June 15, 1926. 1,588,438

H. N. BLISS

METHOD AND APPARATUS FOR SELECTIVE ELECTRICAL TUNING

Filed Nov. 4, 1924 3 Sheets-Sheet 1

Fig. 1.

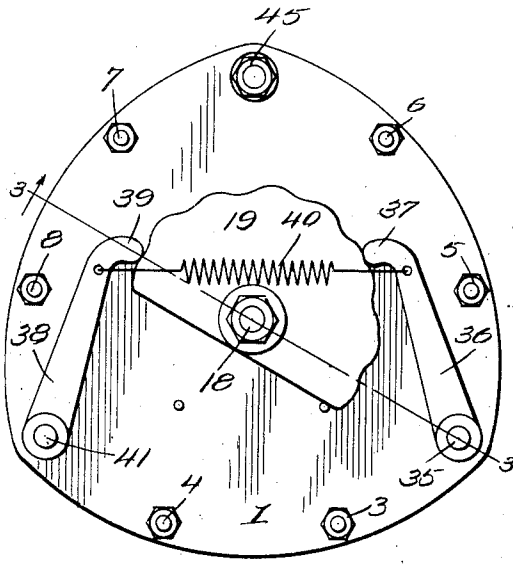


Fig. 2.

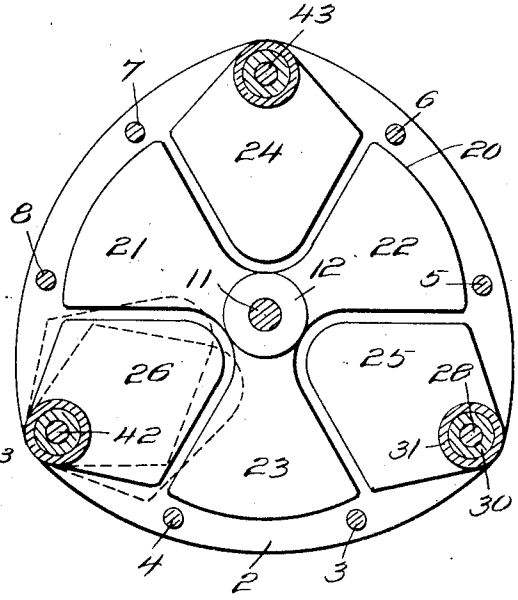
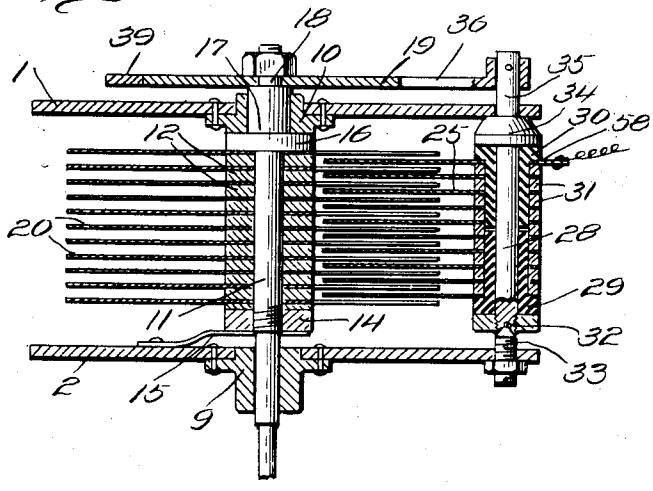


Fig. 3.



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Fig. 4.

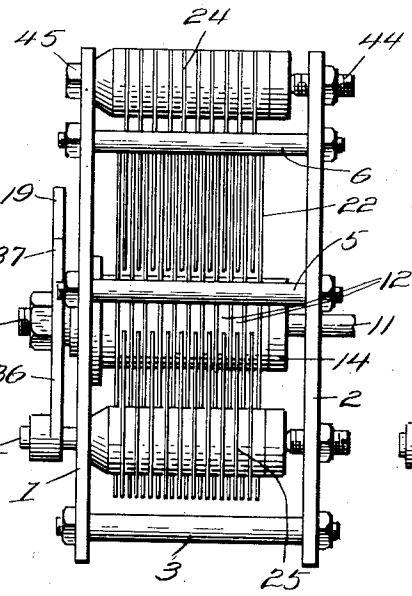


Fig. 6.

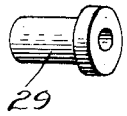


Fig. 7.

