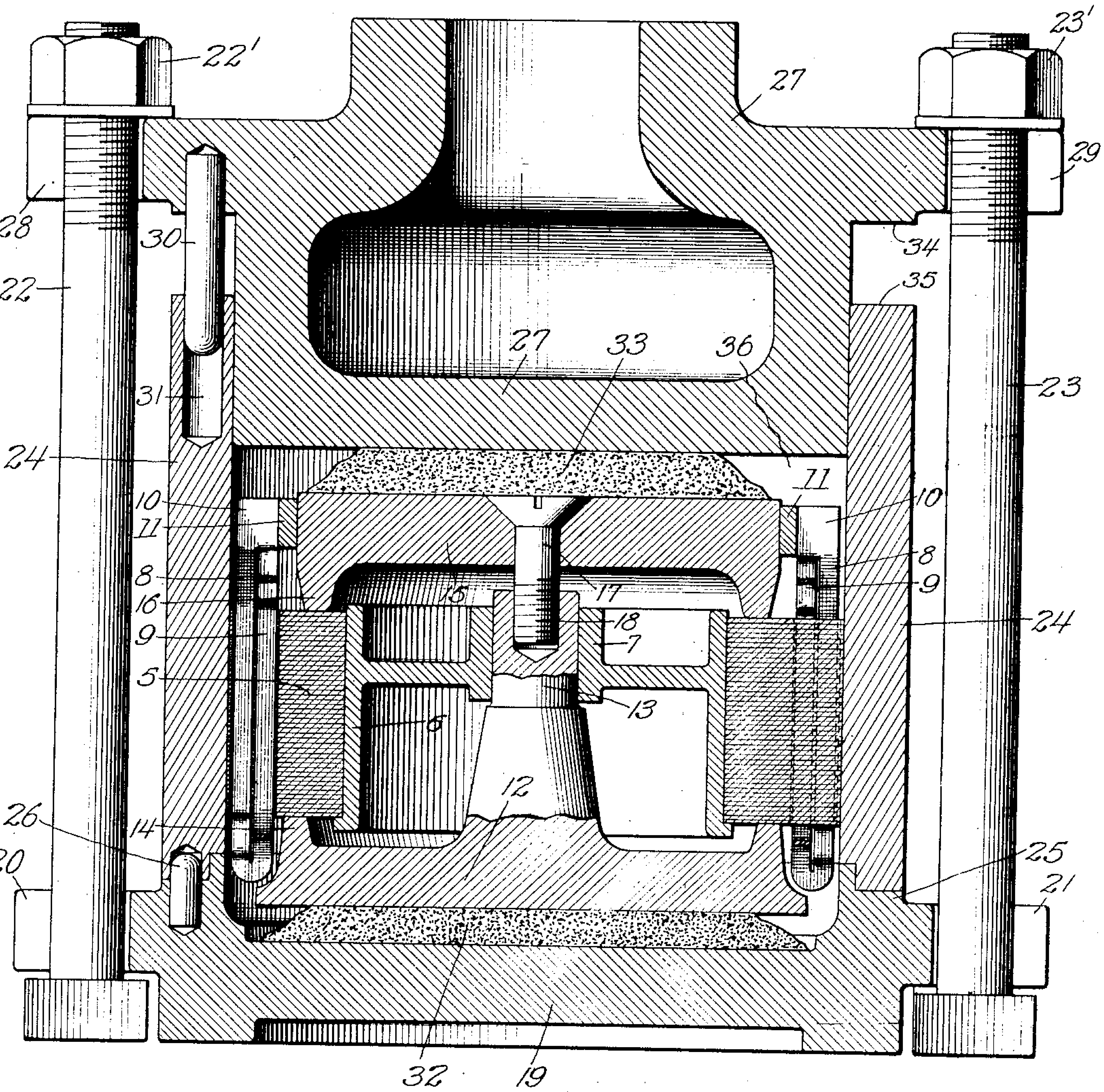
Jan. 2, 1923. 1,440,951

V. G. APPLE.
ARMATURE CONSTRUCTION.
FILED APR. 27, 1918.

2 SHEETS-SHEET 1

Fig. 1.



