Oct. 10, 1933. F. G. SCHWEISTHAL 1,929,537

CENTRIFUGAL TACHOMETER

Filed Aug. 31, 1931 2 Sheets-Sheet. 1

Fig. 1

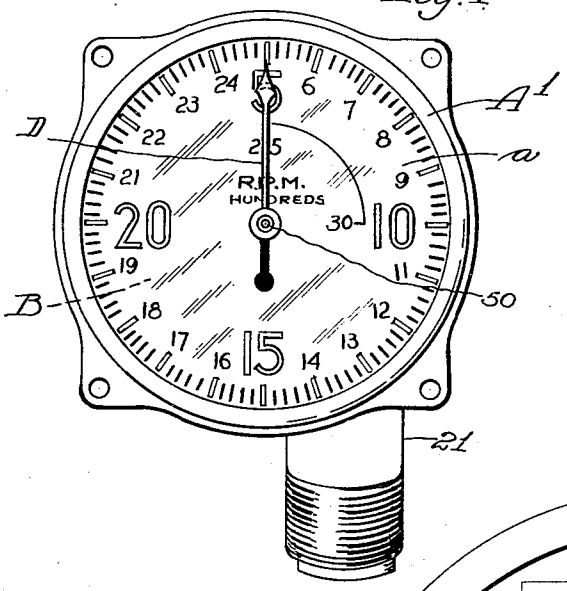


Fig. 6.

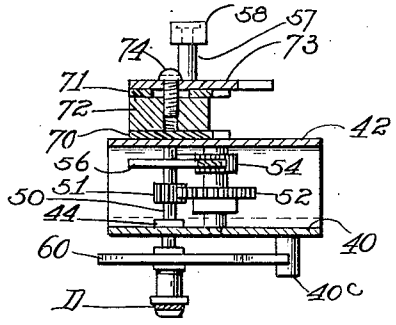


Fig. 2.

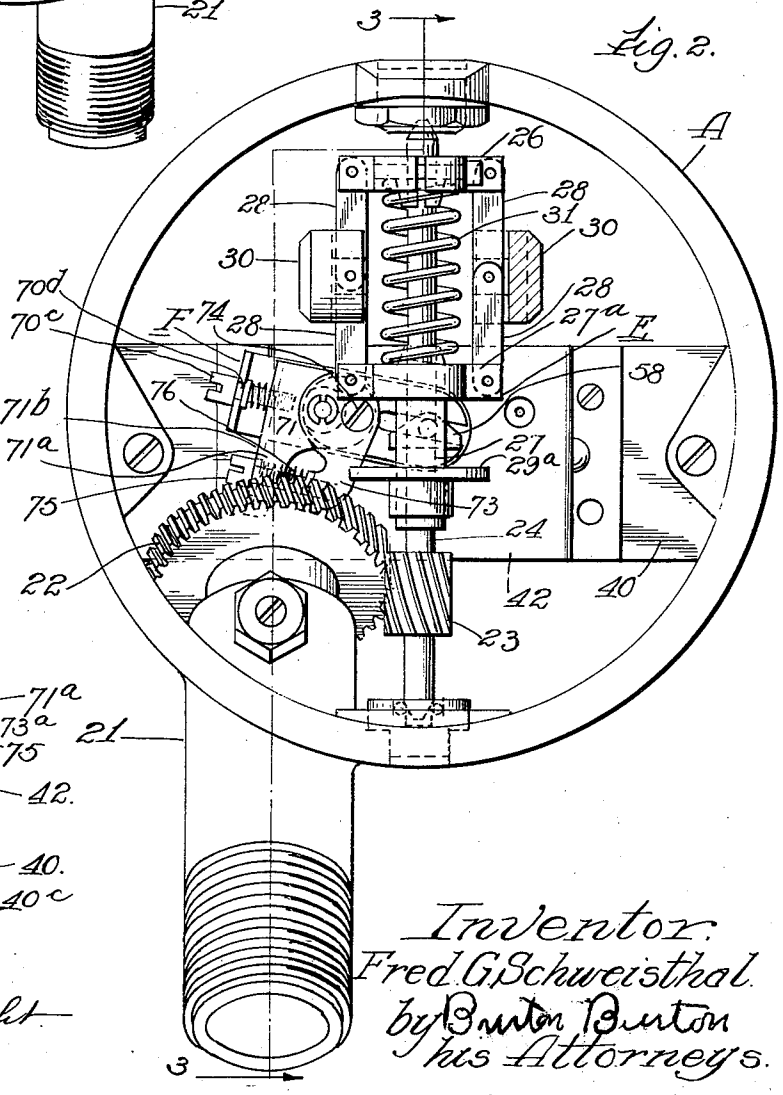
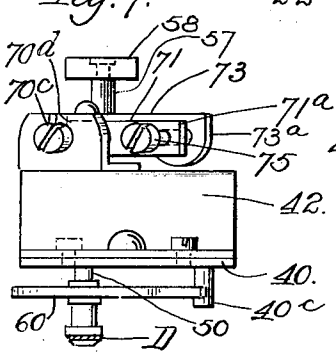