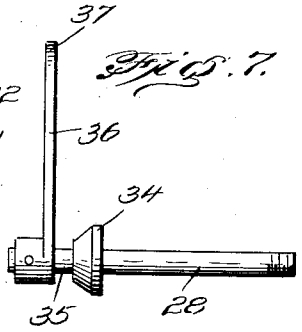
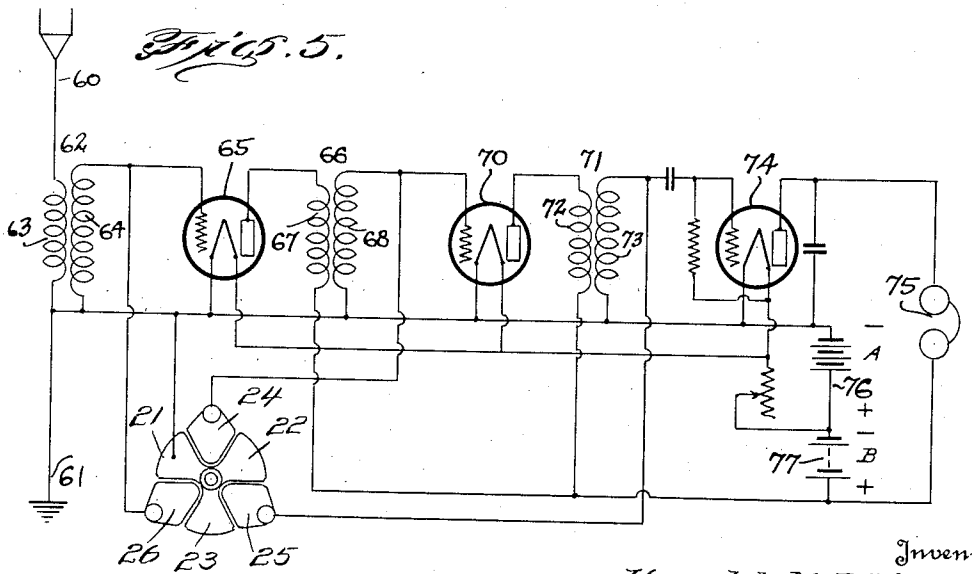


Fig. 5.



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Fig. 8.

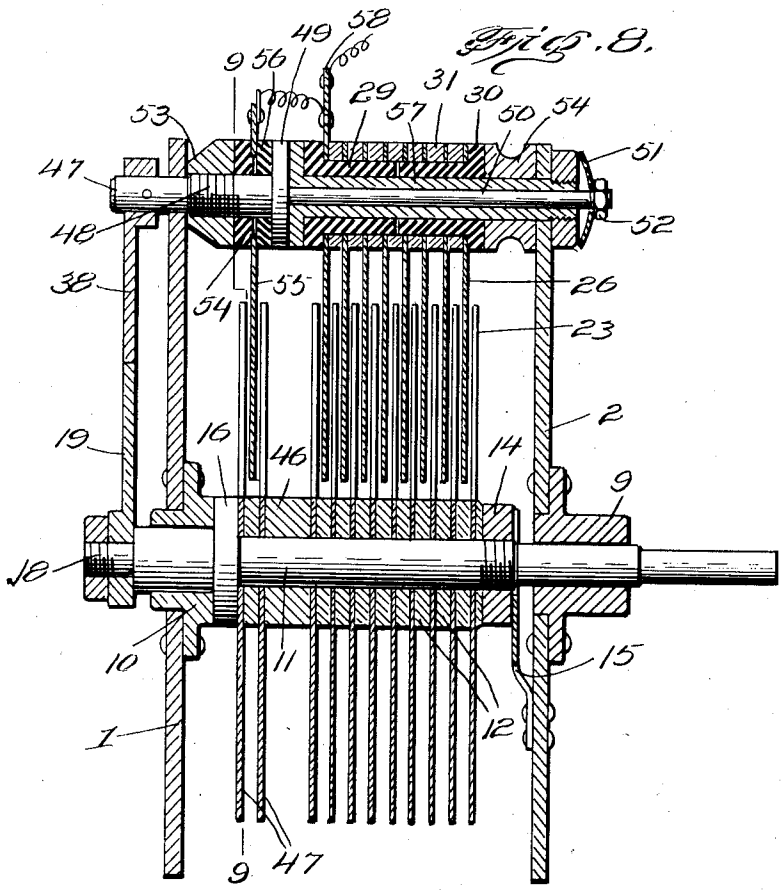
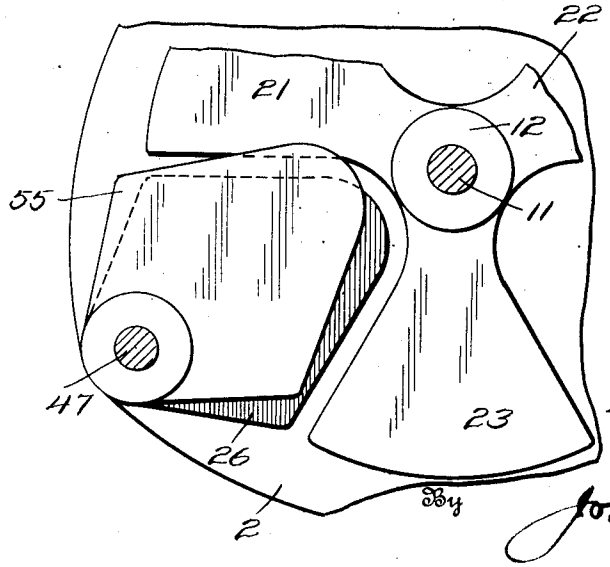


