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VARIABLE CONDENSER

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Fig. 1.

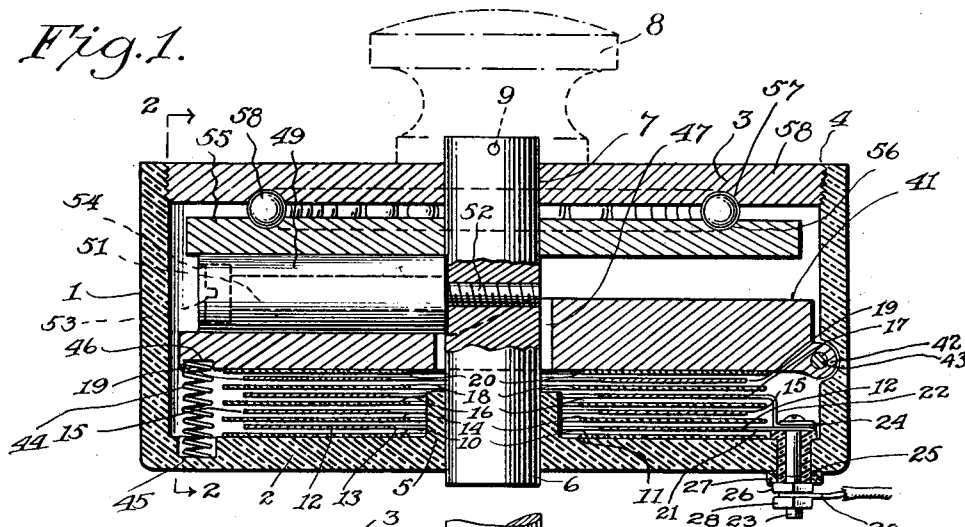


Fig. 2.

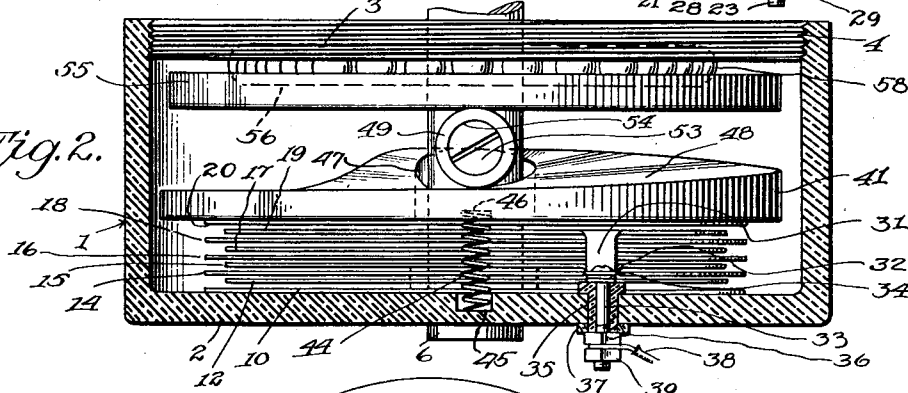
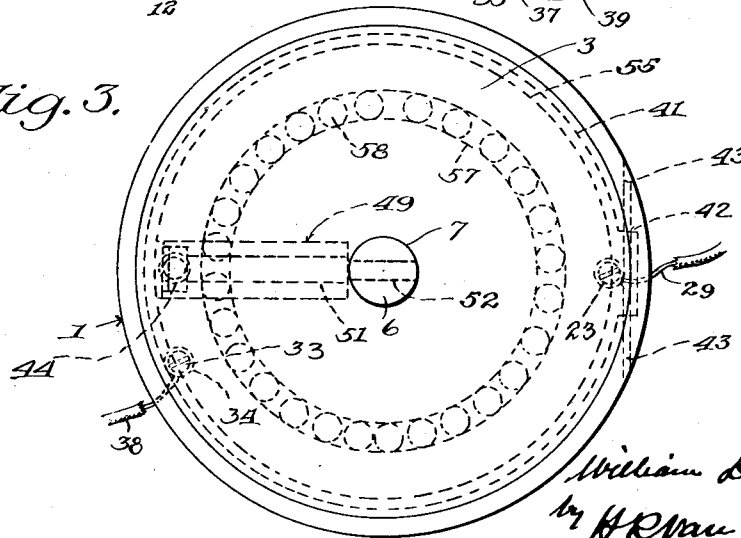


Fig. 3.



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UNITED STATES PATENT OFFICE.

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VARIABLE CONDENSER.

Application filed February 14, 1924. Serial No. 692,868.

My invention relates to condensers, and more particularly to variable condensers.

An object of my invention is to provide a condenser structure in which the adjustments of capacity may be made with a minimum of wear and tear on the condenser elements.

Another object of my invention is to provide a condenser in which adjustments may be made with a minimum of friction of the operating parts.

