Nov. 6, 1934. M. H. BENNETT 1,979,856

CONDENSER ASSEMBLY JIG

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Fig. 1.

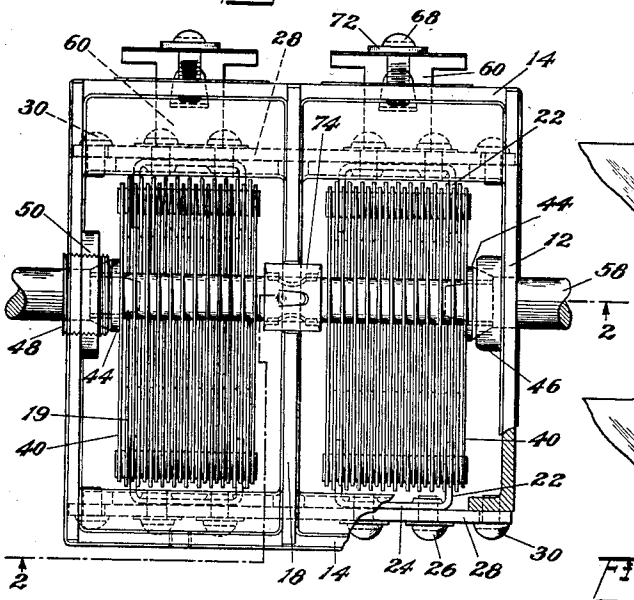


Fig. 5.

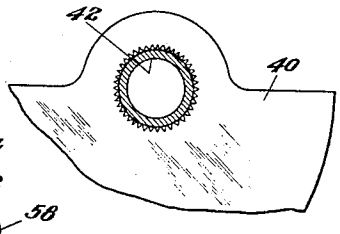


Fig. 6.

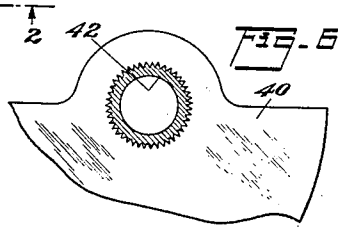


Fig. 3.

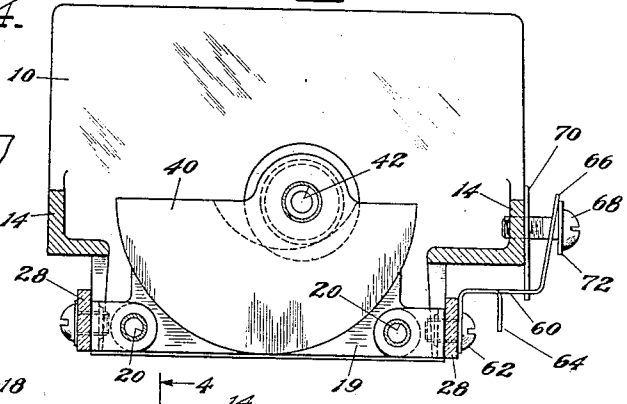


Fig. 4.

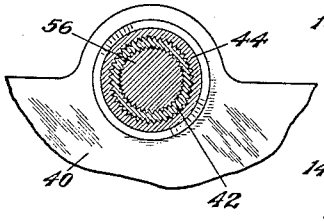


Fig. 2.

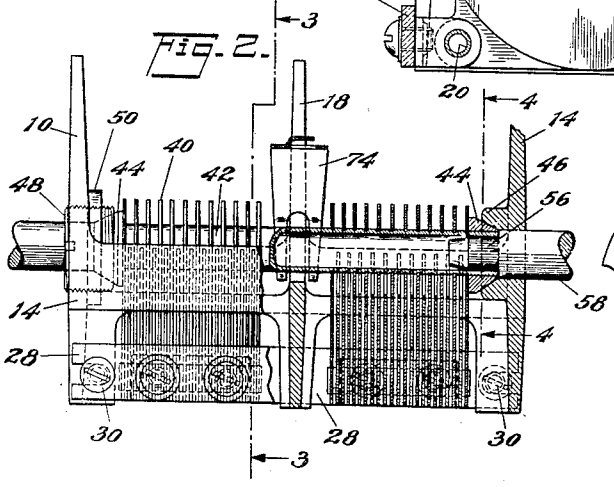
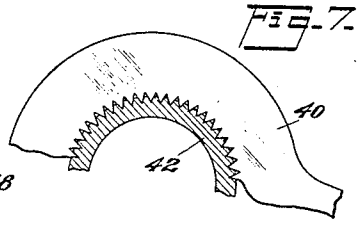


Fig. 7.