Fig. 7.



Witness
A. O. McKnight

Inventor.
Fred G. Schweisthal.
by Burton Burton
his Attorneys.

Oct. 10, 1933. F. G. SCHWEISTHAL 1,929,537

CENTRIFUGAL TACHOMETER

Filed Aug. 31, 1931 2 Sheets-Sheet. 2

Fig. 3.

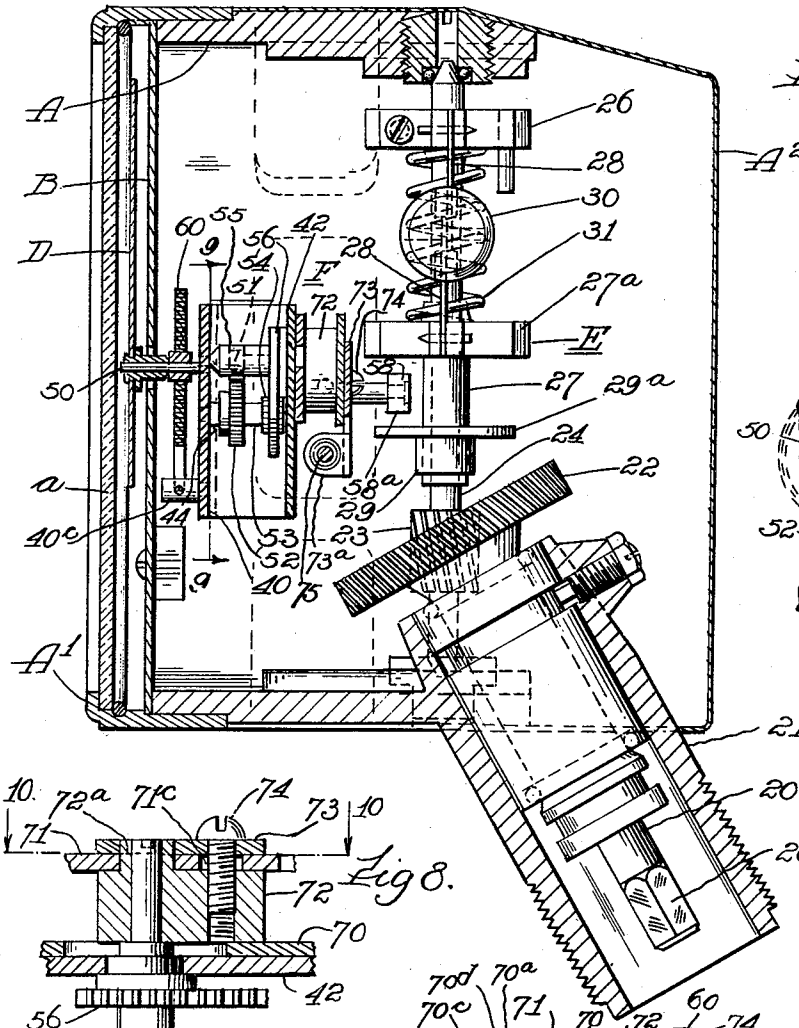


Fig. 9.

