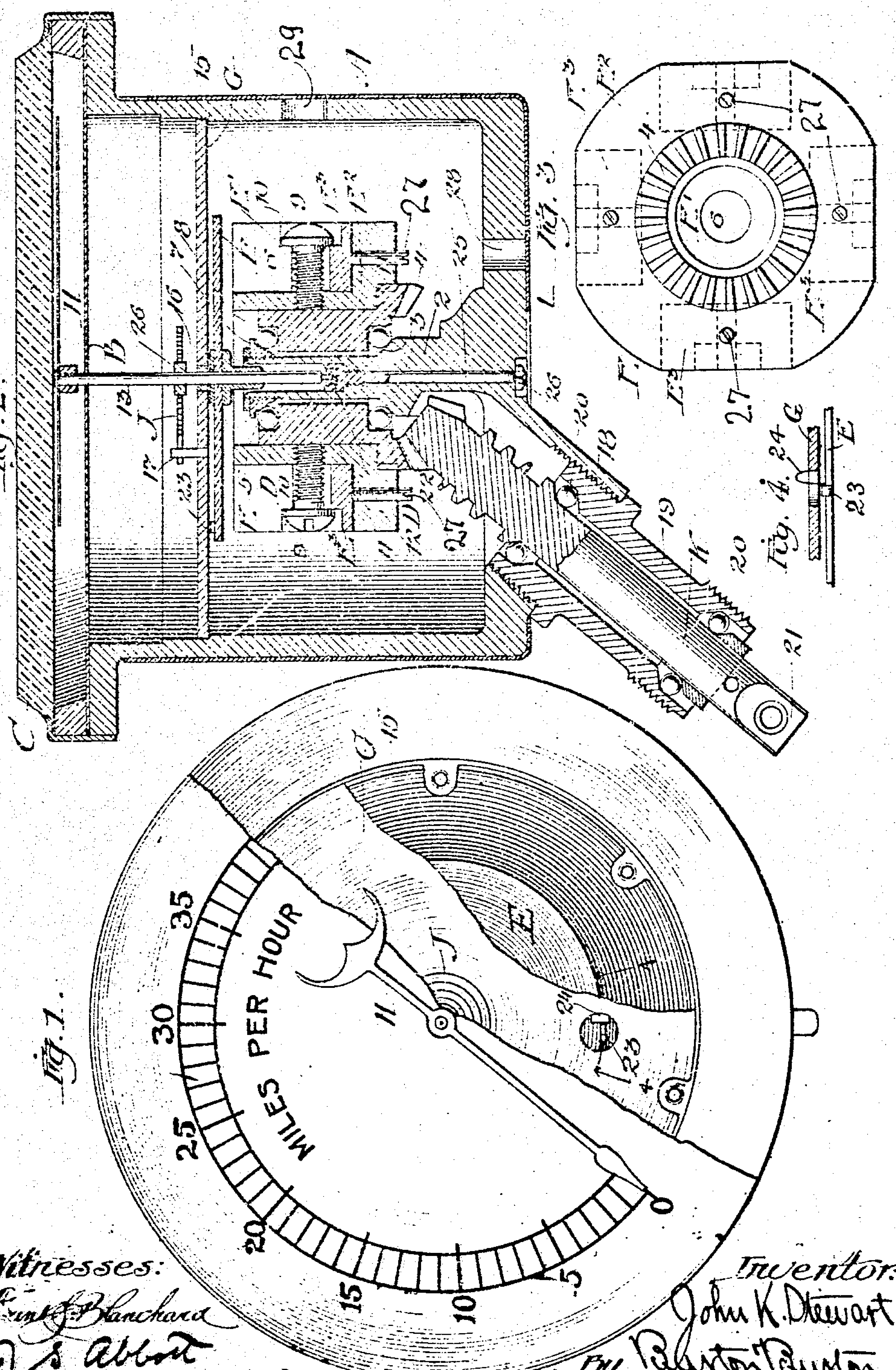
J. K. STEWART.

MAGNETIC TACHOMETER.