Fig. 9.



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Patented June 15, 1926. 1,588,438

UNITED STATES PATENT OFFICE.

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METHOD AND APPARATUS FOR SELECTIVE ELECTRICAL TUNING.

Application filed November 4, 1924. Serial No. 747,846.

My invention relates broadly to systems of electrical tuning, and more particularly to a method and apparatus for selectively tuning a plurality of electrical circuits to resonance by means of an apparatus unit having a single manual control.

One of the objects of my invention is to provide a method by which a plurality of electrical circuits, each of which may have inherently different characteristics, may be tuned to resonance at the same frequency for the efficient transfer of energy from one circuit to the other at a selected frequency.

Another object of my invention is to provide a system of electrical tuning by which a series of electrical circuits may be simultaneously adjusted to resonance at a particular frequency from a single control with means for automatically compensating for electrical differences which may exist between the several circuits whereby energy at the selected frequency may be efficiently transferred from one circuit to another.

Still another object of my invention is to provide an automatic multiple variable condenser for selectively tuning a plurality of electrical circuits by operation of a single control with means under control of the condenser for compensating for electrical differences which inherently exist in the several electrical circuits.

A further object of the invention is the provision of a variable condenser construction having a rotatable shaft member and laterally projecting co-extensive plate portions carried thereby with stator capacity areas arranged adjacent the rotatable shaft, and between which said laterally projecting co-extensive plate portions may be intermeshed with a mechanical connection between the rotatable shaft and the mountings for the stator capacity areas whereby the stator capacity areas may be angularly rocked with respect to the co-extensive plate portions through a distance proportioned to the movement of the rotatable shaft.

A still further object of my invention is to provide a construction of variable condenser in which a rotatable shaft carries a plurality of rotor plates arranged to intermesh with sets of stator plates with a cam device operated by movement of the rotatable shaft in such manner that the cam engages arms arranged to rock the stator plates through selected angular distances in accordance with the rotation of the shaft.

My invention further resides in the construction of a variable condenser in which a plurality of sets of rotor plates may be intermeshed with a plurality of sets of stator plates with a mounting between the plates whereby the position of the stator plates may be simultaneously varied upon variation in the position of the rotor plates for compensating for electrical distances which may exist in circuits which include said sets of plates.

My invention also resides in the construction and arrangement of parts of a multiple automatic condenser for the selective tuning of a plurality of electrical circuits by operation of a single control as will be more fully pointed out in the specification hereinafter following by reference to the accompanying drawings, in which:

Figure 1, is a rear view of the condenser construction employed in the circuit arrangement of my invention showing the method of varying the angular position of two sets of stator plates simultaneously with the change in position of the rotor plates; Fig. 2 is a cross-sectional view taken through the condenser illustrating the rotatable shaft and the arrangement of the sets of rotor plates and corresponding sets of stator plates; Fig. 3 is a vertical cross-sectional view taken through the condenser along line 3—3 of Fig. 1 showing the arrangement of the rotor plates and one set of the stator plates illustrating the mechanical interlinkage between the cam on the rotor shaft and the rocker arm on one of the stator shafts; Fig. 4 is a side view of the assembled condenser; Fig. 5 represents the circuit arrangement employed in my method of selective electrical tuning of a radio receiving circuit; Fig. 6 is a perspective view of one of the insulated bushings employed for the support of the stator plates; Fig. 7 is a detail view of the shaft construction for the stator plates showing the connection of the rocker arm with the shaft; and Figs. 8 and 9 are partial cross-sectional and plan views respectively of a modified construction of variable condenser wherein a single plate out of the set of stator plates is rocked simultaneously with the movement of the rotor co-acting with corresponding plates of the rotor for compensating for electrical differences in the circuits with which the sets of plates are connected.

