March 4, 1930. A. E. MARSHALL 1,749,042

VARIABLE CONDENSER

Filed Sept. 8, 1924 2 Sheets-Sheet 1

Fig. 1.

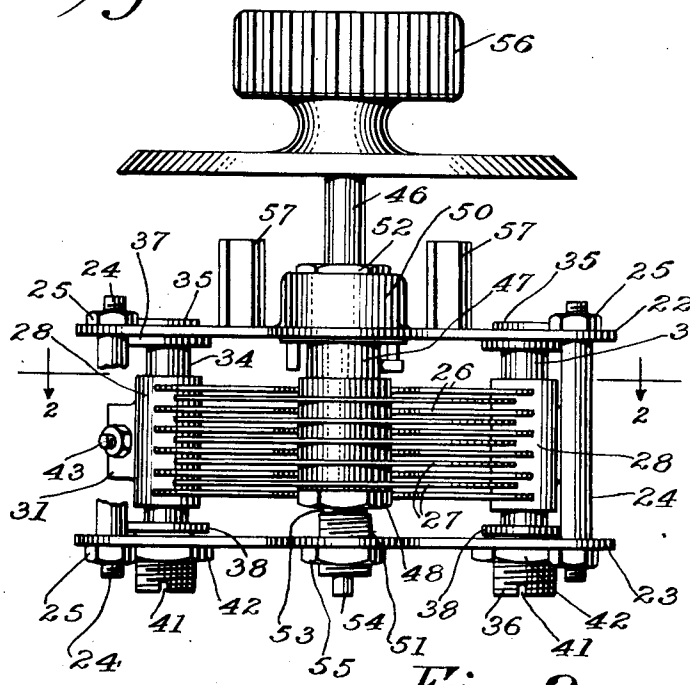


Fig. 4.

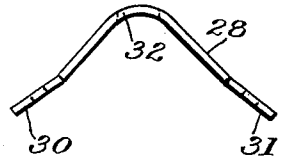


Fig. 5.

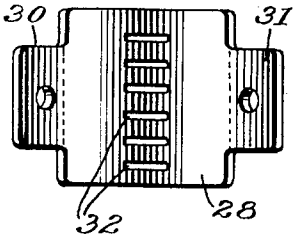


Fig. 2.

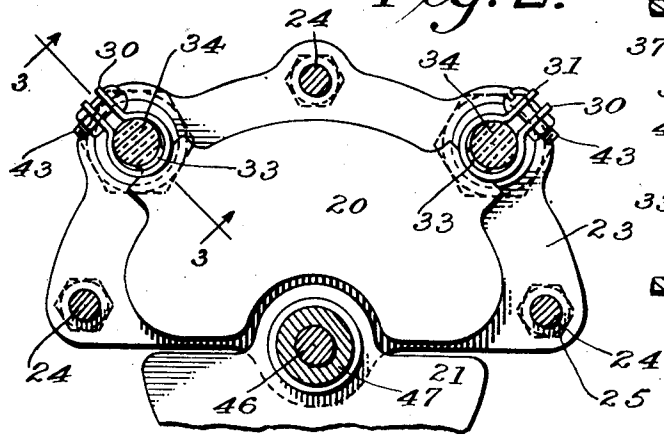


Fig. 3.

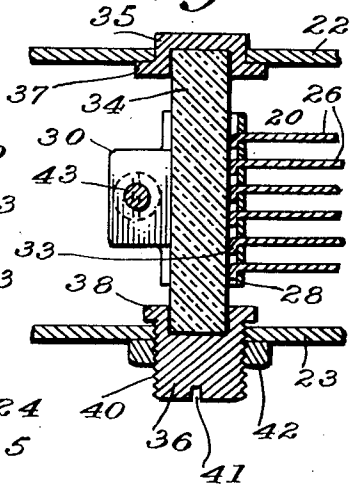


Fig. 7.

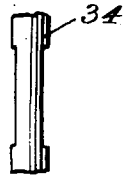


Fig. 8.

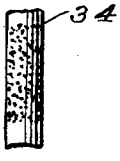
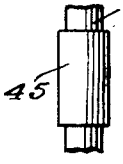


Fig. 9.