Heretofore, adjustment of capacity in condensers has usually been effected by bodily moving one of the condenser elements in relationship to another condenser element. In some cases, it has been necessary to distort the movable condenser element, and in such instances, continued long use may result in deterioration of the movable element. In the type of condenser where the movable element is not distorted but is bodily moved, mechanism for keeping the movable element properly aligned with the fixed element in all adjustments of the condenser has rendered the condenser liable to derangement and short circuits.

It is to overcome these difficulties existing in prior art structures that this invention was conceived. With these and other objects in view which may be incident to my improvements, the invention consists in the parts and combinations to be hereinafter set forth and claimed, with the understanding that the several necessary elements comprising my invention, may be varied in construction, proportions and arrangement, without departing from the spirit and scope of the appended claims.

In order to make my invention more clearly understood, I have shown in the accompanying drawings means for carrying the same into practical effect, without limiting the improvements in their useful applications to the particular constructions, which for the purpose of explanation, have been made the subject of illustration.

In the drawings:—

Figure 1 is a vertical sectional view taken through the center of the device;

Fig. 2 is a view with a part of the side wall of the casing of the condenser broken away, looking in the direction indicated by the arrows in line 2—2 of Fig. 1;

Fig. 3 is a top plan view.

My condenser comprises an insulating cas-

ing, upon the floor of which are placed the elements of the condenser which, in the present instance, consist of sheets of mica interleaved with metal foil. Above the elements of the condenser, lies a compression member having a sloped upper surface operating as a cam surface. Adapted to travel over the cam surface is a roller, which is swung with the rotative movement imparted to a central shaft through a turning knob. To insure that the roller shall be swung in substantially the same plane without undue stress on the central shaft, the top of the casing is provided with a ball race, and a bearing support piece has a similar ball race in its upper surface. The bearing support piece is adapted to rotate parallel to the upper wall of the casing, being held in spaced relationship from the upper wall by means of ball bearings.

The roller bears against this bearing support, and the longitudinal strain on the central shaft is relieved thereby. There is a spring means operating against the compression member, tending to relieve the strain on the stack of flexible elements. The adjustment of capacity is effected by swinging the roller to compress the compression plate against the flexible elements of the condenser. The capacity of the device will vary in accordance with the amount of compression to which the flexible condenser elements are subjected.

Referring to the drawings for a more detailed description, I have shown a condenser casing comprising an annular side wall 1, and a bottom wall 2. The casing may be made of insulating material, but this is not necessary as provision is made to insulate the condenser elements from the casing. A disk 3 of material similar to that of the casing forms the top wall, and is provided with screw-threads 4 which engage with screw-threads formed on the upper interior of the side wall 1. By screwing down the upper or top wall 3 into the side wall 1, a very compact, neat casing is formed. The bottom wall 2 is provided with an annular centrally located inwardly projecting protuberance 5. Projecting through an aperture centrally formed in the protuberance 5, is the end of a centrally located shaft 6, which may be made of metal. The upper end of the shaft 6 projects through a centrally located aperture 7 formed in the upper wall 3 of the

casing. An operating knob 8, which is keyed to the shaft 6 by means of a pin 9, is adapted to rotate the shaft 6 to accomplish the setting of the condenser, as will be later described.

Resting on the floor of the condenser, is a flexible disk 10 of mica, which comprises one of the insulating disks of the condenser. The disk 10 is provided with a central aperture 11 which fits around the protuberance 5 formed in the lower wall 2 of the casing. There is a considerable clearance between the outer periphery of the protuberance 5 and the edge of the aperture 11 which, to an extent, insures that the disk 10 will not come into abrasive contact with the central protuberance 5. The disk 10 is preferably attached to the bottom wall 2 of the casing by some suitable adhesive. Lying on the insulating mica disk 10 is an annular strip of metallic foil 12, provided with a central aperture 13 somewhat larger than the central aperture 11 of the mica sheet 10. The annular sheet 12 of metallic foil is of lesser diameter than the insulating sheet 10 so that the sheet 10 overlaps the foil 12 at the inner and the outer edges. Mounted over the foil 12 is an insulating sheet of mica 14, of shape and dimensions similar to the insulating sheet 10. Mounted above the insulating mica sheet 14 is an annular foil member 15 of similar construction to the foil member 12. This condenser stack comprising flexible elements laid one on top of another, consists of insulating sheets of mica corresponding to the mica sheet 10, which I have designated by the numerals 16, 18 and 20, and between the mica sheets 16 and 18, and the mica sheets 18 and 20, are sheets of metallic foil 17 and 19 respectively, corresponding to the strip of metallic foil 12. This whole stack of flexible condenser elements may be held together by some suitable gum or adhesive.

