Dec. 17, 1940. A. EISELE 2,224,954

MAGNET

Filed April 7, 1937 2 Sheets-Sheet 1

Fig. 1

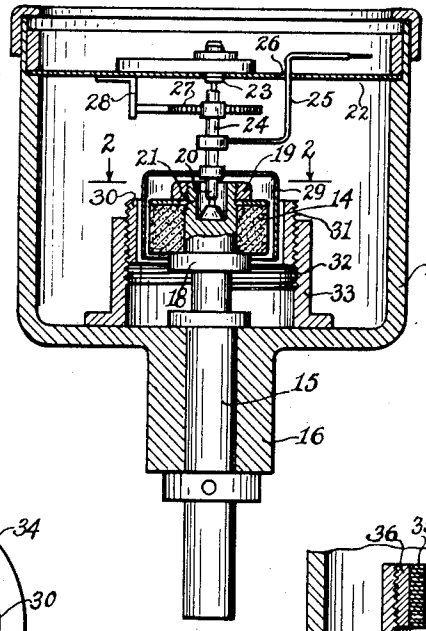


Fig. 13

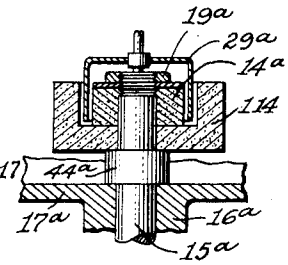


Fig. 2

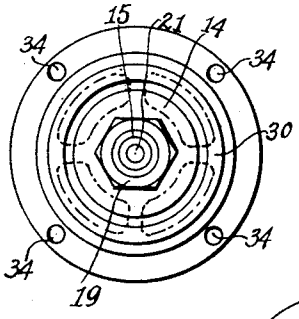


Fig. 3

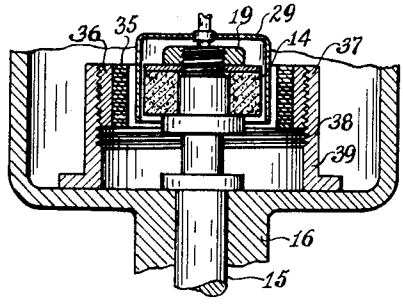


Fig. 5

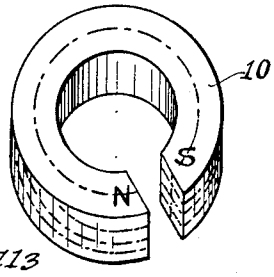


Fig. 12

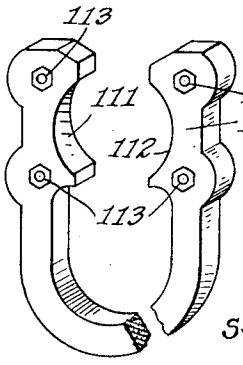


Fig. 4

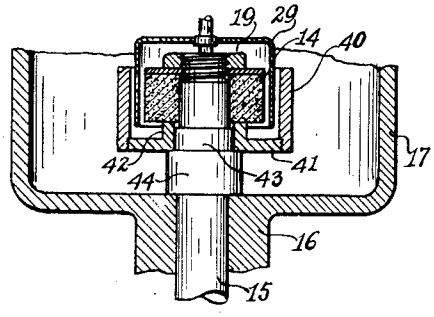
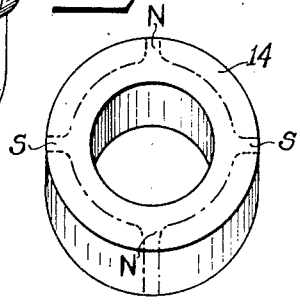


Fig. 6



INVENTOR.
ALBERT EISELE

BY Van Deventer + Grier

ATTORNEYS.