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2 SHEETS-SHEET 2

Fig. 3.

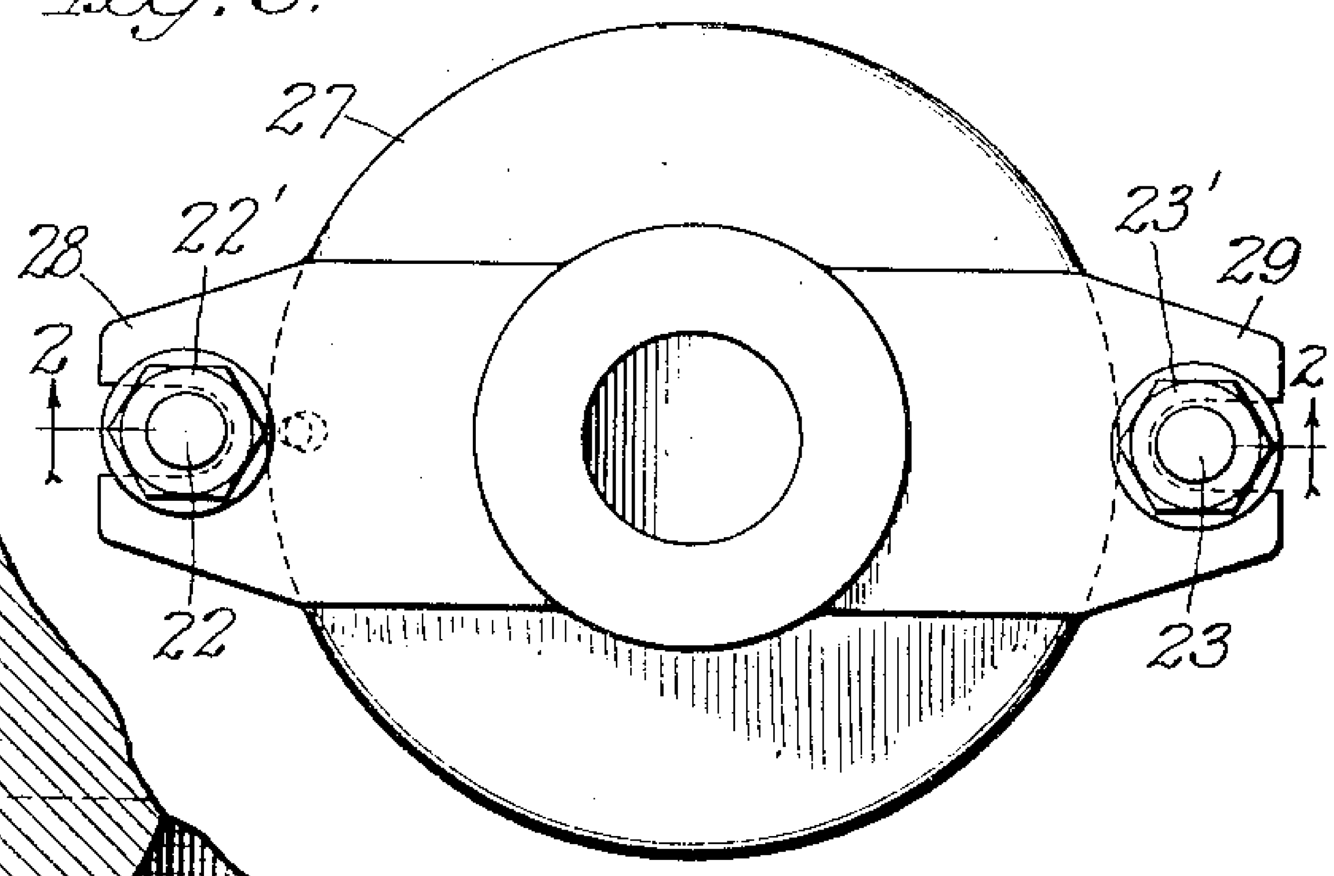
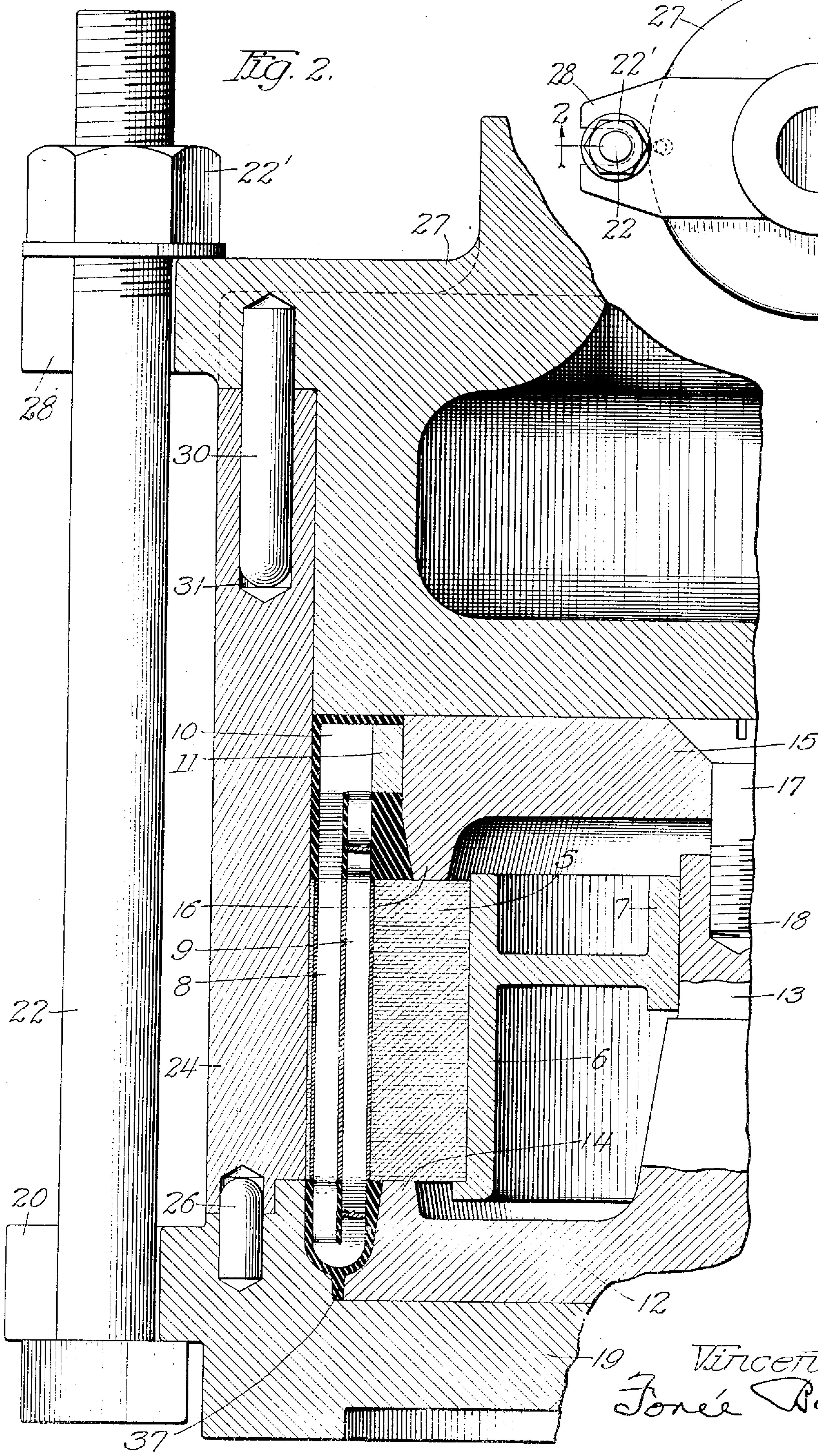