It will be understood that a condenser pile built of interleaved flexible insulating sheets of mica and sheets of metallic foil is as a whole flexible and compressible. In a stack of flexible elements so formed there is a considerable degree of compressibility, and by reason of the inherent resilience of the material of which the stack is formed, upon release of pressure the stack tends to assume its former dimensions.

In other words, a stack so formed will compress under pressure and expand upon release of pressure, thus giving a variation in the total capacity of the device, since the capacity varies inversely as the distance between the plates. It is also true that the dielectric existing between the metallic plates of the condenser comprises air and mica. When the condenser stack is under greatest pressure and the plates are the closest together, more air is excluded from

the stack than is the case where the stack is under light pressure. The capacity of a condenser varies directly as the dielectric constant.

The dielectric constant for air is 1, and for mica it varies between 4 and 8. Thus, the greater the compression, the less air is included between the plates and the more mica. Therefore, upon increase of pressure, the proportion of air to mica as dielectric is decreased and inversely the proportion of mica to air is increased. Since mica has a higher dielectric constant than air, the greater the pressure, the greater will be the actual value of K . C equals $K \frac{A}{d}$;

where C is the capacity; A is the inside area of the plates; d is the distance between the plates; and K is the actual dielectric constant, which will vary between 1, the dielectric constant for air, and 8 the maximum dielectric constant for mica.

Sheets of metallic foil 12 and 17 are provided with extending tabs 21 and 22, respectively, through which fits a binding post 23, whose head compresses a washer 24 against the tabs 21 and 22 and makes electrical connection therewith. The binding post 23 fits through an insulating bushing 25 passing through an aperture formed in the lower wall 2 of the casing. A nut 26 is tightened on the protruding end of the binding post 23 and holds the binding post in place, pressing on an insulating washer 27 which contacts against the lower wall 2. Another nut 28 screwed onto the end of the binding post 23 is adapted to compress a terminal 29 against the nut 26.

The metallic foil members 19 and 15 are provided with extension tabs 31 and 32, respectively, through which passes a binding post 33, whose head contacts with a holding washer 34, to hold the tabs 31 and 32 firmly in electrical connection with the binding post. The binding post 33 passes through an insulating bushing 35 extending through the bottom wall 2 of the casing. A holding nut 36 holds the binding post firmly in place, and bears against an insulating holding washer 37 which contacts with the wall 2 of the casing. A terminal 38 is adapted to be held between the nut 36 and another nut 39 on the binding post 33. Thus, electrical connection may be made from the outside with the flexible metallic plates of the condenser stack, the whole of which is formed of flexible elements. By reason of the fact that the condenser elements and the connections are insulated from the casing, it is not necessary to have the casing formed of insulating material, though it may so be formed.

Adapted to bear on the upper mica sheet 20 of the condenser stack is a compression member 41, which may or may not be formed

of insulating material, and is hinged at 42 to a hinge pin 43 that extends into the walls of the casing, as can be plainly seen in Fig. 3. On the opposite side of the compression member 41 from its hinged attachment to the side wall of the casing, is a compression spring 44, whose lower end rests in an annular depression 45 formed in the upper inner side of the lower wall 2 of the casing.

At its upper end, the spring rests in an annular depression 46 formed in the lower side of the compression member 41. The compression spring 44 constantly tends to raise the compression member 41 and release the pressure. An enlarged central aperture 47 is formed in the compression member, through which passes the shaft 6. The aperture 47 is purposely made of sufficient size so that the compression member 41 may be swung on its hinge over an appreciable arc without contacting with the central shaft 6.

The upper surface 48 of the compression member 41 has a slope which I have indicated in Fig. 2 as taking the form of a spiral or volute, though the particular shape of surface may be varied. This surface 48 acts as a cam surface, and upon it is adapted to roll a roller or wedging member 49 mounted on a shaft 51, whose inner end 52 is screw-threaded into the shaft 6. The head 53 of the shaft 51 fits into an aperture 54 formed in the outer end of the roller 49, and prevents the roller from longitudinal movement on the shaft 51.

By moving the operating handle 8, the roller 49 may be swung in a horizontal plane, and its surface will pass over the sloped cam surface 48 of the compression member 41. The compression member 41 will take a position, therefore, depending on the position of the roller 49.

To prevent the roller 49, as well as the shaft 51 and the shaft 6 from being subjected to too great strain, there is mounted above the roller 49 a bearing support disk 55 having a ball race 56 therein. A ball race 57 is formed in the lower side of the top wall 3 of the casing, and balls 58 travel in these adjacent ball races. The bearing support disk 55 takes the upward pressure on the roller in its rolling contact with the sloped surface 48 of the compression member 41. By reason of the fact that the bearing support disk 55 travels on ball bearings, the roller 49 is not prevented from freely rolling on the upper surface 48 of the compression member.