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Fig. 8.

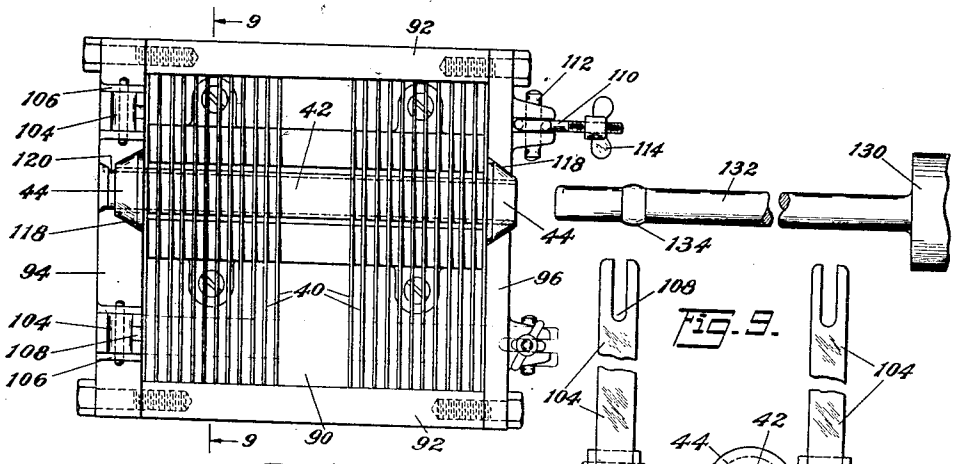


Fig. 9.

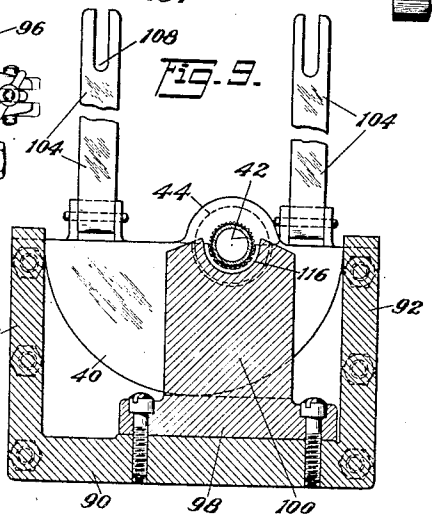


Fig. 11.

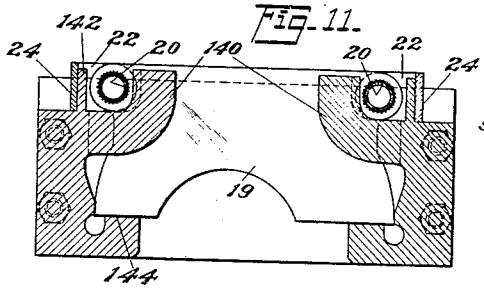
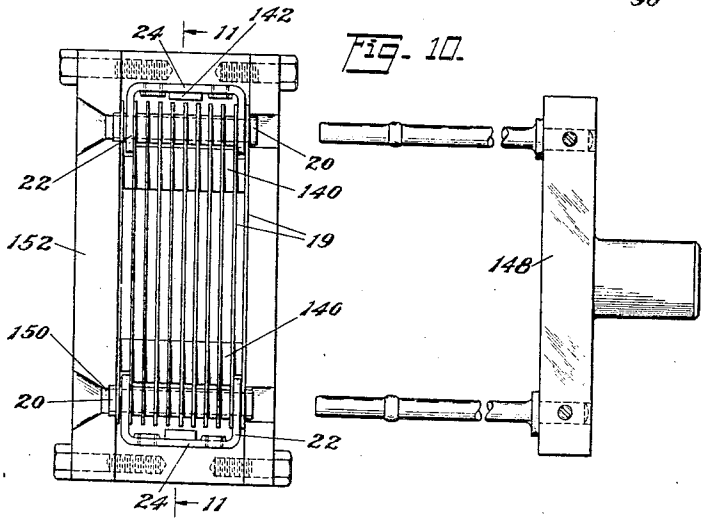


Fig. 10.



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CONDENSER ASSEMBLY JIG

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Original application April 7, 1932, Serial No. 603,785. Divided and this application December 7, 1933, Serial No. 701,321

5 Claims. (Cl. 29—84)

The present invention relates to condensers and to the method of manufacturing condensers, and, more particularly, adjustable multiple plate condensers of the air dielectric type.