APPLICATION FILED NOV. 16, 1908.

956,221.

Patented Apr. 26, 1910.



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MAGNETIC TACHOMETER.

956,221. Specification of Letters Patent. Patented Apr. 26, 1910.

Application filed November 16, 1908. Serial No. 462,755.

To all whom it may concern:

Be it known that I, JOHN K. STEWART, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Magnetic Tachometers, of which the following is a specification, reference being had to the drawings forming a part thereof.

This invention relates to the class of speed-measuring devices in which there are associated three elements, a magnet, its armature and a third element of low magnetic resistance interposed in the magnetic f ld, one of the three elements being rotated, and a second having an indicating device, as an index finger, and being mounted for oscillation against a yielding resistance or biasing means, the deflection of the index finger being caused by the magnetic drag of the rotating element upon the oscillating element.

It consists in the features of construction and their combination shown and described as indicated in the claims.

In the drawings:—Figure 1 is a face view of a tachometer embodying this invention, the dial plate and armature disk being each in part broken away to disclose their elements. Fig. 2 is an axial section of the same. Fig. 3 is an inverted plan view of the magnet. Fig. 4 is a detail section at the line 4—4 on Fig. 1.

In the structure shown embodying this invention there is employed an inclosing case, A, cylindrical in form, open at one end of the cylinder, at which there is mounted the dial plate, B, which is preferably protected by a glass, C. At the center of the case, rigid with the back or bottom disk, 1, thereof, there is erected, preferably formed integrally with the case, a post, 2. This post is reduced in diameter at its upper part, forming an inclined shoulder, 3, which constitutes the ball seat of a ball bearing, indicated by the balls, D, and about the reduced part there is journaled the magnet element, E. As illustrated, the magnet element, E, comprises a central iron or steel member, E^1, unmagnetized, which terminates at the lower end in an interior bevel-gear rim, 4, is axially apertured to pass onto the reduced upper portion of the post and rabbeted at both ends at 5 around said axial aperture, 6, to afford angular ball seats for the anti-friction balls, D, at the upper and lower ends. A take-up cone, 7, is screwed onto the upper end of the post to retain the balls in place, and the entire magnet element on the post. This central member, E^1, is secured by drive fit in an axial aperture, 8 in a second member, E^2, of non-magnetic material, as brass, copper or aluminum, and to this second member there are secured the horse shoe magnets, E^3, any convenient number of such magnets being provided, four being employed in the structure shown. The non-magnetic member, E^2, is recessed to form seats for receiving the magnets E^3, which fit tight in their seats, being, however, additionally secured by bolts, 9, for whose heads the bolt holes through the magnet are cylindrically countersunk at 10, so that there shall be no protrusion beyond the surface of the magnet blocks. These bolts take into the member, E^2. The magnets, E^3, are all disposed with their poles at the upper end alternating in circumferential order about the axis of the magnet element, so that they constitute a multipolar magnet.

The post, 2, is axially bored at 11 from its upper end, and receives at the bottom of said bore a step bearing, 12, for the spindle, 13, of a disk, F, of material having low magnetic resistance, as aluminum, which is positioned so as to be spaced a very short distance from the upper poles of the magnet.

The case, A, is interiorly rabbeted to form a shoulder, 15, for an armature disk, G, which also serves to complete the inclosure of the chamber in which the magnet and the disk, F, are located. The spindle, 13, of the disk, beside its step bearing at 12 may be provided with a second steadying bearing at 16, at the center of the disk, G, which is penetrated by the spindle, and carries at its upper end an index finger, H. A little above the armature disk, G, there is located a helical spring, J, connected at its inner end with the spindle and at its outer end with a stud, 17, mounted in the armature disk, G.

