

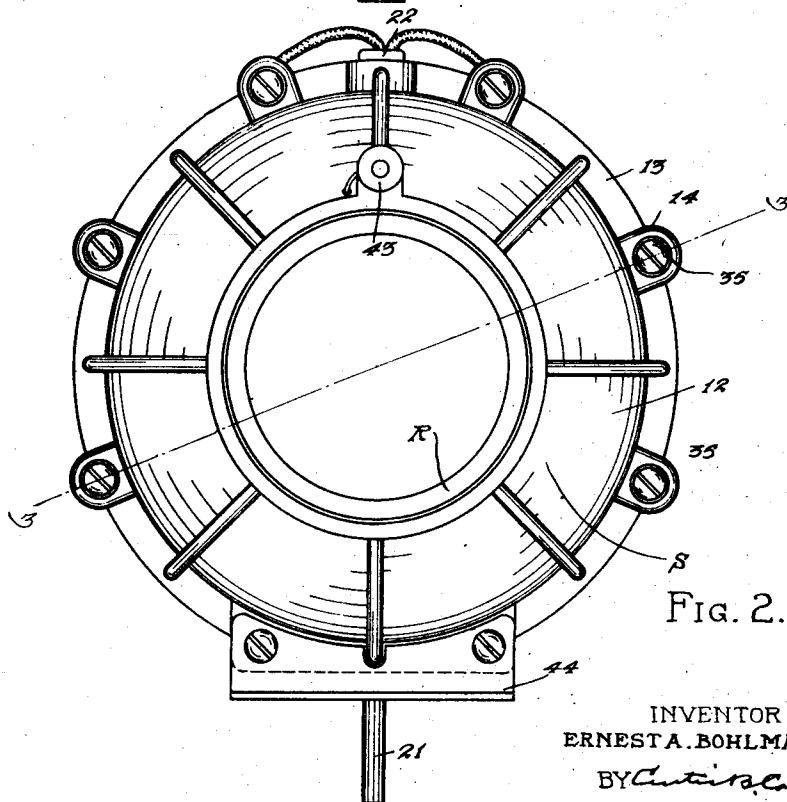
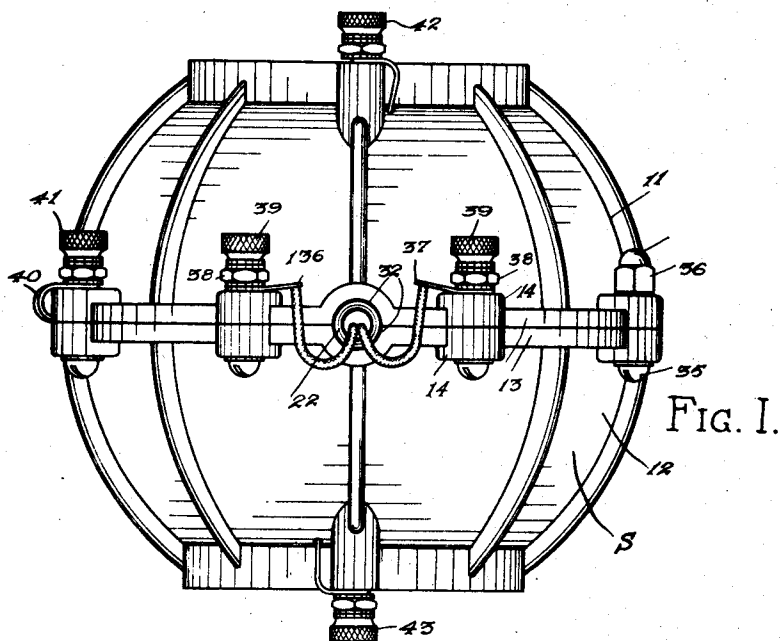
Aug. 10, 1926.

1,595,752

E. A. BOHLMAN
VARIABLE INDUCTANCE

Filed Oct. 25, 1922

3 Sheets-Sheet 1



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Aug. 10, 1926.