An important object of the invention is to provide an assembly jig by means of which, in accordance with the method herein described, a condenser may be assembled having exceptionally accurate spacing of the plates and permanence of their predetermined spaced relation.

In accordance with the invention, not only can a single unit group of condenser plates be assembled, but a plurality of rotor units for a gang condenser may, equally well, all be assembled as a gang of units and with the same ease and efficiency as the assembly of the plates of one unit has heretofore been accomplished.

Other objects and advantages of the invention will appear from the following description taken in connection with the accompanying drawings, which illustrate a preferred embodiment of an assembly jig constructed in accordance with the invention and which also illustrate certain condenser structure resulting from assembly by means of the jig as hereinafter described.

In the accompanying drawings:

Fig. 1 is a top plan view, partly in section, of a gang condenser assembled in accordance with the present invention;

Fig. 2 is a vertical longitudinal sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a vertical transverse sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is an enlarged fragmentary transverse section showing the assembly of one of the rotor plates and taken on the line 4—4 of Fig. 2;

Fig. 5 is a fragmentary view showing one of the rotor plates and sleeve just prior to their assembly;

Fig. 6 is a view of the same parts showing them assembled together;

Fig. 7 is a fragmentary view showing in more detail the rotor plates and sleeve in their assembled relation;

Fig. 8 is a top plan view of the spacing and holding assembly jig for maintaining, in spaced relation for assembly to a common sleeve, a plurality of groups of rotor plates to form the several rotor plate units of a gang condenser, and showing the rotor assembling tool;

Fig. 9 is a vertical transverse sectional view taken on the line 9—9 of Fig. 8;

Fig. 10 is a top plan view of the holding and spacing assembly jig for the assembly of a plurality of stator plates to form a stator plate unit, and showing also the stator plate assembling tool; and

Fig. 11 is a vertical transverse sectional view taken on the line 11—11 of Fig. 10.

Referring in detail to the drawings and particularly to Figs. 1, 2 and 3, there is illustrated a gang condenser comprising two units or two cooperating sets of rotor and stator plates. The condenser shown includes a pair of frame end plates 10 and 12 and frame side plates 14 integrally or otherwise connecting said frame end plates. The end plates may extend beyond the condenser units both vertically and laterally as shown in Figs. 2 and 3 to provide shields for the several units, which, within the condenser frame, may be shielded by a similar shielding plate 18.

The stator plates 19 forming a single unit are assembled together by means of stator plate sleeves 20, which pass through the several stator plates of a unit near opposite lower edges of the plates, as indicated in Fig. 3, the assembly of and connection between said sleeves and stator plates being hereinafter more fully described. Each stator plate assembly sleeve 20 preferably also passes through and is similarly connected with the spaced-apart parallel arms 22 of a stator plate bracket 24 (Fig. 1), which is secured by screws 26, or otherwise, to an insulating strip 28 whose ends are secured as at 30 to the opposite frame end plates 10 and 12. It will be understood that a pair of brackets 24 is provided for each stator plate unit and that the several stator plate units are insulated from each other by reason of the insulating stator unit mounting strip 28.

One group, or, as here shown, several groups or units of rotor plates are all assembled on a single sleeve in electrical contact therewith and in fixed, permanently maintained, spaced relation thereon.

As shown, the rotor plates 40 are assembled on the rotor plate assembly sleeve 42, the assembly being accomplished as hereinafter more fully described. At each end of the sleeve 42 a conical bushing or bearing 44 is provided, fast on sleeve 42. One of the bearing bushings 44 is rotatably mounted in a conical seat provided for it in a boss 46 formed as an integral part of, or carried by, the end frame plate 12. The other bushing 44 bears rotatably in a conical seat provided for it in a bearing member 48 extending through and threaded in the frame end plates 10, and axially adjustable therein and provided with a locking washer 50, by which the bearing 48 may

be locked in fixed adjusted relation to the frame end plate 10.

Into each end of the rotor plate sleeve is inserted for a short distance the reduced, longitudinally grooved or toothed end 56 of a short stub shaft 58, the teeth of which bite into the sleeve metal so that each stub shaft is non-rotatably fixed with respect to the rotor plate sleeve. Rotation of one of the stub shafts 58, therefore, causes rotation of the rotor plates with respect to their associated stator plates for effecting variation in condenser capacity.