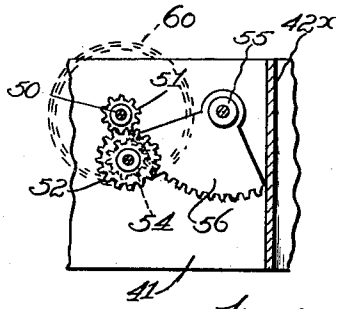


Fig. 10.

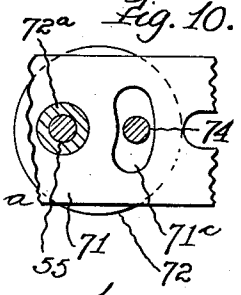


Fig. 4

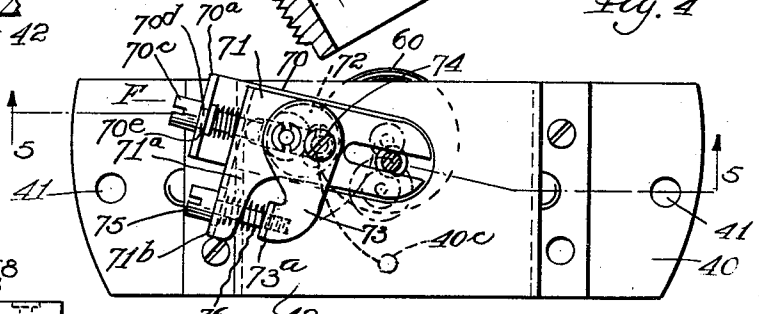
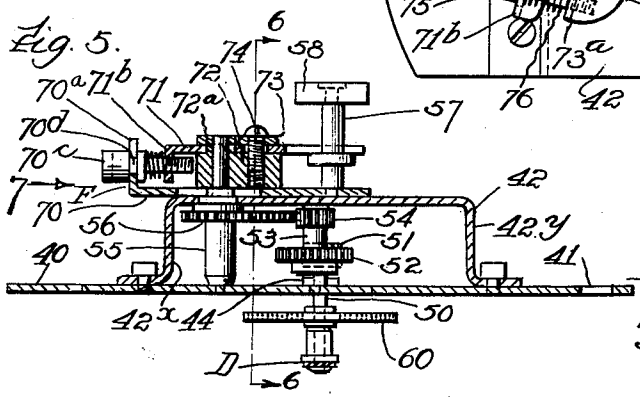


Fig 8.

Fig. 5.



Inventor.
Fred G. Schweisthal.
by Burton Burton
his Attorneys.

Patented Oct. 10, 1933 1,929,537

UNITED STATES PATENT OFFICE

1,929,537

CENTRIFUGAL TACHOMETER

Fred G. Schweisthal, Chicago, Ill., assignor to Stewart-Warner Corporation, Chicago, Ill., a corporation of Virginia

Application August 31, 1931. Serial No. 560,315

3 Claims. (Cl. 264—15)

The purpose of this invention is to provide an improved construction of an instrument for indicating rotary speed,—number of revolutions per minute,—of a rotary shaft, obviating certain defects in and objections to constructions of this character hitherto in use.

The invention consists in the elements and features of construction shown and described as indicated in the claims.

In the drawings:

Figure 1 is a face view of an instrument embodying this invention.

Figure 2 is a magnified rear or inner side elevation of the same with an enclosing member of the case removed for disclosing the interior mechanism.

Figure 3 is a section at the line 3—3 on Figure 2.

Figure 4 is an elevation of a portion of the mechanism seen in like elevation in Figure 2 removed from the casing.

Figure 5 is a section at the line 5—5 on Figure 4.

Figure 6 is a section at the line 6—6 on Figure 5.

Figure 7 is an elevation looking in the direction of the arrow 7 on Figure 5.

Figure 8 is an enlarged detail portion of Figure 5.

Figure 9 is a section at the line 9—9 on Figure 3.

Figure 10 is a section at the line 10—10 on Figure 8.