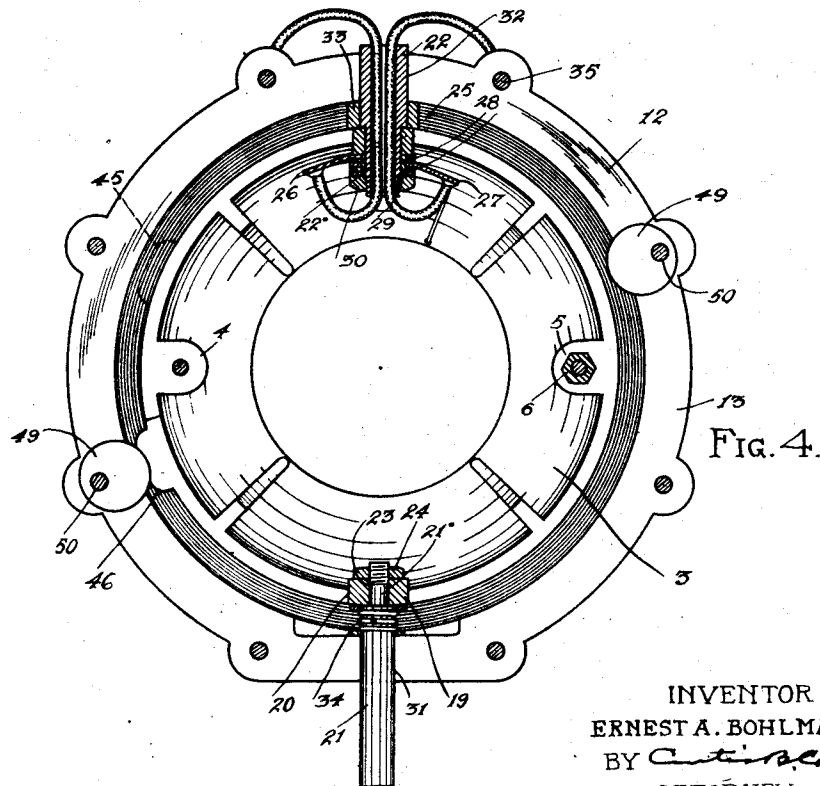
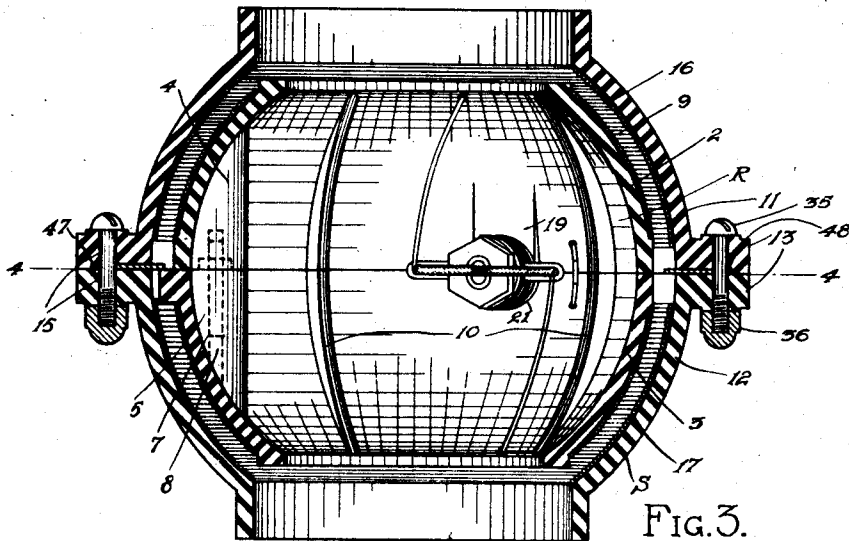
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VARIABLE INDUCTANCE