INVENTOR
Albert E. Marshall.
BY
Lowrey and Cole
ATTORNEY

March 4, 1930. A. E. MARSHALL 1,749,042

VARIABLE CONDENSER

Filed Sept. 8, 1924 2 Sheets-Sheet 2

Fig. 10.

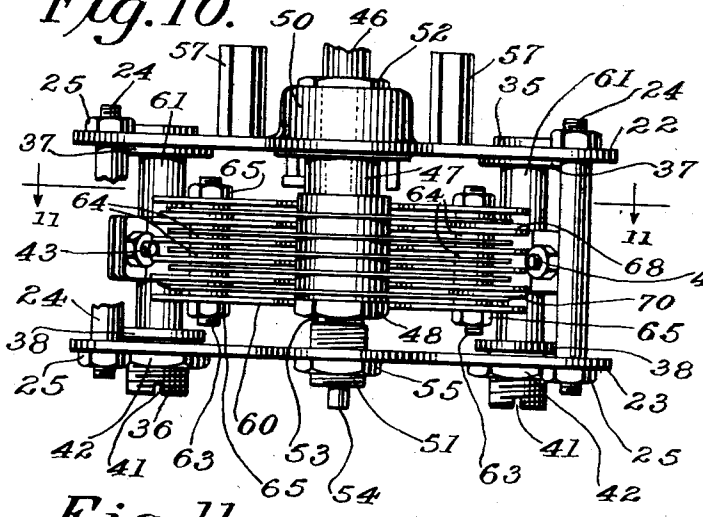


Fig. 6.

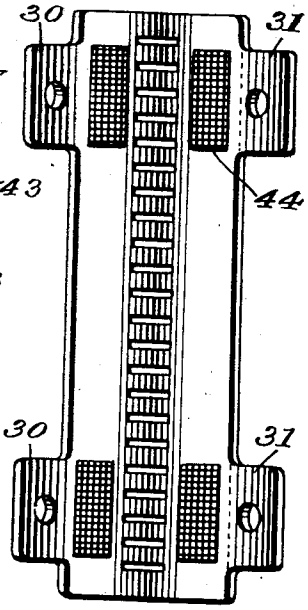


Fig. 11.

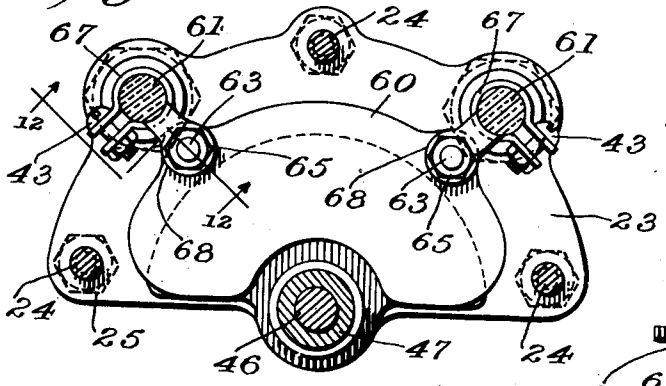


Fig. 12.

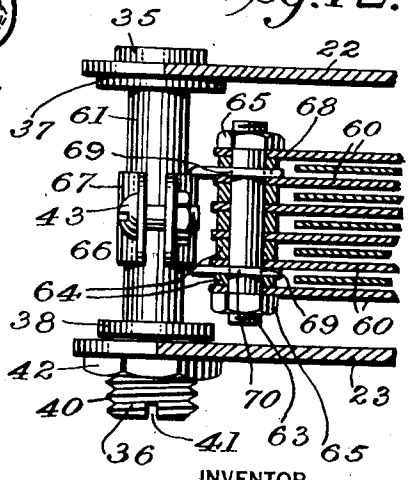
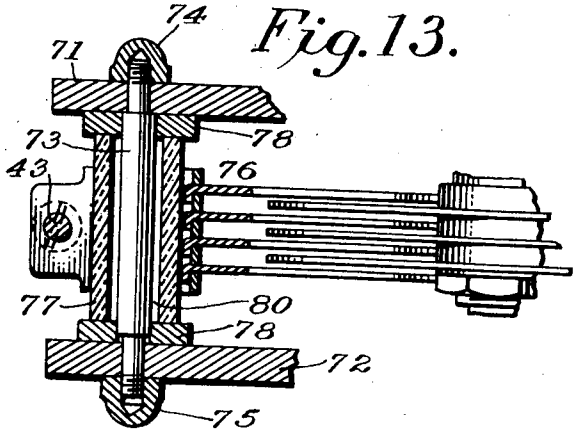


Fig. 13.