Referring to the drawings in detail:

The instrument comprises a casing comprising a main body member, A, in and on which other casing parts of the mechanism are mounted, including a front bezel member, A^1, for carrying the transparent front plate or shield, *a*, and the graduated dial or face plate, B, and a rear closure member, A^2, in cup form arranged to telescope over the main body member, A, as may be understood from Figure 3.

The dial or face plate is graduated for indicating revolutions per minute in hundreds, that is, each point indicating one hundred revolutions per minute more than the last preceding point in the graduated circle reading in clockwise direction in which the index hand, D, is rotated, by increase of speed of the mechanism. 20 is a driving shaft journaled at 21 in the casing member, A, and arranged, as seen at 20^a, for coupling at its outer end to the shaft of the mechanism whose rotary speed is to be indicated. At its inner end the shaft, 20, carries a driving gear, 22, meshing with a driven gear pinion, 23, on the shaft, 24, of the centrifugal unit indicated in totality by reference character, E. This centrifugal unit is of conventional construction as to its centrifugal features, comprising a cross head, 26, which is split for clamping rigidly on the shaft, 24, adjacent the upper end bearing of said shaft, and a sleeve member, 27, slidingly journaled on the shaft, 24, adjacent and above the gear pinion, 23. The sleeve, 27, is furnished at its upper end with a cross head, 27^a, corresponding in form and dimensions to the cross head, 26.

The cross heads, 26 and 27^a, have their corresponding ends connected at opposite sides of the shaft by toggle links, 28, 28, the two links of each toggle being pivotally connected together at one end, with the pivots carrying the centrifugal weights, 30, 30; at the opposite ends respectively the links are pivotally connected to the cross heads. A compression spring, 31, coiled about the shaft, 24, between the two cross heads reacts between said cross heads for holding them normally spaced apart to the limit of the toggle link connections described.

The sleeve, 27, carries at the lower end spaced downwardly from the cross head, 27^a, a collar, 29, drive-fitted on the sleeve so as to be rotated therewith, and said collar has at the upper edge a transaxial flange, 29^a, whose upper surface is flat directly transverse to the axis of the shaft, 24. This flange constitutes the means of operating the index hand, D, in accordance with the centrifugal movement of the weights of the centrifugal unit, and thereby in accordance with the rotary speed of the shaft, 24, and the initial driving shaft, 20.

The mechanism by which this flange actuates the index hand, D, will now be described. For mounting the mechanism there is provided a mounting frame structure comprising a plate, 40, secured at opposite ends to the main casing member, as seen at 41, 41, and a bracket plate, 42, flexed at its opposite ends, as seen at 42^x, 42^y, to step it on the plate, 40, and space the intermediate part of its length off from the plate, 40.

Journaled in the bracket plate, 42, and having a stepped bearing, as seen at 44, in the plate, 40, is a spindle, 50, of the index hand, D. A small gear, 51, on this spindle back of the mounting plate, 40, meshes with and is driven by a gear, 52, on a shaft, 53, journaled in the plates, 40 and 42, and having adjacent the plate, 42, a gear, 54. Pivotally mounted on the bracket plate, 42, at the

rear side thereof, is a lever element, indicated in totality by reference character, F, the pivot member, 55, of this lever member, rigid with said lever member, as hereinafter described, being journaled in both plates, 40 and 42, and extended between them, and having rigid with it adjacent the plate, 42, and in the plane of the gear, 54, a sector gear, 56, meshing with said gear, 54, and of arcuate extent for giving the spindle, 50, one-and-a-quarter revolutions for carrying its index hand around the entire dial, and also dimensioned for encountering a suitable stop on the bracket plate, 42,—as the flexed end part, 42^x,—for limiting the gear-train-and-index-hand-actuating swing in the direction for giving the index hand its anti-clockwise movement; that is, in the direction toward the zero position of the index hand.

The lever unit, F, comprising two lever members, 70 and 71, associated, as hereinafter described, carries at one end, fixed on the lever member, 70, a pivot stud, 57, which projects toward the shaft, 24, parallel to the flat face of the flange, 29^a; and said lever member carries pivotally on the pivot stud, 57, at said end a shoe, 58, having a flat face, as seen at 58^a, for bearing on said flat face of the flange.