The bottom, 1, of the case has an obliquely projecting hollow boss, 18, into which is screwed the journal bearing, 19, of a shaft, K, having ball-bearings at 20, 20, in said journal-bearing element. This shaft, K, at its inner end within the case terminates in a bevel pinion, 22, which meshes with the internal bevel gear, 4, for rotating the magnet element. The shaft, K, is designed to be connected in any convenient manner with the shaft whose rotary speed is to be indicated by the instrument, and it is shown squared and apertured at the end, 21, to indicate the intention and adaptation for such connection. A pin, 23, projects from the upper surface of the disk, F, in position to encounter with a cushioning spring stop, 24, mounted on the under side of the armature disk, G; and the collar, 26, on the spindle, 13, which constitutes the means of securing the inner end of the helical spring, J, to the spindle, is adjusted about the spindle to cause the said helical spring to hold the pin, 23, against said spring stop, 24, with slight pressure,—that is, so that it may be withdrawn therefrom by slight magnetic drag upon the disk F when the magnet is rotated in the direction for coiling the helical spring. The index finger, H, is secured on the spindle to register with the zero point of the dial, B, when the pin, 23, is against the spring stop, 24.

The method and principle of operation of this instrument will be obvious to those familiar with magnetic tachometer devices in common use. When the shaft, K, is rotated and rotates the magnet element, the lines of force from the magnetic poles to the armature, G, being cut by the disk, F, produce a drag upon the disk tending to rotate it in the same direction as the magnet, and such tendency being resisted by the spring, J, results in a partial rotation of the disk, F, causing a deflection of the index finger around the dial proportionate to the speed of rotation of the magnet, the tension of the spring being adjusted so that a predetermined maximum speed of rotation of the magnet will produce the maximum deflection for which the dial is graduated. The amount of force involved in the drag upon the disk, F, which produces the oscillation and speed indication is not very great, and the instrument is sensitive to any extraneous disturbance. Any considerable agitation of the air within the chamber in which the disk, F, is contained, or where such agitation might affect the disk, is liable to disturb the accuracy of the indication. For this reason the magnetic element which is rotated is constructed, as shown, with the non-magnetic member, E^2, filling up all interspaces between the magnetic polar elements and producing a substantial cylindrical and exteriorly smooth body for rotation, and one, therefore, which tends in the slightest possible degree to produce any agitation of or currents in the air by its rotation. It will be observed that in the construction shown, the armature, G, serves the double purpose of acting as the armature and closing the chamber in which the sensitive oscillating element, F, is located. By axially boring the post, 2, to locate the step bearing, 12, deeply therein there is obtained wide spread of the bearings of the spindle, 13, which contributes materially to the steadiness of the action of the disk, F, and certainty of the speed indication which it gives; indeed, the construction shown in this respect very nearly dispenses with the necessity for the bearing, 16, and reduces to an almost negligible amount the service of this bearing, for the long stemmed oscillating element stepped so far below the level of the oscillating disk tends to balance on that step bearing after the manner of a spinning top, and lateral pressure occurs at the bearing, 16, only so far as the entire instrument may be subject to jars or disturbance of position.

Preferably the step bearing, 12, for the spindle, 13, being a "jewel" is embedded in the upper end of a threaded post or stem, 25, which is screwed down through the fixed post, 2, that post being for that purpose axially bored through its entire length, and threaded for a suitable distance to engage the threaded post, a jam-nut, 26, being provided on the lower end of the threaded stem or post, 25, to secure the latter against accidental rotation. This construction provides means for vertically adjusting the step bearing, 12, to adjust the distance of the oscillating low-resistance element, F, from the magnet poles for any purpose for which such adjustment may at any time be desirable.

In order to provide means for compensating for loss of energy of any magnet so as to retain proper indication notwithstanding such variation in the strength of the magnet, or to vary the indication, as may be necessary for rendering it correct under any other variation of the circumstances or conditions of the instrument, the magnet may be adjusted axially, being moved toward the armature, G, for increasing the action of the oscillating member, E, and index finger, and being moved away from the armature for diminishing such action and indication. Such adjustment of the magnets is effected by means of adjusting screws, 27, which are set through the lower side of the non-magnetic element, E^2, impinging against the lower side of the magnets, E^3, respectively, and a hole, 28, is made in the bottom of the case in proper position to admit a tool for reaching the said screws, 27. A hole, 29, may also be made through the sides of the case through which the bolts, 9, may be reached for slightly slacking them if necessary when the magnet is to be thus adjusted. The entire case, A, is preferably inclosed in a removable brass or other thin finished metal sheath, which closes the holes, 28 and 29, when they are provided for the purpose stated.