INVENTOR

Albert E. Marshall.

BY

ATTORNEY

Patented Mar. 4, 1930 1,749,042

UNITED STATES PATENT OFFICE

ALBERT E. MARSHALL, OF BALTIMORE, MARYLAND, ASSIGNOR TO CORNING GLASS WORKS, OF CORNING, NEW YORK, A CORPORATION OF NEW YORK

VARIABLE CONDENSER

Application filed September 8, 1924. Serial No. 736,632.

This invention relates to the art of condensers, and more particularly to an improvement in the insulation thereof.

It is the particular object of this invention to provide a variable air condenser, particularly adapted for radio uses, having a low loss, and with this object in view the insulating material is preferably ceramic material, fused quartz or glass having useful insulating properties, of which the type disclosed in United States Letters Patent Number 1,304,623, dated May 27, 1919, to E. C. Sullivan and W. C. Taylor, is an example.

In condenser mountings it is desirable to secure the maximum strength of the insulating member, and to prevent endwise movement of any of the parts in order to preserve a uniform space between the stator and rotor plates.

It is therefore a further object of this invention to provide a method of mounting the insulation in such a manner that it will be durable as well as efficient.

The features of novelty of the present invention consist in the type of insulation used, in the method of employing it as a means of obtaining a rigid stator support, and in the method of mounting it is the condenser.

The desirable features of an insulating material for condensers, particularly condensers employed in the transmission or reception of high frequency radio energy, can be stated as rigidity of structure, high insulating value or low power factor at radio frequencies, low coefficient of expansion, and permanence of electrical and physical characteristics under varying conditions of temperature and moisture.

The preferred shapes of insulating members for a condenser assembly are rods or bushings, as assemblies employing such shapes can be so arranged that the insulation is relatively remote from the high intensity field.

The usual insulating materials heretofore employed in condenser construction are hard rubber and phenolic condensation products, but such insulating materials lack rigidity in rod sections, do not possess a low coefficient of expansion, and are changed in their electrical characteristics, particularly as regards their power factor, by moisture, temperature and sunlight.

With a view to overcoming these objections, it has been suggested that porcelain and ceramic materials, fused quartz, and glass having useful insulating properties, such as the boro-silicate type, would be valuable for condenser insulation, but heretofore it has been impossible to provide suitable means for utilizing them.

Among the unsuccessful attempts may be mentioned the use of glass strips or rectangular section rods in a manner similar to that in which the hard rubber and phenolic condensation products are used. This was unsatisfactory because the drilling of the strips introduces weaknesses and causes breakage when the stator is finally adjusted and locked in position. Furthermore, when thus mounted, ceramic or glass strips would not withstand the handling shocks to which the condenser would be subjected in shipment and normal use. Another difficulty arose in an attempt to use a hollow tube and a cone end adjustment, since this tended to split the insulating tube. Furthermore, the limitations of glass-house practice make it difficult to provide rods or tubes of accurate diameter and uniform length.

I have therefore developed an insulator which has flat ends, and a method of mounting by which slight inaccuracies in length and diameter may be overcome, and this method is discussed in detail below.