A spiral spring, 60, attached at its inner end to the spindle, 50, of the index hand, D, is attached at its outer end to a stud, 40^c, carried by the plate, 40, said spring being coiled in the direction for reacting on the spindle to resist the rotation of the index hand in clockwise direction away from the position at which the sector gear, 56, is stopped on the bracket end, 42^x, as above mentioned, corresponding to a rest position of the index hand.

Upon considering the construction as thus far described, it may be recognized that actuation of the centrifugal unit, causing the sleeve, 27, to slide along the shaft, 24, a varying distance, according to the rotary speed of the shaft, 24, derived through the intermeshing gears, 22 and 23, from the inleading shaft, 20, enables the flange, 29^a, encountering and engaging the shoe, 58, to rock the lever unit, F, and its rigid pivot member, 55, causing the sector gear 56, to actuate the remainder of the gear train which connects said sector gear with the spindle of the index hand, D, for rotating said index hand over the graduated dial.

At this point, for understanding the adjustment for calibration hereinafter described, it is noted that of the lever unit the arm to which movement is communicated from the centrifugal unit, sometimes hereinafter referred to as the actuated arm of the lever, consists of the parts, 70 and 71, extending from the pivot member, 55, to the shoe, 58; and that the sector gear, 56, constitutes an actuating arm of the lever unit, being the part by which the movement derived from the centrifugal unit is communicated to the registering element.

And upon consideration it will be recognized that with proper calibration, involving adaptation of the spring reaction to the mass of the centrifugal weights, and the adaptation or adjustment of the lever member as to the effective length of the lever arm carrying the shoe, 58, the resulting speed indication may be rendered correct for indicating the rotary speed of the inleading shaft, 20.

It will be understood that the adaptation of the spring reaction to the mass of the centrifugal weights is closely approximated in the original designing of the construction by good engineering judgment and experience; and that the correction of calibration, for which provision must be made by adjustability of some elements of the structure, will be concerned with only a relatively small inaccuracy of speed indication, which may accordingly be corrected by a comparatively small change in the leverage between the centrifugal actuated member, 29^a, of the centrifugal unit and the index-hand-actuating gear train. The provision for such leverage will now be described.

Referring to Figures 4 and 5, this lever unit may be seen to comprise the two lever members, 70 and 71. The member, 70, is lodged directly upon the outer surface of the bracket member, 42, and is connected, as hereinafter described, with the pivot member, 55, which extends through said bracket member; and said lever member, 70, has at the end opposite the shoe-carrying end of the lever unit a transversely projecting lug or flange, 70^a. The lever member, 71, is formed with a transversely projecting lug or flange, 71^a; and this latter lever member is secured rigidly, but adjustably, as and for the purpose hereinafter described, on the pivot, 55, with the flange, 71^a, extending toward the web of the lever member, 70, parallel to and inward with respect to the pivot from the flange or lug, 70^a. A screw, 70^c, having a groove, 70^d, and engaged thereby with the flange, 70^a, as seen at the slot, 70^e, is screwed into the flange, 71^a, for adjusting the two lever members, 70 and 71, longitudinally of each other for varying the effective length of the operating arm of the lever unit by varying the distance from the lever fulcrum,—the pivot, 55,—to the pivot stud, 57, on which the shoe, 58, is carried.

Upon consideration of the construction described, it will be recognized that change of length of the operating arm of the lever unit has no effect upon the position of the index hand at the stage of rotary speed of the centrifugal unit, at which the member 29, by its flange 29^a, encountering the shoe, 58, has rocked the lever to a position parallel with the face of said flange; and for the adjustment for calibration to render the indication at the dial at this stage correct,—that is, in agreement with a master instrument of like construction,—there must be provided means for adjusting the index-hand-operating gear train with respect to the lever, whose pivot member, 50, is the initial train actuating element.