In operation, by revolving the handle 8, the roller 49 will travel over the sloped surface 48 of the compression member 41. The compression member 41 is caused to compress the stack of flexible condenser elements in one direction of rotation, which in the present instance would be counter-clockwise, and

in the other direction of rotation, the spring 44 will raise the compression member 41 and relieve the pressure on the condenser stack. As previously explained, the capacity of the condenser is increased in proportion to the pressure, since capacity is inversely proportional to the distance between the conducting plates, and directly proportional to the dielectric constant. The greater the pressure, the less air is included in the condenser, and the true or effective dielectric constant more nearly approaches the dielectric constant of the mica.

In my form of condenser, there is a minimum of wear and tear on the elements of the condenser, since none of the elements are subjected to abrasion in changing from one setting of the condenser to another setting. The parts of the condenser are few, and the construction strong and durable. While delicate and minute settings may be accomplished, the means for effecting the capacity changes is not delicate or easily subject to injury.

I may so adjust the factor of friction between the various moving parts, that it will be an easy matter to make the capacity adjustments, yet the force exerted on the roller by the cam surface when the condenser plates are under compression, will not be sufficient to cause the condenser to automatically reset itself.

Though I have shown the compression member as hinged to the side of the casing, it is to be understood that it is not necessarily attached and may freely float within the casing.

While I have shown and described the preferred embodiment of my invention, I wish it to be understood that I do not confine myself to the precise details of construction herein set forth by way of illustration, as it is apparent that many changes and variations may be made therein, by those skilled in the art, without departing from the spirit of the invention, or exceeding the scope of the appended claims.

I claim:—

1. A variable condenser comprising flexible elements in superposed relationship, a compression member adapted to bear on the flexible elements, and a wedging member operating to vary the pressure of the compression member on said elements, the compression member having a cam surface to be engaged by the wedging member.

2. A variable condenser comprising flexible elements in superposed relationship, a support on which the flexible elements rest, a compression member adapted to bear on the elements, said member having a cam surface, and a wedging member adapted to bear on the surface of the compression member to vary the pressure on the elements.

3. A variable condenser comprising flexi-

ble elements in superposed relationship, a pivoted compression member adapted to bear on the flexible elements, and a wedging member operating to vary the pressure of the compression member on said elements, the compression member having a cam surface to be engaged by the wedging member.

4. A variable condenser comprising flexible elements in superposed relationship, a support on which the flexible elements rest, a pivoted compression member, and means to vary the pressure of the compression member on the elements, said member having a cam surface to be engaged by said means.

5. A variable condenser comprising flexible elements in superposed relationship, a support on which the flexible elements rest, a pivoted compression member adapted to bear on the elements, said member having a cam surface, and a wedging member adapted to bear on the surface of the compression member to vary the pressure on the elements.

6. A variable condenser comprising superposed flexible elements, a compression member having a sloped upper surface, a roller bearing on the sloped upper surface, and means to cause relative movement between the upper surface and the roller to vary the pressure on the elements.

7. A variable condenser comprising superposed elements in contact with each other, a compression member having a sloped surface, a roller bearing on said surface, and means to move the roller over the surface to vary the pressure on the elements.

8. A variable condenser comprising superposed flexible elements in contact with each other, a support on which the elements rest, a pivoted pressure member bearing on the elements and having a sloped surface, a roller bearing on said surface, and means to move the roller over the surface to vary the pressure on the elements.

9. A variable condenser comprising superposed elements in contact with each other,

a compression member having a sloped surface, a roller bearing on said surface, and a shaft for swinging the roller, whereby the elements are subjected to varying pressure.

10. A variable condenser comprising a casing, superposed flexible elements in contact with each other on the floor of the casing, a compression member having a sloped surface and pivoted on the wall of the casing, a roller bearing on the upper surface, a shaft for swinging the roller, and means cooperating with the upper wall of the casing to take the strain transmitted to the roller.

11. A variable condenser comprising a casing, superposed flexible elements in contact with each other on the floor of the casing, a compression member having a sloped surface, a roller bearing on the upper surface, a shaft for swinging the roller, and a bearing support against which the roller bears.

12. A variable condenser comprising a casing, superposed flexible elements in contact with each other on the floor of the casing, a compression member having a sloped surface, a roller bearing on the sloped surface, a shaft for swinging the roller, an upper wall of the casing, a bearing support, and ball bearings between the bearing support and the upper wall of the casing.

13. A variable condenser comprising a casing having upper, lower and side walls, superposed flexible elements in contact with each other on the lower wall of the casing, a compression member having a sloped surface and pivoted on the side wall of the casing, a roller bearing on the sloped surface, a shaft for swinging the roller, a bearing support, ball bearings between the bearing support and the upper wall of the casing, and a spring cooperating with the compression member tending to constantly return the condenser to its minimum setting.

In testimony whereof I affix my signature.

WILLIAM DUBILIER