A trimmer condenser may be associated with each of the main condenser units and, as here shown, each may include a relatively resilient metallic plate 60 bent as indicated in Fig. 3, the bottom of the plate being secured, as by a screw 62, to the insulation strip 28. The portion 64 of the plate may be turned down to form a wire terminal connection. The upper portion 66 of the plate 60 may be moved toward or allowed to move from the main condenser frame by a screw 68 taking into said frame and which bears against the upper portion 66 of the trimmer condenser plate, which is normally urged away from the main condenser frame by its own resilience, a small insulating strip 70 being provided between the trimmer condenser plate and the main condenser frame, and a screw head insulating washer 72 being provided to prevent screw 68 from making electrical contact with the trimmer condenser plate. A wiper 74 may, if desired, contact with the rotor sleeve 42 and shielding plate 18.

Referring now more particularly to the assembly jig of the present invention, and especially to Figs. 8 and 9, for the assembling of the rotor plates into one or more rotor plate units or groups upon a rotor plate sleeve 42, a jig or rotor plate holder is provided and may comprise a bottom 90, sides 92 and ends 94 and 96. A removable spacer 98 may be secured to the bottom of the holder and is provided with a plurality of spacing elements 100 whose thickness is the same as the space desired between the rotor plates and which, in turn, are spaced apart a distance equal to the thickness of the rotor plates, to accommodate the rotor plates between them. It is evident that the holder may be designed to accommodate the plates for a single condenser unit or for as many units as may be desired to form a gang condenser.

In assembling one or more units or groups of plates in accordance with the invention, the individual plates are first placed, as shown in Fig. 8, between the spacing members 100. Their top edges are roughly aligned and are then brought into and maintained during assembly in final alignment by a pair of aligning arms 104 pivotally carried between pairs of lugs 106 on end plate 94. These arms are shown in vertical position in Figs. 8 and 9 and are lowered to horizontal position, as indicated in dotted lines in Fig. 8, to bear upon the upper edges of the rotor plates 40 and thereby align them in position for assembly on the rotor plate sleeve. The aligning arms 104 are forked at their free ends, as at 108, and in their horizontal position the forked ends of said arms are adapted to receive the threaded free ends of clamping rods 110 each of which is pivotally attached at 112 to the outer face of the jig end plate 96. A clamping screw or wing nut 114 is provided on each pivoted rod 110 to bear upon the upper faces of the arms 104 to clamp them firmly in horizontal position to hold the rotor plates in alignment for the assembling operation. The upper edges of the spacer elements 100 may be cut away as indicated at 116 to accommodate the sleeve 42 upon which the rotor plates are to be assembled.

The end plates 94 and 96 are provided with seats 118 to accommodate the bearings 44.

The rotor plates are provided with aligned, generally circular openings, the portion of each plate bounding its circular opening being provided with serrations or inwardly pointing teeth, as shown particularly in Fig. 7. The bearing bushings 44 being provided with similar teeth, said bearings are placed in their jig seats in the position of Fig. 8, and the rotor plate sleeve, which at this time has a diameter such that it fits loosely within the rotor plate openings and bearing bushings, is thrust loosely through the rotor plates and bushings positioned in the jig or holder. The jig end plate 94 has its seat 118 formed to prevent longitudinal movement of the rotor plate sleeve from right to left, as viewed in Fig. 8, when the sleeve has been inserted through the aligned rotor plate and bushing openings far enough to abut the portion 120 of the end plate. The sleeve 42 is made of electrically conducting material sufficiently expansible, such as copper or other comparable material, so that when an expanding tool is forced through the sleeve it will expand radially from the position of Fig. 5 into the position of Figs. 6 and 7, exterior parts of the sleeve 42 entering or flowing between the serrations or teeth, so that the teeth have the effect of biting into the sleeve. This results in exceptional and permanent electrical contact and secures the rotor plates and bearing bushings in permanent predetermined spaced relation on, and in non-rotatable relation with, the rotor plate sleeve.

For the expanding operation, a tool such as the expanding tool 130 (Fig. 8) may be employed, and, as indicated, it may comprise a shank 132 of sufficiently small diameter to fit easily within the unexpanded sleeve, an enlargement 134 being carried by or formed on the shank 132, the diameter of the enlargement being the same as the internal diameter of the sleeve is to be after the expanding operation.

The plates forming each stator group may be assembled in the same manner except that each group or unit of stator plates is carried by sleeves 20, separate sleeves being provided for each of the stator plate units.

As shown in Figs. 10 and 11, a stator plate jig or holder may be provided whose sides are formed with oppositely extending plate spacing arms 140 whose thickness is equal to the distance desired between adjacent stator plates and which, in turn, are spaced apart from each other a distance equal to the thickness of the stator plates to hold the plates therebetween in desired spaced relation.