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MAGNET

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Fig. 7

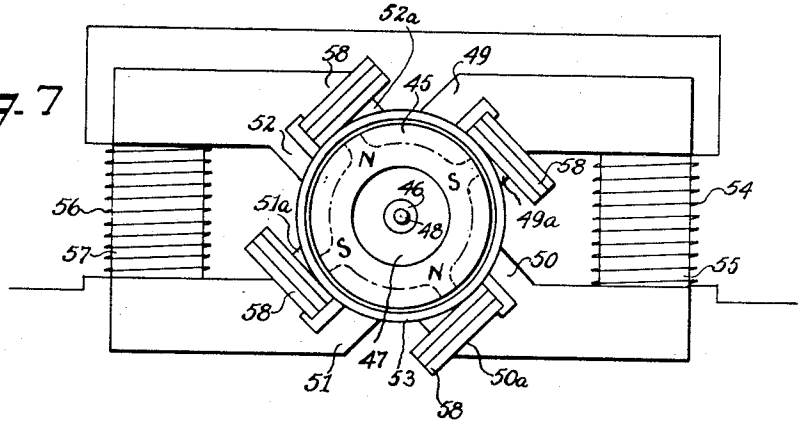


Fig. 8

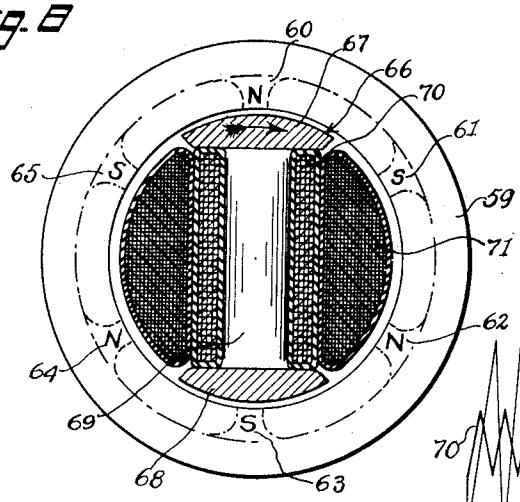


Fig. 9

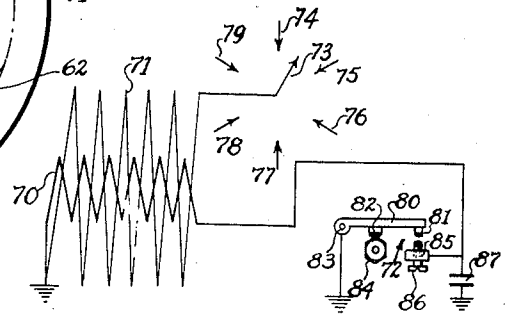


Fig. 10

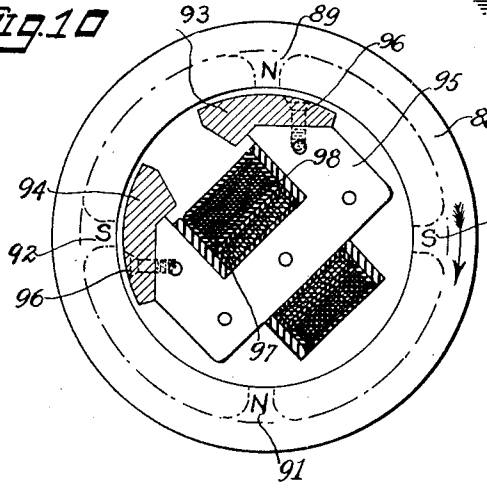
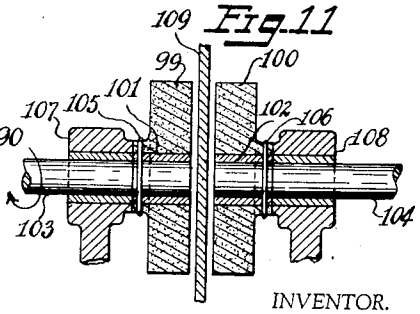


Fig. 11



INVENTOR.
ALBERT EISELE

BY Van Deventer + Grier

ATTORNEYS.

UNITED STATES PATENT OFFICE

2,224,954

MAGNET

Albert Eisele, Berlin-Charlottenburg, Germany

Application April 7, 1937, Serial No. 135,413
In Germany April 9, 1936

4 Claims. (Cl. 264—13)

This invention relates to improvements in magnets and has for a principal object the provision of a magnet of any desired shape, not necessarily corresponding to the location of the poles.