Fig. 2.



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Patented Jan. 2, 1923. **1,440,951**

UNITED STATES PATENT OFFICE.

VINCENT G. APPLE, OF DAYTON, OHIO.

ARMATURE CONSTRUCTION.

Application filed April 27, 1918. Serial No. 231,291.

To all whom it may concern:

Be it known that I, VINCENT G. APPLE, a citizen of the United States, residing at Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Armature Construction, of which the following is a specification.

My invention relates to improvements in armature construction and has especial reference to a method of procedure whereby to provide substantially indestructible insulation and support for the armature and commutator.

The proper insulation of armatures is one of the greatest problems in armature construction, the true principles involved being but little understood or appreciated.

It has heretofore been the general custom to enclose armature conductors, prior to their application to the core, with a fibrous material, such as a single or double winding of cotton thread and to use other similar kindred material, such as cotton fabric to supplement the thread covering as the wires or conductors are applied.

These substances are pervious to moisture, and liquids, such as water, oil and the like, and being subjected to repeated changes of temperature of wide variations rapidly deteriorate.

The fibrous insulating material first becomes brittle and then charred, thus reducing and frequently destroying its mechanical and insulating resistance.

In my improved method of constructing armatures, I have entirely eliminated all hydroscopic insulating materials and have substituted more stable and refractory supports for the conductors, and furthermore the insulating material is applied after the conductors are in place on the core and is of such character as to positively maintain all parts of every conductor firmly in place.

There are two other disturbing causes in an operating armature that tend to break down or destroy its insulation. The mechanical vibrations of the conductors, when loosely supported upon the core, produce rapid, relative movement of the wires, with respect to each other and with the core, causing the insulating covering to become chafed and worn away, finally permitting metallic contact between the conductors and between the conductors and core which, of course, destroys the operative use of the armature.

The other cause is the rapidly recurring magnetic attraction and repulsion of adjacent conductors, by their change of electrical polarity due to the rotary movement of the conductors thru magnetic fields of varying intensity and character.

In the cyclic operation of a pair of adjacent conductors of an armature, they are, at certain stages of their rotation, of the same polarity and their mutual magnetic influences tend to cause them to move closer together; at other critical points in their functional movement they are of opposite polarity, causing them mutually to repel each other. These slight movements, when permitted, are each so infinitesimal as to resemble molecular disturbances, but they are just as real as if they were more extensive and as such movements are occurring many times in each revolution of an armature, having loosely supported conductors, their destructive effects in the aggregate is not to be overlooked.

The kinetic energy thus induced in the armature conductors will, sooner or later, cause crystallization of the metal and this will increase the internal resistance, and loss of dynamic energy.

To overcome the causes for these undesirable effects I provide a method of procedure and means for firmly and positively holding and securing every part of every armature conductor, immovably in place, so that it may not be moved in the slightest degree from its initial position and to facilitate the mode of procedure, I place the insulation after the conductors are mounted on the core.

In some instances I may connect the commutator sections to the armature conductors and temporarily support them in spaced-apart relation, and subsequently force a suitable insulating mastic or other well adapted material around and between the conductors and sections, by suitable pressure, using this means as the only permanent support for the conductors and commutator, as well as an insulator for the parts.

A very suitable insulating material that may conveniently be used for the purpose is one having plastic and adhesive qualities, embodied in plastic sheets, powdered or finely comminuted form, which becomes liquid by application of suitable heat and pressure and subsequently hardens and becomes strong after cooling and which is substantially unaffected when heated again to the same or a greater temperature.

In the accompanying drawing I have shown a press or mold in which an armature, as a whole, may be contained and by the operation of which the insulating mastics may be forced into all of the interstices between the separated parts of the armature and commutator.

Fig. 1 shows a central sectional elevation of the armature before pressure has been applied to the parts.

Fig. 2 is a part of a similar section, showing the position of the insulating mastic in the places which it will occupy in the finished armature, this section being taken on line 2—2 of Fig. 3.

Fig. 3 is a plan view of the press.

In all the views the same reference characters are employed to indicate similar parts.

Before placing the armature in the press, I place the conductors upon the core and temporarily support them in proper spaced apart relation, pair them and weld, or otherwise secure the ends of the conductors to the commutator sections, and suitably space them temporarily apart, leaving interstices or spaces between the adjacent conductors and between the conductors and the core. The spacing material may be of an absorbing or fibrous nature, such as fish paper, or the like, which becomes absolutely nonhydroscopic when saturated and treated with the insulating material.