In assembling the stator plates, the bracket 24 is placed in position on the holder against a guide or positioning flange 142 and the stator plates 19 of the unit are placed between the spacer elements 140, the lower edges of the stator plates, as viewed in Fig. 11, resting on the supporting bottom 144 of the jig, and the aligned, generally circular openings through the stator plates aligning with the corresponding openings in the bracket arm 22.

The aligned openings in the stator plates and bracket arms receive the stator plate sleeves 20 as in the case of the rotor plate assembly, the sleeves being then expanded by a suitable tool

148 into serrations in the stator plates defining their openings and into similar serrations defining the bracket arm openings. Upon expansion of the sleeves 20 by the expanding tool, the sleeve material flows, as already described, into the spaces between the serrations or teeth, firmly locking the stator plates and brackets in desired electrical contact and relatively non-rotatable relation. Suitable seats 150, formed in the end plate 152 of the stator plate jig, prevent longitudinal movement of the sleeves in the direction of travel of the tool during the expanding operation.

After expansion of the unit sleeves in the manner described, the stator plate unit may be removed from its jig and the rotor plate unit or units may be removed from the rotor plate jig.

The stator plate units may now be individually fixed in the condenser frame, as indicated in Fig. 1, their cooperating rotor plates being interleaved therewith and the right-hand bearing bushing 44 being located within its boss 46. Bearing 48 is now threaded into its opening in frame end plate 10 until it is in desired relation with the left-hand bearing bushing 44 of the rotor plate assembly, in which position the bearing 48 is locked by the lock washer 50.

It will be evident from the foregoing that the invention provides for assembling the plate elements in accurately spaced relation, and for permanent maintenance of the elements in that relation, as well as in particularly efficient electrical contact; and, further, that in the case of gang condensers, the several rotor plate units may all be assembled on a single sleeve by a single operation. It will also be noted that the condenser plates may be blanked with the desired serrations or teeth and that no expensive or bulky assembling bearings or bushings are required; also that the slotting of such bearings or bushings by milling operations, as hitherto practiced, is eliminated. Moreover, the openings in the condenser plates do not have to be large enough to receive such bearings or bushings, but only large enough for a single sleeve, with the result that valuable plate area is saved, permitting a reduction in overall size, not only of the plates, but also, and consequently, in the size of the condenser frame. Furthermore, it is not necessary to use solder or lubricant on the plates or sleeves. It will be understood, of course, that the herein described assembly is carried out without deforming the plates. As great accuracy is possible with the method of the present invention, a smaller air gap may be provided between condenser plates. Where it is desired to change from one air gap to another, it is necessary only to substitute new spacer devices in the assembly jigs.

This application is a division of my application Serial No. 603,785, filed April 7, 1932, for "Condensers and method and apparatus for making same".

What is claimed is:

1. A condenser plate assembly holding jig having fixed therein a plurality of parallel plate spacing projections for holding in predetermined aligned spaced parallel relation a series of condenser plates, and having a plate sleeve seat in cooperative relation to said spacing projections for preventing longitudinal movement of a condenser plate sleeve, said seat having an expanding tool accommodating opening therein, and said jig having a plurality of plate aligning abutments.

2. A condenser plate assembly holding jig having a plurality of parallel plate spacers for holding in predetermined spaced parallel relation a series of condenser plates, and having a plate sleeve seat in cooperative relation to said spacers for preventing longitudinal movement of a condenser plate sleeve, and a condenser plate edge aligner.

3. A condenser plate assembly holding jig including a plurality of parallel plate spacers for holding in predetermined spaced parallel relation a series of condenser plates, a condenser plate edge aligner, means for holding said edge aligner in aligning position, and a plate sleeve seating abutment for limiting longitudinal movement of a condenser plate sleeve in a predetermined direction in said holding jig.

4. A condenser plate assembly holding jig including a plurality of parallel plate spacers for holding in predetermined spaced parallel relation a series of condenser plates, a pivotally movable condenser plate edge aligner, pivotally movable holding means for maintaining said edge aligner in aligning position, and a plate sleeve seating abutment for limiting longitudinal movement of a condenser plate sleeve in a predetermined direction in said holding jig.

5. A condenser plate assembly holding jig including a plurality of parallel plate spacers for holding in predetermined spaced parallel relation a series of condenser plates, a pivotally movable condenser plate edge aligner, pivotally movable holding means for maintaining said edge aligner in aligning position, and a plate sleeve seating abutment for limiting longitudinal movement of a condenser plate sleeve in a predetermined direction in said holding jig, said seating abutment having an expanding tool accommodating opening therein.

MORRIS H. BENNETT.