates, bridge 40 members for holding said plates in spaced relation, certain of said bridge members being provided with integrally formed  
45 brackets, insulation strips secured to said brackets and being secured on each side of the bridge of said frame to support said stator element, a rotor element comprising a plurality of plates and bridging members for  
50 holding said plates in spaced relation, a shaft for rotatably supporting said rotor element and means on said rotor element to permit adjustment of said rotor element longitudinally along said shaft relative to  
said stator element.

13. A device of the character described 55 including a U-shaped frame, a stator element comprising a plurality of plates, bridging members for holding said plate in spaced  
60 relation, certain of said bridge members being provided with integrally formed brackets for securing said stator element to said frame, a rotor element comprising a plurality of plates and bridging members holding said plates in spaced relation, a  
65 rotary shaft extending through the free ends of said frame, bearings in said frame, bearings on said shaft and adjustable on said shaft into contact with the bearings in said frame to prevent longitudinal movement of  
said shaft, and adjustable means for ad- 70 justably securing said rotor element longitudinally along said shaft relative to said stator element.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 2d day 75 of February, 1925.

HARRY H. IDE.