A further object of the invention is the provision of a tachometer having a rotor comprised of an annulus having a plurality of magnetic poles imparted thereto, said poles being distributed about said annulus thereby distributing the pull equally about said rotor.

Heretofore in such tachometers it has been customary to construct the rotor of a bar magnet formed into a ring with a gap between the ends thereof. This gap, when the ring was magnetized, formed a north and a south magnetic pole and as this was rotated the pull due to current induced in the cooperating member was all on one side.

With the new and improved annulus having, for example, four poles magnetically formed therein, the pull is equally distributed about the rotor.

Another object of the invention is the provision of an annulus formed of coercitive material having magnetically impressed therein a plurality of poles, and the utilization of said annulus as the rotor for electric motors, particularly in synchronous types of motors.

Still another object of the invention is the provision of a cylindrical magnet formed of highly coercitive material and forming a source of magneto-motive force for magnetos.

Still another object of the invention is the provision of magnetoes emloying cylindrical magnets of the kind stated, having a plurality of poles magnetically formed therein and having an armature with pole shoes spanning diametrically opposite magnetic poles, other poles falling between the poles being spanned, thereby eliminating the necessity of driving the distributor at a speed other than that of the armature.

Still another object of the invention is the provision of a magneto having a cylindrical magnet wtih a plurality of invisible poles magnetically impressed therein and forming a rotor.

Other objects and advantages of the invention will be apparent to those skilled in the art.

Referring to the drawings, Figure 1 is a sectional elevation of a tachometer employing my new improved magnet.

Figure 2 is a plan view taken along the line 2—2 of Figure 1 with the armature omitted.

Figure 3 is a fragmentary sectional elevation similar to Figure 1 with the exception that the outside inductor ring is stationary and is laminated.

Figure 4 is similar to Figure 3 with the exception that the inductor ring is carried on the shaft with the magnet and rotates therewith.

Figure 5 is an isometric view of the usual type of magnet employed in tachometers.

Figure 6 is an isometric view of the new and improved annular magnet, after the same has been magnetized, the path of the magnetic flux being indicated by dot-dash lines.

Figure 7 is a view of an synchronous clock motor employing one of the new and improved annular magnets as an armature.

Figure 8 is an end view of one of the new and improved magnets as applied to a magneto, the magneto armature being shown in section.

Figure 9 is a diagrammatic representation of the magneto circuits showing the primary and the associated interrupter and the secondary and its associated distributor.

Figure 10 is a view showing one of the new and improved magnets as a rotor and showing the stationary armature pole shoes and windings in section.

Figure 11 is a sectional view showing an arrangement of two molded disk magnets rotatably mounted adjacent to each other with a non-ferrous wall or diaphragm therebetween.

Figure 12 is a view of one form of molded magnet suitable for use in electrical meters, showing threaded inserts molded in, and

Figure 13 is a fragmentary sectional elevation, similar to Figure 4, except that the outside inductor ring is molded of magnetic material.

Referring now to Figure 5 an existent form of tachometer magnet 10 is illustrated. This magnet is formed of a bar of magnet steel and the ends 11 and 12 thereof are spaced apart from each other forming therebetween a gap 13. When this magnet is magnetized the end 11 may for example be of north or N polarity and the end 12 may be of a south or S polarity. The disadvantages of this type of magnet are:

1. That it gradually loses magnetic strength, and

2. It exerts its pull only within an area adjacent the gap 13.

Figure 6 illustrates the new and improved magnet 14, which is made in the form of an annulus. The composition from which this magnet is made may consist of finely divided highly coercitive steel, and a suitable binder or other means may be employed for holding such particles together. The composition may be varied in accordance

with the use to which the magnet may be put, for example, it may contain particles of cobalt, nickel and/or other non-ferrous materials. No gaps are formed in the annulus and any number of poles may be magnetically formed therein. For example, in Figure 6 the series of dot dash lines indicate four magnetic poles two north poles and two south poles. It has been found that an annulus so formed and magnetized remains, after suitable aging, unchanging as to magnetic strength and as to the locations of the magnetic poles formed therein.