With the above and other objects in view, which will be apparent as the description proceeds, I have disclosed my invention in the following specification, taken in connection with the accompanying drawings, in which:

Fig. 1 is a side elevation of a variable condenser embodying my invention; Fig. 2 is a horizontal section on the line 2—2 of Fig. 1; Fig. 3 is a vertical section on the line 3—3 of Fig. 2; Fig. 4 is a horizontal plan view of one of my metal holders or clamps before it is bent to final shape; Fig. 5 is a vertical elevation of the holder shown in Fig. 4; Fig. 6 is

a vertical elevation of a modified holder or clamp before it is bent to final shape; Figs. 7, 8 and 9 are side elevations showing details of modified forms of insulating members; Fig. 10 is a side elevation showing a modification of my invention; Fig. 11 is a horizontal section on the line 11—11 of Fig. 10; Fig. 12 is an elevation, partly in section on the line 12—12 of Fig. 11; and Fig. 13 is a vertical section through a further modification.

By referring to the accompanying drawings, and particularly to Figs. 1–5 thereof, it will be seen that I have illustrated a commercial form of condenser, with my improvements applied thereto. In these figures the condenser comprises a stator assembly 20 and a rotor assembly 21 which are secured together, between end plates 22 and 23, by a plurality of threaded rods 24 and nuts 25, in the manner described below.

I have designated the stator plates 26 and the rotor plates 27. The stator plates 26 are preferably secured in position by the use of a metal clamp or holder 28 (see Figs. 3, 4 and 5), which consists of a flat sheet of metal cut to the shape shown in Fig. 5 and provided with the perforated ears or lugs 30 and 31 and with a series of horizontal openings 32 of sufficient width to accommodate the stator plates 26. While I have illustrated an eleven plate condenser in Figs. 1–5, it will be obvious that the number of plates may be varied as desired, but in case a large number of plates are used, e. g., forty-three, a longer clip will be required, as shown in Fig. 6, and this will have two or more sets of lugs 30 and 31. Each of the stator plates 26 is formed with a plurality of projections 33 which are of such a size that they may readily be inserted through the openings 32 in clamps 28 and subsequently bent at right angles to the main surface of the plate to lock them in position. These clamps are adapted to cooperate with any desired number of rods 34 (two being illustrated herein) of the desired insulating material, and of any suitable diameter, e. g. $\frac{5}{16}$ of an inch.

The rods are secured in place between the end plates 22 and 23 in any desired manner, but preferably by means of cup shaped retaining members 35 and 36, provided with retaining flanges 37 and 38, respectively, which abut against the adjacent portions of the end plates. In order that the insulating rods may be individually adjusted to the desired position between the end plates to compensate for slight variations in the length of the rods, the cup shaped member 36 is also provided with a threaded portion 40 which passes through a correspondingly threaded recess in the end plate 23. The end of the member 36 is also provided with a slot 41 to permit its ready adjustment by means of a screw driver. When the rods 34 have thus been adjusted to the proper position between the end plates, they are locked in this position by check nuts 42.

To assemble the stator plates 26 in position upon the insulator rods 34, the projections 33 on the stator plates are inserted through the openings 32 in the clamp 28. The projections 33 are then bent at right angles to the surface of the stator plates, or are milled, to anchor them in the clamps 28. The latter are then bent to shape around the insulator rods 34, bolts 43 are passed through the mating perforated lugs 30 and 31 of the clamps, and, after the stator plates have been adjusted to the desired height, the bolts 43 are tightened.

If the rods are of uniform diameter this will provide sufficient pressure to secure the plates in position. However, it is difficult to produce glass rods of accurate diameter, and I have therefore also provided means for utilizing commercial glass rods, which are not of absolutely uniform diameter, in such a manner that a tight lock will be secured between the clamp and the insulating rod. As shown in Fig. 7, one or two small flat portions may be ground on the rod to provide a bite for the clamp 28. On the other hand, if desired, the rod may be roughened or sand blasted, as shown in Fig. 8, and the clamp may be lined with soft metal 44, as shown in Fig. 6. This lining could be secured to the clamp in any suitable manner, as by spot welding, and would be compressed against the roughened portion of the rod when the bolts 43 are tightened. As indicated in Fig. 9, a further way of providing a tight lock is by applying a suitable metal coating 45 to the desired portion of the rod, as by electroplating, by shrinking on a metal collar through difference in expansion, or by the thermal decomposition of a metal salt, and, after normal adjustment of the clamp, using solder or equivalent means to lock it in position.