Heretofore in the art in systems of tuned radio frequency amplification employed in sensitive radio receiving apparatus it has been necessary to selectively tune the input circuits of a plurality of electron tubes connected in cascade. The adjustment of these several condensers is often tedious and requires careful manipulation by an experienced operator. The several adjusting devices must be individually adjusted to a nicety in order to place the several circuits in a condition of resonance. Complications often arise by reason of lack of adjustment of any one of the several adjusting devices, rendering the circuits inefficient or totally ineffective for a desired signal. By my present invention I provide a method and apparatus for selective electrical tuning by means of a single control. I provide a rotor having a plurality of sets of laterally projecting plates and a corresponding number of sets of stator plates for co-operation therewith, the sets of plates being connected in shunt with the several circuits which are to be selectively tuned to a given signaling frequency. I find that it is necessary to compensate for differences which exist in the several electrical circuits and I therefore provide means for mechanically changing the angular position of the stator plates with respect to the rotor plates simultaneously with the rotation of the rotor plates. I employ a substantially flat semi-circular cam on the end of the rotor shaft arranged to cooperate with rocker arms upon which are mounted the stator plates whereby the rotor plates may be moved between the stator plates and differences in the electrical circuits in which the sets of rotor and stator plates are included compensated for by angular movement of the stator plates. By means of a single control a plurality of electrical circuits may be adjusted simultaneously by the apparatus as herein described.

Referring more particularly to the drawings, reference character 1 designates the rear supporting plate for the multiple automatic condenser while reference character 2 shows a front supporting plate. The plates are connected together by means of standards 3, 4, 5, 6, 7 and 8 disposed about the periphery of front and rear plates 1 and 2. A bearing 9 is carried by plate 2 and a bearing 10 by plate 1 aligned therewith in which the shaft 11 is journaled. The shaft 11 has spacer members 12 carried thereon with the rotor 20 having plates 21, 22 and 23 spaced one from another thereon by means of the spacing members 12 which serve as separators. The plates are secured in position on the shaft 11 by means of a nut 14 at one end and a spacing member 16 at the other end which engages shoulder 17 of the shaft 11 and bears against the bearing 10. The securing member 14 is held in position by means of a resilient yoke device 15 which bears on the flat surface of the member 14 and constantly urges the shaft in the direction of bearing 10. The shaft 11 is provided with a screw threaded end 18 upon which the cam 19 is secured by means of a nut or other suitable securing device. The cam 19 has a substantially semi-circular edge face cut in a manner determined by the electrical characteristics of the circuits with which the multiple automatic condenser is employed as will be hereinafter described in more detail. The stator plates for the condenser are shown at 24, 25 and 26 carried by shafts 43, 28 and 42 respectively. The stator plates 24 are permanently located in position by means of adjustable set screws 44 in end plate 2 and the nut 45 in end plate 1. The shafts 28 and 42 are arranged to rock or have angular movement in either direction. Figure 3 illustrates the arrangement of the angularly movable plates. Shaft 28 is countersunk at the end 32 into which the adjustable screw 33 centers. A shoulder 34 is provided on the shaft 28 and bears against the end plate 1 carrying thereon the insulated bushings 29 and 30 securing the stator plates 25 and separator members 31 in position on the shaft. The shaft 28 projects through the end plate 1 as indicated at 35 and carries thereon a rocker arm or lever 36 having an end 37 bent toward the cam face 19 and arranged to engage and ride upon the edge thereof rocking the shaft 28 in accordance with the angular movement of lever 36. Similarly the stator plates 26 on shaft 42 are provided with a rocker arm 38 connected to an extension 41 of the shaft 42. The rocker arm 38 has an end 39 directed in the direction of the end 37 and arranged to engage the edge surface of cam 19. The rocker arms 36 and 38 are constantly drawn toward each other by means of a spring 40 and the operation of the cam 19 is such that it tends to move the rocker arms 38 and 36 apart against the action of spring 40. The terminals for the condenser are formed by the rotor shaft 11 and each of the sets of stator plates 24, 25 and 26 as represented by the extension member 58 on the set of stator plates 25. It will be observed that the entire set of stator plates 26 are arranged to be rocked in the construction illustrated in Figs. 2 and 3. I may also provide a construction as illustrated in Fig. 8 wherein a single stator plate 55 is rocked upon movement of cam 19 and lever arm 38. In this arrangement the stator plates 26 pass between rotor plates 23 and are carried on insulated bushings 29 and 30 and spaced by separators 31. The bushings 29 and 30 are disposed upon a tubular mem-