I claim:—

1. In a magnetic tachometer, in combina-

tion with a case, an armature disk mounted on the case wall and inclosing a chamber within the case, a post within the case coaxial with said chamber, a magnet carrier mounted for rotation on the post, a carrier-actuating shaft journaled in the case wall and projecting into the chamber, for rotating the carrier; a low resistance disk positioned between the armature disk and one end of the carrier and mounted for oscillation about the axis of rotation of the carrier, such carrier being provided with a plurality of peripheral recesses, and horse shoe magnets mounted in such recesses having all their poles toward the disks.

2. In a magnetic tachometer in combination with a case, a post within the case, a permanent magnet element and an armature, one mounted for rotation on the post and the other supported fixedly on the case, and a low resistance disk positioned between the magnet and the armature, mounted for oscillation about the axis of the rotating element; the magnet element comprising a magnet carrier of non-magnetic material, and a plurality of horse shoe magnets secured on such carrier arranged in a circle about said axis of rotation, the carrier being peripherally recessed to receive the magnets, the latter having their outer surfaces substantially flush with the outer surface of the carrier.

3. In a magnetic tachometer in combination with a case, an armature disk mounted on the disk wall and inclosing a chamber within the case, a post within the case coaxial with said chamber, a magnet carrier mounted for rotation on the post, a carrier-actuating shaft journaled in the case wall and projecting into the chamber, for rotating the carrier; a low resistance disk positioned between the armature disk and one end of the carrier and mounted for oscillation about the axis of rotation of the carrier, said magnet carrier comprising a central member by which it is mounted on the post; a non-magnetic member mounted on and encompassing said central member and having a plurality of peripheral recesses and horse shoe magnets secured fixedly in such recesses with their poles facing toward said disks.

4. In a magnetic tachometer, in combination with a case, a rigid post within the case; a permanent magnet element and an armature, one mounted for rotation on the post and the other supported fixedly on the case; a low-resistance disk positioned between the magnet and the armature having a spindle provided with a step bearing within the post and extending through the fixed element; a spring which operates to hold the disk yieldingly against rotation from a predetermined position; an indicator carried by the spindle, and means for adjusting the magnet axially with respect to the distance of its poles from the armature.

5. In a magnetic tachometer, in combination with a case, a rigid post within the case; a permanent magnet element and an armature, one mounted for rotation on the post and the other supported fixedly on the case; a low-resistance disk positioned between the magnet and the armature having a spindle provided with a step bearing within the post and extending through the fixed element; a spring which operates to hold the disk yieldingly against rotation from a predetermined position; an indicator carried by the spindle, the magnet element comprising a plurality of horseshoe magnets and a carrier on which they are rigidly mounted, and means for adjusting the magnets longitudinally on the carrier to vary the distance from their poles to the armature.

6. In a magnetic tachometer, in combination with a case, a rigid post within the case; a permanent magnet element and an armature, one mounted for rotation on the post and the other supported fixedly on the case; a low-resistance disk positioned between the magnet and the armature having a spindle provided with a step bearing within the post and extending through the fixed element; a spring which operates to hold the disk yieldingly against rotation from a predetermined position; an indicator carried by the spindle; the magnet comprising a plurality of horseshoe magnets; a non-magnetic carrier having seats for the horseshoe magnets; screws set through said carrier impinging against the neck or bow of the horseshoe magnets respectively, the case having an aperture through which such screws are accessible.

In testimony whereof, I have hereunto set my hand, in the presence of two witnesses, at Chicago, Illinois, this 12th day of November, 1908.

JOHN K. STEWART.

In the presence of—
JULIA S. ABBOTT,
M. GERTRUDE ADY.