Figure 1 shows the application of an annulus 14 such as is shown in Figure 6 as the motivating member of a tachometer. The annulus 14 is secured to the upper end of a shaft 15, which is suitably journaled in a boss 16 integral with a housing 17. The annulus 14 members up against a shoulder 18 and is secured to the shaft 15 by means of a nut 19. The upper end of the shaft 15 has formed therein a counterbored depression 20, carrying a jewel or other suitable pivot bearing 21.

A partition 22 which may also form a dial for the tachometer carries a pivot bearing 23 preferably in vertical alignments with the pivot bearing 21. A needle shaft 24 is pivotally mounted in the bearings 21 and 23 and carrying a needle 25 which extends through an arcuate slot 26 formed in the partition 22. A suitable hair spring 27 has one end thereof connected to the shaft 24 and the other end to a bracket 28 carried on the underside of the partition 22.

The shaft 24 also carries a cup shaped member 29 which embraces the annulus 14. This cup shaped member may be made of copper, aluminum or any other suitable non-ferrous material so that eddy currents induced therein by the lines of force of the annulus will cause the shaft 24 to be rotated and the needle 25 to be moved over the square on the upper surface of the partition 22 against the tension of the hair springs 27, the amount of movement in accordance with the speed at which the annulus is rotated.

To form a return path of the magnetic lines of force a soft iron ring 30 is provided. This ring has a hole formed therein of such diameter as to allow suitable clearance for the walls of the cup shaped member 29. The ring 30 may be provided with threads 31 which match threads 32 formed in a suitable supporting member 33 which is secured to the housing 17 in concentric relation to the annulus 14 and the cup 29. By means of the threads 31 and 32 the height of the ring 30 relative to the annulus 14 may be adjusted to a point where the best results are obtained. The supporting member 33 may be secured to the housing 17 by screws, not shown, passing through holes 34 shown in Figure 2.

In Fig. 3 the annulus 14 is mounted in the same relation to the cup shaped member 29 as that shown in Figure 1. However in place of the solid soft iron ring 30 it may be desirable, especially on devices operating at high speed, to laminate the material forming the return path for the flux due to the fact that the hysteresis might cause excessive heating of a solid ring. In Figure 3 the ring forming the return path for the flux, designated by the numeral 35 is formed of a stack of laminations held together by an outer ring 36. The outer ring 36 may have threads 37 formed thereon matching threads 38 in a supporting member 39, so that the laminated ring 35 may be adjusted relative to the annulus 14.

In the modification shown in Figure 4, the annulus 14 may be in the same relation to the cup shaped member 29 as that shown in Figures 1 and 3. However, the soft steel or iron ring 40 forming the return path for the magnetic flux is arranged to rotate with the annulus 14 thereby making the lines of force cut the walls of the cup shaped member 29 in a sharper and more pronounced manner which is inducive to better results. The ring 40 may be threaded onto a brass or other non-ferrous metal disk 41. The disk 41 may be provided with a hub 42 and bored out to fit the stepped portion 43 of the shaft 15. The annulus 14 and the disk 41 are together clamped against the shoulder 44 of the shaft 15 by means of the nut 19. With this arrangement it is unnecessary to laminate the ring 40 due to the fact that the path of the magnetic flux does not change with the polarity as it does in the other arrangements shown or in the devices of the prior art.

A further modification illustrated in Figure 13 contemplates substituting for the ring 40 in Figure 4, a secondary annulus 114 of highly coercitive steel similar to the annulus 14*a*, magnetized and having its poles preferably in opposite relation to the poles of the annulus 14*a*; for example where a north pole appears on the annulus 14*a*, a south pole would appear in the ring 114, in which case the pull on the cup-shaped member would be much greater than is the case in Figure 4, where the ring 40 is employed using soft iron or steel. As many poles may be impressed in the ring 14*a* and opposite poles in the ring 114 as desired. It must be understood, however, that I am not limited to the placing of opposite poles in line with each other as just described. For example, where a north pole appears in the annulus 14*a*, a north pole could likewise appear in the ring 114, in which case the lines of force would buck each other. However, when the annulus and ring are rotated, these lines of force will cut the walls of the cup and induce eddy currents therein.