ber 57 forming a journal for a shaft 50. The stator plates 26 are spaced with respect to the end plates 1 and 2 by means of spacer members 53 and 54 with the shaft 50 passing through the bearing 57 and being secured by spring washer 51 retained under tension by means of nut 52. The shaft 50 is provided with an annular journal 49 which bears against member 57 forming a bearing surface therewith. The extension 47 of the shaft 50 is screw threaded as represented at 58 enabling spacing member 53 to be secured thereon, which member also serves as a bearing member. Insulated washers 54 and 56 are gripped between the shoulder 49 of the spacing member 53, locking plate 55 rigidly with respect to shaft 50 whereby plate 55 may be rocked between plates 47 of the rotor. The plates 47 of the rotor are spaced from the other plates of the rotor by means of a spacing washer 46. Connection is made from stator plate 55 with stator plates 26 and with an exterior circuit through projecting lugs on the plates and a flexible connection indicated at 58.

The operation of the multiple automatic condenser will be understood from the description given hereinbefore. The application of the apparatus to a radio receiving circuit is illustrated more clearly in Fig. 5 wherein an antenna ground system is represented at 60 and 61. A tuning transformer 62 is employed in the system with a primary winding 63 and secondary winding 64 in connection therewith. An electron tube 65 is connected to function as an amplifier of radio frequency energy. A transformer 66 has its primary 67 connected in the output circuit of electron tube 65 and its secondary winding 68 connected in the input circuit of tube 70 which is also arranged to function as a radio frequency amplifier. Radio frequency transformer 71 is provided with its primary winding 72 connected in the output circuit of tube 70 and its secondary winding 73 connected in the input circuit of a tube detector 74. A responsive device 75 may be connected in the output circuit of the detector or a plurality of stages of audio frequency amplification may be employed. The filaments of all of the electron tubes may be supplied from battery 76 while the plate potential for the several tubes is supplied from battery 77. The rotor plates 21, 22 and 23 are connected to one side of each of the secondary windings 64, 68 and 73 of radio frequency transformers 62, 66 and 71 respectively. The stator plates 24, 25 and 26 are respectively connected with the opposite side of secondary windings 68, 73 and 64. The cam 19 is so arranged that upon movement of the rotor shaft the sets of stator plates may be individually rocked to compensate for the electrical differences in the several electron tube circuits as the rotor plates are interleaved between the sets of stator plates.

It will be understood that the apparatus illustrated in the drawings is one of the preferred embodiments of my invention and has been used merely to facilitate the explanation of the principle of my invention and that modifications may be made and that I therefore desire that no limitations be placed upon my invention other than those imposed by the scope of the appended claims.

What I claim and desire to secure by Letters Patent of the United States is as follows:—

1. A variable condenser, comprising a rotatable shaft, a capacity area carried by said shaft and having a plurality of co-extensive plate portions projecting from said shaft, a plurality of stator shafts positioned adjacent said rotatable shaft and carrying capacity areas thereon in such position that said co-extensive plate portions projecting from said shaft may be moved to over-lie in varying degrees, said capacity areas forming said stators, and means for angularly rocking each of said last mentioned capacity areas simultaneously with and in proportion to the rotary movement of said co-extensive plate portions.

2. Means for selectively tuning a signal receiving system having a plurality of independent circuits coupled one to another throughout a series of stages, comprising a rotatable member having capacity areas corresponding in number to the number of circuits to be tuned, a corresponding number of capacity areas forming stators arranged adjacent said rotatable member and each independently connected with an opposite side of each of said circuits, said capacity areas having means whereby the angular position thereof may be varied simultaneously with and in a fixed proportion to the movement of said rotatable member.