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3 Sheets-Sheet 2



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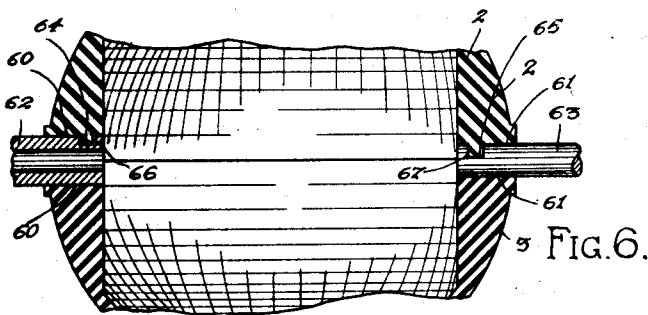
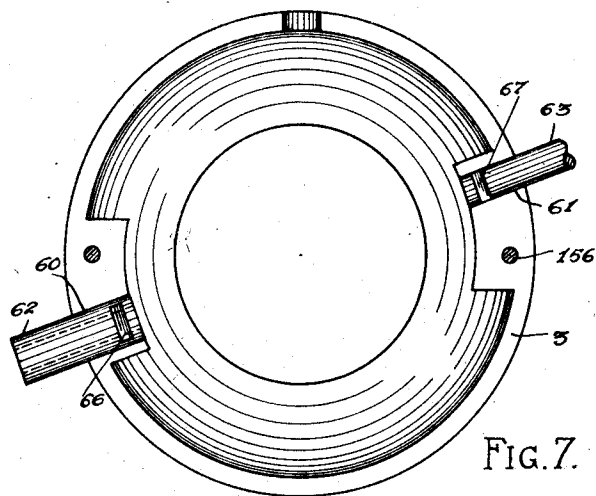
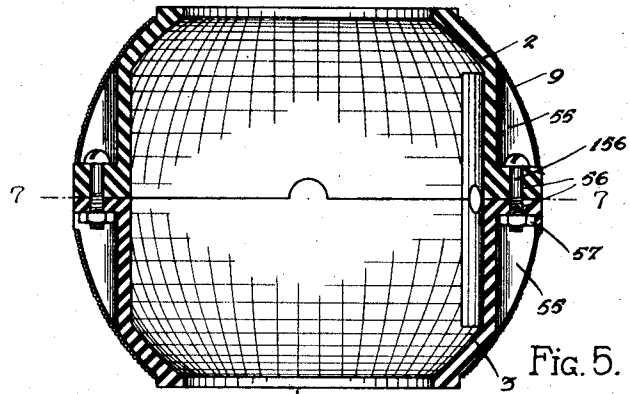
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VARIABLE INDUCTANCE

Filed Oct. 25, 1922

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

ERNEST A. BOHLMAN, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

VARIABLE INDUCTANCE.

Application filed October 25, 1922. Serial No. 596,740.

My invention relates to variable inductances, and has to do more particularly with a pair of coils, one stationary and the other rotatable, inside the stationary coil. Inductances of this type are commonly known in the art as variometers, and an object of my invention is the provision of an improved variometer which is provided with structural features which facilitate the assembly of a variometer of this type and at the same time provide an improved variometer structure which will be most efficient in its operation.

A variometer of the above type is provided with a stator which contains the stationary coil or winding and a rotor upon which the movable coil or winding is wound, and which rotor may be rotated within the stationary winding through a fixed degree of rotation. Various stops have been designed to limit the rotation of the rotor, but these are more or less complicated, and a feature of my invention is the provision of a novel stop arrangement for the rotor which accurately limits the rotation of the rotor, which is simple in construction and which comprises no complicated parts or fastening means.

Another feature of my invention is the provision of a novel spherical rotor which is constructed of two moulded halves, which insures accurate dimensions of the parts and the novel means for securing the halves together and at the same time presents a smooth surface upon which the coil or winding of the rotor may be wound.

Another feature of my invention is the provision of an improved pivot shaft for rotatably supporting the rotor inside of the stator and the novel means for holding the shaft in position in the rotor without the aid of screws or nuts, thus providing an improved and simplified shaft construction.

For a more complete understanding of my invention, reference may be had to the accompanying drawings, in which like reference characters in the several views denote like parts, and in which

Fig. 1 is a side elevation of the variometer of my invention;

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

Fig. 3 is a sectional view along the line 3—3 of Fig. 2, to clearly illustrate the structure of the rotor and stator;

Fig. 4 is a sectional view along the line

4—4 of Fig. 3, clearly illustrating the position of the rotor when in position inside of the stator;

Fig. 5 is a sectional view of a rotor illustrating a modified means for securing the two halves of the rotor together;

Fig. 6 is a sectional view of the rotor illustrating another method of holding the pivot shaft of the rotor in place in the stator; and

Fig. 7 is a sectional view along the line 7—7 of Fig. 5.

Referring now more in detail to my invention as illustrated, it comprises a rotor R spherical in form and moulded in two halves 2 and 3 of suitable insulating material, such as bakelite. Each half 2 and 3 of the rotor R has integrally formed therewith a pair of lugs 4 and 5 diametrically opposite each other, and hexagonal nut inserts 6 are moulded in the lug 4 of the rotor half 2 and the lug 5 of the rotor half 3 during the moulding operation of the halves of the rotor R. Suitable orifices 7 extend through the lug 5 of the rotor half 2, and the lug 4 of the rotor half 3, and are of a size to receive the screws 8, which have screw-threaded engagement with the nut inserts 6 in the lugs 4 and 5 of the rotor halves 2 and 3 to clamp the two halves 2 and 3 of the rotor R together. With this method of assembly of the two halves of the rotor R a smooth spherical surface is presented for winding the coil or winding 9 of the rotor R. Longitudinal ribs 10 are integrally formed with the rotor halves 2 and 3 upon their inner spherical surfaces and serve to strengthen the halves.