Although it forms no part of the present invention, for clearness of illustration, I have shown the relation of my insulated stator plate assembly 20 to the remainder of the condenser. The illustrations show a condenser assembly, which includes two insulating and three connecting rods, but it will be obvious that a variety of combinations of insulating and end plate connecting rods can be employed without departing from the spirit of my invention, as, for instance, three stator insulating rods and three or four end plate connectors.

Referring now particularly to Figs. 1 and 2, it will be seen that the rotor assembly 21 consists of a plurality of rotor plates 27 which are secured in spaced relation on a supporting rod 46 between a boss 47 thereon and a locking nut 48. If desired, the boss may be replaced by a bushing secured to the rod in any convenient manner. The rod 46

is mounted in suitable bearings 50 and 51 in the end plates 22 and 23, respectively, and is locked against longitudinal movement by a nut 52. The lower bearing 51 consists of a bushing threaded into the end plate 23 and adapted to be adjusted into contact with a shoulder 53, on rod 46, near its lower end. Below this shoulder the rod is provided with a reduced portion 54 which fits into the bushing 51. The bushing is locked in the desired position by a nut 55. The rod 46 projects beyond the bearing 50 and carries the usual graduated operating knob 56. Suitable stops 57 are provided for positioning the condenser adjacent to a panel (not shown).

In Figs. 10–12 I have illustrated a modified method of mounting the stator plates 60 in connection with the insulating members 61, of which two or more are preferably used. This consists in mounting the stator plates on two or more threaded rods 63 and spacing them apart by washers 64, the stator assembly being held together rigidly by nuts 65 on the rods 63. This results in offsetting the stator plate supports from the insulating members 61. For this purpose I use a modified shape of clamp 66 which comprises a body member 67 corresponding in general to the holder or clamp member 28, but differing therefrom in that it omits the openings 32 and substitutes a pair of arms 68 and 70 which project at right angles to the axis of the body member. These arms are provided with registering openings 69 of a suitable diameter to accommodate the rods 63 and at the same time prevent the passage of the washers 64 therethrough. This construction utilizes the same arrangement of end plates 22 and 23, tie rods 24, and cup shaped members 35 and 36 as the embodiment of my invention illustrated in Figs. 1–5.

In Fig. 13, I have disclosed a further modified construction in which the condenser is provided with the usual end plates 71 and 72 spaced apart by a plurality (usually three) of metal rods 73. In this modification the insulating material consists of tubular members which surround the rods 73 and are clamped into position by nuts 74 and 75 threaded on the rods 73. The stator plate assembly 76 shown herein is like that illustrated in Figs. 1–5 (although it could be of the type illustrated in Figs. 10–12) and may be secured to the tubular insulating members 77, of which two or more are used, by any of the above described means, suitable washers 78 of compressible material being inserted between the end plates 71 and 72 and the ends of the insulating members 77. This modification eliminates certain parts, and therefore simplifies the construction, without sacrificing any of the desirable insulating effects produced by the embodiments of my invention described above. It is essential, however, that the internal diameter of the insulators be made larger than the external diameter of the non-insulating rods 73, to provide an air gap 80 of about $\frac{1}{16}$ of an inch. As thus constructed, the capacity of the condenser is not changed and the same result is obtained as with the separate metal connecting rods used in the constructions described above, whereas the omission of the air gap results in contact between the insulating tube and central rod, causing high residual capacity.

It will be apparent that in all the embodiments of my invention described above the end plates are in direct contact with the rotor plates, but that the stator plates are insulated from these. Hence, the end plates 22 and 23, and the cup shaped members 35 and 36, may be either of metal or insulating material, at the option of the manufacturer.

It will also be understood that in all of the modifications of my invention discussed above the insulating material referred to may be either glass, fused quartz or ceramic material, but I prefer that this shall be glass of the character referred to.

I claim:

A condenser mounting, comprising end plates, stator plates, an insulator extending between the end plates, and means for securing the stator plates rigidly thereto, said means comprising a clamp member provided with a plurality of recesses through which the ends of the stator plates are inserted and bent at right angles to the surface of the stator plates, and means for rigidly securing the clamp member to the insulator.

ALBERT E. MARSHALL.