3. A variable condenser comprising in combination a rotary shaft, a plurality of rotor plates carried by said shaft in spaced relation, a plurality of sets of stator plates spaced one from another and positioned on opposite sides of said shaft, said rotor plates projecting on opposite sides of said shaft and between said stator plates and means for moving each of said sets of stator plates simultaneously with the movement of said rotor plates.

4. A variable condenser comprising in combination a rotary shaft, a plurality of rotor plates carried by said shaft in spaced relation, a plurality of sets of stator plates spaced one from another and positioned on opposite sides of said shaft, said rotor plates projecting on opposite sides of said shaft

and between said stator plates and means for simultaneously moving each of said sets of stator plates in a selected proportion relative to the movement of said rotor plates.

5. A variable condenser comprising in combination a rotary shaft, a plurality of rotor plates carried by said shaft in spaced relation, a plurality of stator plates spaced one from another and positioned radially about said shaft, said rotor plates projecting radially from said shaft and between said stator plates, and means interposed between said rotary shaft and said stator plates but electrically insulated therefrom for controlling the movement of said stator plates in fixed proportion to the movement of said rotor plates.

6. A variable condenser comprising in combination a rotatable shaft, rotor plates carried by said shaft, a plurality of independent shafts positioned adjacent said rotatable shaft and carrying separate sets of stator plates thereon, said rotor plates being adapted to overlie said stator plates in varying degrees in accordance with the movement of said rotatable shaft, and means interposed between the several shafts for moving said stator plates simultaneously with the movement of said rotor plates.

7. A variable condenser comprising in combination a rotatable shaft, rotor plates carried by said shaft, a plurality of independent shafts positioned adjacent said rotatable shaft and carrying separate sets of stator plates thereon, said rotor plates being adapted to overlie said stator plates in varying degrees in accordance with the movement of said rotatable shaft, a cam positioned on said rotatable shaft and means secured to said independent shafts adapted to engage said cam whereby movement is imparted to said stator plates simultaneously with the movement of said rotatable shaft.

8. A variable condenser comprising in combination a rotatable shaft, rotor plates carried by said shaft, a plurality of independent shafts positioned adjacent said rotatable shaft and carrying separate sets of stator plates thereon, said rotor plates being adapted to overlie said stator plates in varying degrees in accordance with the movement of said rotatable shaft, a cam secured to said rotatable shaft and rocker arms secured to said independent shafts and adapted to contact with said cam whereby said stator plates are moved simultaneously with the movement of said rotatable shaft.

9. A variable condenser comprising in combination a rotatable shaft, rotor plates carried by said shaft, a plurality of independent shafts positioned adjacent said rotatable shaft and carrying separate sets of stator plates thereon, said rotor plates being adapted to overlie said stator plates in varying degrees in accordance with the movement of said rotatable shaft, a cam secured upon the end of said rotatable shaft and rocker arms secured to said independent shafts and adapted to be moved by the movement of said cam whereby said stator plates may be rocked through given angular distances simultaneously with the rotation of said rotatable shaft.

10. A variable condenser comprising in combination a rotatable shaft, rotor plates carried by said shaft, a plurality of independent shafts positioned adjacent said rotatable shaft and carrying separate sets of stator plates thereon, said rotor plates being adapted to overlie said stator plates in varying degrees in accordance with the movement of said rotatable shaft, a cam secured upon the end of said rotatable shaft and a pair of rocker arms secured to a pair of said independent shafts and having their ends directed toward each other in contact with said cam whereby said stator plates may be moved simultaneously with the movement of said rotatable shaft.

11. A variable condenser comprising in combination a rotatable shaft, rotor plates carried by said shaft, a plurality of independent shafts positioned adjacent said rotatable shaft and carrying separate sets of stator plates thereon, said rotor plates being adapted to overlie said stator plates in varying degrees in accordance with the movement of said rotatable shaft, a cam secured upon the end of said rotatable shaft, rocker arms secured upon the ends of said independent shafts and having their ends engaged in sliding contact with the surface of said cam and means for constantly urging said rocker arms against said cam whereby movement of said cam imparts movement to said stator plates.

12. A variable condenser comprising in combination a single rotor and a plurality of stators, means for rotating said rotor with respect to said stators and means for rocking a selected number of said stators through a selected angular distance in proportion to the movement of said rotor.

13. A variable condenser comprising in combination a set of rotatable plates, a plurality of independent sets of stator plates arranged in such manner that said rotatable plates may be intermeshed with said stator plates in varying degrees and means for varying the angular position of a portion of said stator plates in a selected proportion with respect to rotation of said rotatable plates.

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