In the modification shown in Figure 7, which may represent electrical motors, particularly small synchronous motors, an annulus 45 may be provided with a hub 46, a suitable web 47 serving to connect the hub to the annulus, forming an armature for the motor. A shaft 48 forms a support for the annulus in concentric relation to the poles 49, 49*a*, 50, 50*a*, 51, 51*a*, 52, 52*a*. A suitable ring 53 may be positioned between the annulus and the poles of the motor. Where the ring is used, in some cases, it may be of hardened steel and magnetized, and in other cases it may be constructed of soft iron or steel and may be either solid or laminated. The poles 49, 49*a*, and 50, 50*a*, are excited by a coil 54 wound on the core 55 and likewise the poles 51, 51*a* and 52, 52*a*, may be excited by a coil 56 carried on a core 57. The poles 49*a*, 50*a*, 51*a*, and 52*a*, are embraced by closed conductors 58 which cause the magnetic fields produced by such poles to lag behind the flux produced by the poles 49, 50, 51 and 52. Since the flux set up by these poles forms a rotating field the pole arrangement shown in Figure 7 will produce two rotating fields displaced by the lag above mentioned. When the new and approved annulus 45 is placed in this combined rotating field it forms a rotating armature.

In the modification shown in Figure 8, the an-

nulus may be in the form of a cylinder 59 which may have magnetically impressed therein internally in any desired arrangement of poles, for example six poles, one north pole being indicated by the numeral 60, south pole by the numeral 61, a second north pole as 62, a second south pole as 63, a third north pole as 64, and a third south pole as 65. An armature 66 which may be of the usual H type has pole shoes 67 and 68 and a core 69 carrying the windings. The primary winding 70 is wound next to the core and the secondary winding 71 is wound on top of the primary winding, a suitable insulation being provided between and about the windings.

It will be noted that the shoe 67 is under the influence of the north pole 60 and the shoe 68 is under the influence of the south pole 63. The poles 61, 62, 64 and 65 are not influencing the armature. Therefore when the shoes 67 and 68 respectively break from the influence of the poles 60 and 63 respectively and at the same time the interrupter 72 opens, a spark will be induced in the secondary winding 71.

The magneto having poles as shown in Fig. 8 would not have to have the distributor geared down slower than the speed of the armature. In fact the distributor rotor could be carried by the armature and directly connected to the secondary winding, in which case six sparks would be distributed during each revolution of the armature. This is shown diagrammatically in Figure 9, the distributor rotor being indicated by the numeral 73 and the distributor contacts as 74 to 79 inclusive.

In Fig. 9 the interrupter 72 may consist of a lever 80 carrying a contact 81, a bumper 82 and may be pivoted on a suitable grounded pivot 83. An insulated anvil 85 may carry a suitable contact point 86 in cooperative relation with the contact 81. A condenser 87 is connected in parallel with the contact points 81 and 86. A suitable cam 84 carried by the armature acts against the bumper 82, thereby opening the contacts 81 and 86 six times during each revolution of the armature.

In the modification shown in Fig. 10, an annulus 88 made in the form of a cylinder is rotatively mounted. It may have any desired number of poles magnetically impressed therein, for example, four poles namely, a north pole 89, a south pole 90, a north pole 91 and a south pole 92. Since the magnetic cylinder 88 is rotatively mounted the armature may remain stationary. This armature may consist of pole shoes 93 and 94 respectively, under the influence of poles 89 and 92 in the relative positions shown in the figure.

These shoes may be secured to a laminated yoke 95 in any suitable manner, for example, by means of a screw 96. The yoke 95 may carry a primary winding 97 having a secondary winding 98 positioned thereabout, the primary and the secondary being adequately insulated from each other and from the yoke 95.

As the cylinder 88 is rotated, for example, in the direction of the arrow, a suitable interrupter, not shown being provided, four sparks will be generated by the winding for each revolution of the annulus 88. Therefore if the cylinder 88 has rotating therewith a distribution rotor, it will furnish sparks suitable for firing a four cylinder gas engine without the necessity of gearing the distributor down to slower speed than that of the cylinder 88.