The stator S of the variometer is also spherical in form and moulded in two halves 11 and 12 of suitable insulation material such as bakelite. Each stator half 11 and 12 has integrally formed therewith a flange 13 and a plurality of offset portions 14 which are provided with orifices 15. A pair of coils or windings 16 and 17 are shaped to conform with the inner spherical surfaces of the stator halves 11 and 12, and rest therein and are held in position by means of suitable adhesive liquid, such as shellac or collodion, which when dry permits the windings 16 and 17 to adhere to the inner surfaces of the stator halves 11 and 12 of the stator S.

The rotor halves 2 and 3 of the rotor R

are each provided with a semi-circular tongue 19 and a semi-circular shaped notch diametrically opposite, so that the tongue 19 of each of the rotor halves 2 and 3 register with the notches 20 of the rotor halves 2 and 3 when the said rotor halves 2 and 3 are clamped together to form the rotor R, as previously described. A pair of shafts 21 and 22 are provided for rotatably supporting the rotor R as a whole inside of the stator S. The shaft 21 is provided with a reduced portion 21' whose end is threaded and which extends through a suitable orifice 23 in the tongue 19 of the rotor half 3 and is secured to the rotor half 3 by means of a nut 24 which has screw-threaded engagement with the threaded end of the reduced portion 21' of the shaft 21. The shaft 22 which forms the other shaft support is tubular in form and is provided with a reduced portion 22' which extends through an orifice 25 in the tongue 19 of the rotor half 2. Terminals 26 and 27 to which the terminals of the windings 9 of the rotor R are soldered are supported upon the reduced portion 22' of the shaft 22 which extends through the tongue 19 of the rotor half 2, and which are suitably insulated from each other and the shaft 22 by means of insulation washers 28 and sleeve 29. A nut 30 is provided which has screw-threaded engagement with the threaded end of the reduced portion 22' of the shaft 22 to secure the shaft 22 to the rotor half 2 and also clamp the terminals 26 and 27 upon the shaft 22.

The stator halves 11 and 12 are provided with semi-circular recesses 31 and 32 diametrically opposite, and the recesses 31 in each of the stator halves 11 and 12 form an orifice of a size to permit the shaft 21 to extend through, and the recesses 32 in each of the stator halves 11 and 12 form an orifice of a size to permit the shaft 22 to extend through, the said orifices formed by the recesses 31 and 32 forming bearings for the said rotor R when the same is rotated.

The rotor R is adapted to rotate within the assembled stator S and is supported upon the shafts 21 and 22 and held in concentric relation with the stator S by means of a spacer washer 33 which is placed upon the shaft 22 between the rotor R and inner face of the stator S. A spring 34 is placed upon the shaft 21 and rests between the rotor R and inner face of the stator S to prevent any longitudinal movement of the rotor R as a whole in its bearings, and also provides a friction means for holding the rotor in any of its adjusted positions. When the rotor R is in its position as illustrated in Fig. 4, the stator half 11 is placed in position and screws 35 pass through the orifices 15 in the flange 13 of the stator halves 11 and 12, and nuts 36 having screw-

threaded engagement with the screws 35 clamp the stator halves to form the spherical shaped stator S. Certain of the screws 35 are adapted to receive terminals 136 and 37 to which the winding terminals of the coil 9 of the rotor R are soldered, the said winding terminals from the interior connection terminals 26 and 27 being led through the hollow shaft 22 to the terminals 136 and 37, and a suitable nut 38 clamping the said terminals 136 and 37 in position. Thumb screws 39 are also provided which have screw-threaded engagement with the screws 35 and are for the external circuit connections. The inside terminals 40 of the windings 16 and 17 of the stator halves 11 and 12 are brought out through suitable openings in the stator halves 11 and 12 to the terminal or binding post 41 secured to one of the screws 35. The other terminals of the windings 16 and 17 of the stator halves 11 and 12 are brought through suitable openings and connected to the external terminals 42 and 43 secured to the stator halves 11 and 12. Brackets 44 are secured to the stator halves 11 and 12 by means of the screws 35 and nuts 36 and permit the variometer as a whole to be secured to a panel.