In the embodiment illustrated, 5 shows the laminated core of an armature mounted upon a spider 6, having a hub 7 for a centrally disposed shaft. The conductors 8 and 9 are placed in suitable perforations or grooves in the core and properly spaced apart and then properly paired and welded together, as at 10, and to the commutator sections, the proper paired terminals of the armature being, preferably, welded to the commutator sections 11. Commutator sections are also properly spaced apart and temporarily held by any suitable means, so that when the armature, as a whole, is subjected to pressure, the parts will not be brought into metallic connection thereby.

A plate 12, having a central projecting hub or axis 13, substantially fitting the hollow hub 7, of the armature, is placed on one end of the armature, and a laterally projecting annular flange 14, is brought into contact with the face of the laminated structure 5. A similar plate 15, having an annular flange 16, for engagement with the other side of the laminated core structure, is held in proper relation with the armature core, by a screw 17, which takes into the end of the projection 13, as at 18. The screw 17 is tightened, so that the rims 14 and 16 are brought and held in intimate contact with the side faces of the armature core. The diameter of the plate 15, is, preferably, such as to support the commutator sections 11, concentrically with the bore of the hub 7 of the armature and to effectively cover the active surfaces thereof.

The press proper is made of a base plate 19, having laterally extending open ears 20 and 21 to receive bolts 22 and 23, and providing an open end separable cylindrical part 24, which is placed upon the rim 25 of the base plate and held securely against rotary movement by a dowel pin 26. A head 27 fits neatly in the cylinder 24 and is provided with open ears 28 and 29 for said bolts. An elongated dowel pin 30 fits loosely in the bore 31 made in the end of the cylinder, and serves as a guide to place and hold the head 27 in proper relation with the bolts 22 and 23.

Before placing the armature and the attached plates in the mold, I first put on the floor of the mold, or the top of the base plate 19, an admeasured amount of molding compound, such for example a composition of a suitable quantity of wood cellulose and an adhesive, of which phenol-resin is a base, and which is a product that may be purchased in the open market. However, the material in a semi-liquid form, or other similar and suitable material may successfully be used in its stead. This material is indicated by the reference character 32, and in Fig. 1, the plate 12, which encompasses one end of the armature is shown as resting upon it. A similar material 33 may be placed above the plate 15, if desired. Now the entire press or mold with its contents, is placed in a suitable position to be heated to a relatively high temperature. This will convert the permanent insulating material 32 and 33, into a mobile viscous, sticky mass and when pressure is applied to the head 27 of the mold, the viscous mass is pressed out of its place between the plates 12 and 19 and between the plates 15 and the under surface of the head 27 into all of the open spaces or interstices left between the adjacent conductors, and between the core and the conductors, and between the commutator sections and will fill the pores of the temporary supports when said supports are of a porous or fibrous character. When the undersurface 34 of the head 27 is brought into contact with the upper surface 35 of the cylinder 24, then the lower surface 36 of the head 27 is in actual contact with the upper surface of the plate 15 and the lower surface of the plate 12 is brought into contact with the upper surface of the plate 19 of the press or mold. Therefore, all of the material, 32 and 33, will have been expressed from between these plates, and forced into all of the openings and interstices in the armature windings and the commutator sections, as clearly shown in Fig. 2.

The diameter of the plate 12 is a little less than the diameter of the internal depression made in the plate 19 of the press so that the comminuted material 32, when made semi-fluid by heat, may pass up between the plate 12 and the adjacent annular surface of the plate 19, in which it is contained, thereby forming an annular fin 37, of insulating material, around the armature conductors 8 and 9.

The black, cross-sectional lines in Fig. 2 show the insulating material that has been forced around the temporarily supported armature conductors and commutator segments by the process described.

The heat and pressure may be applied to the mold or press at the same time, if desired, or sufficient heat may first be applied and the pressure applied subsequently. After the heat and pressure have been applied to a sufficient extent, the parts are held in their compressed positions, after being taken from the power press, by the bolts 22 and 23, and by the cooperating nuts 22′ and 23′.