In Figure 11 two molded magnets 99 and 100 may be employed. These magnets may have molded in suitable bushings 101 and 102 respectively and the bushings may form forced fits on the shafts 103 and 104 respectively, the magnet 99 being secured to the shaft 103 by suitable taper pin 105 and the magnet 100 is secured to the shaft 104 by a similar taper pin 106. The shaft 103 is journaled in a suitable bearing 107 and the shaft 104 is journaled in a bearing 108. A diaphragm 109 which may form a portion of the wall of the casing enclosing one of the magnets is positioned in an air gap between the magnet 99 and 100, and is preferably constructed of nonferrous material.

Assuming that the magnet 100 is positioned within a hermetically sealed casing and driven by a motor therein, the magnet 99, due to the fact that both of the magnets are magnetized, will be pulled around by the flux thereby causing the shaft 103 to rotate in unison with the rotation of the shaft 104. Other variations of this embodiment contemplate the movement of a magnet outside the casing in unison with the movement of the magnet inside the casing regardless of whether the magnets are rotated or are moved laterally.

Figure 12 is a view of one form of moulded magnet for use in electrical meters, comprising a substantially U-shaped body 110 having pole shoes 111, 112, formed integral therewith and of the same material. A plurality of inserts 113 positioned adjacent to the pole shoes are provided for securing end plates (not shown) which in turn support moving parts of the meter (not shown). These bushings may be threaded before being moulded in or they may be tapped after the magnet has been moulded.

The provision of a magnet of this kind for meters eliminates entirely all machine work on the magnet, especially in cases where the bushings are pre-tapped.

Although I have illustrated and described several forms and applications of my new and improved molded magnet some of which are in the form of an annulus, a cylinder or a disk, it is obvious that molded magnets according to my invention can be constructed in other shapes for use in all kinds of electrical meters, telephones, head sets, loud speakers, etc., without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a tachometer employing a magnetic annulus formed of highly coercitive steel particles and a binder molded under pressure and having a plurality of alternate magnetic poles impressed therein, a shaft rotatively supporting said annulus, an inductor embracing the outer periphery of said annulus, a pivot shaft supporting said inductor, a stationary annulus concentric with said first annulus and at least partially embracing the perimeter of said inductor, said second annulus being adjustably axially, a pointer carried on said pivot shaft, a scale in cooperative relation with said pointer, and spring means tending to uge said pointer against the direction of rotation of said first shaft.

2. In a tachometer, a magnetic annulus formed of highly coercitive steele particles and a binder molded under pressure and having magnetic poles impressed therein after molding, a casing, a shaft journaled in said casing and rotatively supporting said annulus, an inductor embracing the outer periphery of said annulus, a pivot shaft supporting said inductor, a second annulus supported in

said casing in concentric relation with said first annulus and at least partially embracing the perimeter of said inductor said second annulus being formed of solid ferrous material, a pointer carried on said pivot shaft, a scale in cooperating relation with said pointer, and spring means tending to urge said pointer against the direction of rotation of said first shaft.

3. In a tachometer, a magnetic annulus formed of highly coercitive steel particles and a binder molded under pressure and having magnetic poles impressed therein after molding, a casing, a shaft journaled in said casing and rotatively supporting said annulus, an inductor embracing the outer periphery of said annulus, a pivot shaft supporting said inductor, a second annulus formed of solid ferrous material and adjustably supported in said casing in concentric relation with said first annulus and at least partially embracing the perimeter of said inductor, a pointer carried on said pivot shaft, a scale in cooperative relation with said pointer, and spring means tending to urge said pointer against the direction of rotation of said first shaft, said second annulus being adapted to be adjusted relative to said inductor and said first annulus to regulate the amount said second annulus embraces said inductor.

4. In a tachometer, a casing, a shaft rotatively mounted in said casing, an inductor including a rim in concentric relation to said shaft, a pivot shaft supporting said inductor, a pointer carried on said pivot shaft, a scale in cooperative relation with said pointer, spring means tending to urge said pointer against the direction of rotation of said first shaft, and a rotor carried on said first shaft comprised of a pair of concentric annulae spaced apart from each other, the thickness of said rim plus clearance whereby said inductor may be positioned between and in concentric relation with said annulae at least one of said annulae being formed of highly coercitive steel particles and a binder molded under pressure, and the rim thereof having a plurality of invisible magnetic poles impressed therein after said annulus has been molded.

ALBERT EISELE.