As before stated, the rotor element R is adapted to be rotated within the stator element S through a fixed degree, which in practice is set at 180 degrees, and I provide novel stopping means for stopping the rotor R in its zero position and its extreme position, which is 180 degrees. The rotor half 2 is provided with a stop lug 45 integrally formed therewith, and the rotor half 3 is also provided with a stop lug 46, which lugs 45 and 46 when the rotor halves 2 and 3 are assembled are spaced 45 degrees apart. The stator half 11 is provided with a pair of circular depressions 47 and 48, whose centers are eccentrically displaced in relation to the centers of a pair of diametrically opposite orifices 15 in the flange 13 of the sector half 11. Discs 49 are provided and are of a size to rest in the depressions 47 and 48 and are provided with eccentrically displaced orifices 50 which register with the orifices 15. Now, when the stator half 12 is in place and the two stator halves 11 and 12 are secured together, the discs 49 are held in position. By referring to Fig. 3 and 4 it may be seen that when the rotor R is in the position illustrated in Fig. 4 and the stop lug 46 of the rotor half 3 engages a disc 49 and thus limits the movement in a clockwise direction. Now, when the rotor R is turned in a counter-clockwise direction, the stop lug 45 on the rotor half 2 which is shown in dotted lines in Fig. 4, will engage the disc 49 diametrically opposite the disc 49 that was engaged by the stop lug 46 on the rotor half 2 when moved through 180 degrees of rotation in a counter-

clockwise direction. When the rotor R is again turned in a clockwise direction, the stop lug 45 will again engage its associated disk 49.

From the above description it may be seen that I provide a novel stop arrangement for the rotor R which is simple in construction and does not necessitate a large number of parts.

Referring now to Fig. 5, I illustrate another form of securing the rotor halves 2 and 3 together to form the spherical rotor R. The halves 2 and 3 are each provided with a pair of niches 55 semi-circular in form, and orifices 56 are provided in the flanged portions of the rotor halves 2 and 3 of a size to receive the screws 156, and nuts 57 are provided which have screw-threaded engagement with the screws 156 to clamp the rotor halves 2 and 3 together. The windings 9 of the rotor R are wound upon the halves in a manner as previously described. The spherical surfaces of the halves present a substantially smooth surface as the niches 55 in the halves 2 and 3 are of such width as to receive the nut 56 and are therefore not very wide.

Referring now to Figs. 6 and 7, I illustrate a simplified means for securing the supporting shafts 62 and 63 to the rotor R. The rotor halves 2 and 3 as illustrated in Fig. 6 are each provided with semi-circular recesses 60 and 61 diametrically opposite and when secured by means of the screws 156 and nuts 57, the orifices formed by the recesses 60 and 61 of the rotor halves 2 and 3 are of a size to receive the shafts 62 and 63. The recesses 60 and 61 of the rotor half 2 have integrally formed therewith square lugs 64 and 65, and shafts 62 and 63 are provided with notches 66 and 67 into which the lugs 64 and 65 extend. Now, when the rotor halves 2 and 3 are secured together by means of the screws 156 and nuts 57, to form the rotor R, the shafts 62 and 63 are held in position in the orifices formed by the recesses 60 and 61 against endwise movement and turning by means of the lugs 64 and 65 extending into the notches 66 and 67 of the shafts 62 and 63.

What I claim as new and desire to secure by United States Letters Patent, is:

1. In a device of the class described including a stator element and a rotor element, a pair of hemispherically shaped members comprising said stator element, and a pair of hemispherically shaped members comprising said rotor element, shafts for supporting said rotor element, bearings for said shafts in said stator element for rotatably supporting said rotor element, and stop means integrally formed with said rotor element and operatively associated with stop means secured to said stator for limit-

ing the degree of rotation of said rotor element inside of said stator element.

2. In a device of the class described including a stator element comprising a pair of hemispherically shaped members and a rotor element comprising a pair of hemispherically shaped members, shafts for said rotor, bearings in said stator element for said shafts for rotatably supporting said rotor element inside of said stator element, stop lugs integrally formed with said rotor element and operatively associated with means secured to said stator element for limiting the rotation of said rotor element inside of said stator element.