After the armature and mold have been sufficiently cooled, the nuts 22′ and 23′ may be slightly loosened and the bolts will slip out of the slotted ears 20 and 21, and 28 and 29, and the head 27 may be removed, after which the armature and the connected plates may be taken from the mold and then the plates may be removed from the armature, leaving it completed, ready for its intended operation.

After an armature has been built, in accordance with my method of procedure, it will be impossible for the insulation to be destroyed by any ordinary use to which it may be subjected, and should the armature insulation become destroyed, by any extraordinary means, the entire structure may be thrown away and substituted by a new armature. Repairs of an armature, when made in accordance with my process, are not contemplated. When armatures, or the like, are dipped into a liquid insulating varnish such as bakelite and heated to harden the adhesive without confining the armature and the adhesive in a mold, the adhesive material, before it hardens runs out from between the separated parts and forms hardened stalactites of insulating material, leaving the spaces open and requiring removal of the appendent excrescenses. By confining the armature and insulating material in a mold until the former hardens, the spaces between the wires and between the wires and core are entirely filled producing a hardened homogeneous mass.

Of course it will be manifest, to persons skilled in the art, that other adhesive or filling, moldable, insulating material may be substituted for that herein specifically mentioned, and instead of being in powdered form it may be a heavy mastic, or may partake of any other suitable characteristics.

Having described my invention, what I claim is:—

1. Steps in the method of making armatures which consist in placing armature conductors on a core; appropriately pairing the conductors and connecting each pair to a separate commutator section; placing the armature with attached commutator sections in a mold; temporarily supporting said conductors and sections; then applying a heated moldable insulating material to the enclosed armature while subjected to pressure.

2. Steps in the method of making armatures which consist in placing the armature with attached commutator in a mold with a sufficient quantity of moldable insulating material which hardens by application of heat, then applying heat and pressure to cement the armature and commutator together by said molded insulating material.

3. Steps in the method of making armatures which consist in molding an insulating moldable material about one end of the armature and the inactive surfaces of the commutator to support the latter thereby.

4. Steps in the method of making armatures which consist in molding a ring of insulating moldable material about one end of the armature including the terminal ends of the conductors and a portion of the commutator to support and cement the parts together.

5. The method of making armatures which consist in placing conducting bars on the core and projecting the ends therebeyond; joining appropriate ends together; joining the ends thus paired to appropriate commutator sections; embedding said conducting bars and the inactive surfaces of the commutator sections in a covering of moldable insulating material and applying insulating material to the projecting ends and to the commutator sections as a means of support.

6. The method of making armatures which consists in electrically connecting commutator sections appropriately to terminals of the armature conductors and subsequently molding insulating material about the sections.

7. The method of making armatures which consists in electrically connecting commutator sections appropriately to terminals of the armature conductors; maintaining said sections in spaced relation and subsequently molding a ring of insulating material about said sections and terminals.

8. The method of making armatures which consists in placing conducting bars on the core and projecting the ends there-

beyond; joining appropriate ends together; joining the ends thus paired to appropriate commutator sections; embedding said ends and the inactive surfaces of the commutator sections in a covering of moldable insulating material and supporting the commutator wholly by the bars and insulating material.

9. An armature having in combinative association, projecting conductor ends; a commutator, to sections of which the ends are respectively connected, and a ring of moldable insulating material supported independently of the armature shaft and entirely embedding and covering said ends and all of the inactive surface of the commutator.

10. A conducting member of an armature mounted on a core, said conducting member wholly and the core partly embedded in the same substantially continuous mass of moldable insulating material.

11. In combination with an armature, a commutator having its inactive surfaces embedded in a molded insulating material and a conductor connected thereto, embedded in the same insulating continuous mass and affording the only support for the conductor.

12. An armature having a conductor substantially embedded in a molded insulating material and a commutator connected thereto partially embedded in the same homogeneous insulating mass, said body of insulation extending from the armature to the commutator.

In testimony whereof I hereunto set my hand.

VINCENT G. APPLE.