3. In a device of the class described including a stator element comprising a pair of hemispherically shaped members and a rotor element comprising a pair of hemispherically shaped members, shafts for said rotor, bearings in said stator element for said shafts for rotatably supporting said rotor element inside of said stator, a pair of discs diametrically opposite secured to said stator element, a pair of lugs on said rotor element, one of said lugs adapted to engage one of said discs when said rotor element is rotated in a clockwise direction, and said other lug on said rotor element adapted to engage the other disc secured to said stator element when said rotor element is rotated in a counter-clockwise direction to limit said rotor in its predetermined degree of rotation.

4. In a device of the class described including a stator element comprising a pair of hemispherically shaped members, a rotor element comprising a pair of hemispherically shaped members, a shaft for said rotor element, bearings in said stator element for said shaft for rotatably supporting said rotor element inside of said stator element, screws for securing together said hemispherical halves of said stator, a pair of discs diametrically opposite and eccentrically secured between said halves of said stator element by means of a pair of set screws, said discs projecting inside of said stator element, a lug on said rotor element adapted to engage one of said discs to limit the rotation of said rotor element in a clockwise direction, and a second lug on said rotor adapted to engage the second disc diametrically opposite said first disc to limit the rotation of said rotor element in a counter-clockwise direction in its predetermined degree of rotation in either of said directions.

5. In a device of the class described including a rotor element comprising a pair of hemispherically shaped members, a shaft for said rotor element for rotatably supporting said rotor element, said shaft having notches formed in its body portion, semi-circular recesses in said rotor halves

diametrically opposite forming orifices for receiving said shaft when said rotor halves are secured together, and lugs integrally formed in said recesses of one of said rotor halves for engaging the notches in said shaft thereby securing said shaft in said orifices formed by said recesses in said rotor halves.

6. In a device of the class described including a rotor element comprising a pair of hemispherically shaped members, a pair of shafts for said rotor element, semi-circular recesses in said rotor halves diametrically opposite forming orifices for said pair of shafts, when said rotor halves are secured together, lugs integrally formed in the recesses of one of said rotor halves, said shafts having notches intermediate of their ends into which said lugs extend to hold said shafts in said formed orifices against rotation and endwise movement.

7. In a device of the class described, a pair of hemispherical members having integrally formed lugs, means for engaging said lugs to secure said members together to form a stator element, coils secured to the inner surface of said members, a rotor element comprising a pair of hemispherically shaped members having coils wound thereon, cylindrical members formed integrally with the inner spherical surface of said second pair of members, and extending at right angles to the axis of rotation of said rotor element, means for engaging said cylindrical members to secure said second members together, a pair of shafts secured to said rotor element for rotatably supporting said rotor element in said stator element, and means for leading and connecting the coils of said rotor element to terminals secured to said stator element.

8. A device of the class described including a stator element and a rotor element, separate and independent windings for said rotor element and stator element, a pair of shafts for rotatably supporting said rotor element within said stator element, one of said shafts having a central opening throughout, a pair of connecting terminals secured to said one shaft but insulated therefrom, the terminal ends of the wind-

ings of said rotor element being connected to said pair of terminals, and conductors secured to said pair of terminals and extending through the central opening in said one shaft and having connection with terminals secured to said stator element.

9. A device of the class described including a stator element and a rotor element, separate and independent windings for said rotor element and stator element, a pair of shafts for rotatably supporting said rotor element within and on said stator element, one of said shafts having a central opening throughout, a pair of connecting terminals secured to said one shaft but insulated therefrom, the terminal ends of the windings of said rotor element being connected to said pair of terminals, conductors secured to said pair of terminals and extending through the central opening in said one shaft and having connection with terminals secured to said stator element, and a spacer washer secured to said one shaft for spacing said rotor element relative to said stator element.

10. A device of the class described including a stator element and a rotor element, separate and independent windings for said rotor element and stator element, a pair of shafts for rotatably supporting said rotor element within and on said stator element, one of said shafts having a central opening throughout, a pair of connecting terminals secured to said one shaft but insulated therefrom, the terminal ends of the windings of said rotor element being connected to said pair of terminals, conductors secured to said pair of terminals and extending through the central opening in said one shaft and having connection with terminals secured to said stator element, a spacer washer secured to said one shaft for spacing said rotor element relative to said stator element, and a coil spring for the other of said pair of shafts for exerting a pressure upon said rotor element to retain said rotor element in its rotated position.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 21st day of October, 1922.

ERNEST A. BOHLMAN.