The construction for this purpose will now be described: Referring to Figures 3 and 5, the pivot member, 55, of the lever unit, F, which pivot member carries rigid with it the gear, 56, by which through the gear train, 54, 52, 51, the index hand is actuated against the reaction of the spring 60, is drive-fitted in a bushing element, 72, located on said pivot member, 55, between the lever members, 70 and 71, and incidentally serving to space these lever members apart. On the upper side of the lever member, 71, there is lodged flatly a lever member, 73, which is keyed fast to the bushing, 72, by means of a slotted hub projecting from the upper end of the bushing through the lever member, 71, as seen at 72^a in Figure 8. Said lever arm member, 73, is further secured to the bushing by a headed screw, 74, set through the lever arm member, 73, and extending through an arcuate slot, 71^c, in the lever member, 71, and adapted to be set

for clamping the lever arm at adjusted position within the range of the slot.

It will be understood from this description that the part, 73, can be adjusted about the axis of the pivot, 55, within the range of the arcuate slot, 71^c, thereby rotating the bushing, 72, the sector gear shaft or pivot, 55, and the sector gear, 56, through a substantial angle, and rotating the shaft, 50, of the index hand, and to which the inner end of the spring, 60, is secured, through the angle necessary to set the hand at the proper point of the dial for indicating the speed in accordance with a master instrument.

For the adjustment of the lever arm, 73, as described, it is formed at the end which is extended beyond the edge of the lever member, 71, with a lug or flange, 73^a, which projects toward the plane of the lever member, 70; and the lever member, 71, has a corresponding and cooperating lever arm, 71^b, along whose edge the flange, 71^a, above mentioned, is continuous, projecting toward the plane of the lever member, 70. A headed screw, 75, rotatably engaged with the flange, 71^a, and screwed through the flange, 73^a, has coiled about it, interposed between the flanges, 71^b and 73^a, a compression spring, 76, which reacts for holding the lever arm, 73, stressed away from the lever arm, 71^a.

The slotted head, 75^a, of the screw, 75, affords means by which the operator can adjust the screw, 75, and the lever arm, 73, for the purposes for which such adjustment is provided.

Assuming that in the original set-up of the apparatus at rest position of all the parts, with the index hand held at zero position by the reaction of the spring, 60, that reaction causes the lever unit, 70, 71, to be swung about the axis of the pivot, 55, carrying the shoe, 58, into encounter with the disk, 29^a, and that upon connecting the device with a shaft whose rotary speed is to be indicated, change of relation between the centrifugal action and the resistance thereto is necessary for calibration to obtain correct speed indication, it will be recognized that such change may consist in adjustment of the effective length of the operating arm of the lever unit, as above described, for greater or less angular movement of the index hand from a given amount of centrifugally-caused movement of the flange disk, 29^a.

From this description it may be understood that in the process of adjustment for correction of calibration the operator connects the instrument with a power-driven shaft controllable as to speed, which is also connected with the shaft of an identically constructed master instrument, and regulates the speed of the power shaft to that at which the lever of the master instrument stands parallel with the operating face of the part, 29^a; and while both instruments are running the operator adjusts the lever of the instrument to be calibrated, by means of the screw, 75, as above described, to a position parallel with the operating face of the part, 29^a; and while the parts are in that position the operator may apply the index hand to the spindle of the instrument whose calibration is being corrected, at the position on the dial corresponding to that of the index hand of the master instrument.

The speed of the power shaft being now increased to any desired maximum indicated on the master instrument, the operator, by means of the screw, 70^c as described, adjusts the lever arm as to effective length, to bring the index hand to position on the dial agreeing with that of the index hand of the master instrument. Thus the speed indication being rendered so closely approximated to correctness as to be substantially correct in agreement with the master instrument at two quite widely separated speeds will necessarily be similarly substantially correct in agreement with the master at all speeds.

An important feature of the construction as described consists in the provision of the shoe, 58, affording by its flat face, 58^a, an extended area for bearing on the flange, 29^a, said shoe being pivotally carried so that the flat face at all times maintains flat seating on the flange, 29^a, rendering minimum the wear of both parts due to sliding.

A further important feature consists in the selection of the materials for these two slidingly cooperating parts which are adapted to thus cooperate without necessity for lubrication. This is effected by making the flange member, 29^a, of stainless steel with the flat face highly finished as by polishing, and making the shoe, 58, of a lead and copper alloy, the lead serving for dispensing with lubrication, and the copper by its high thermal conductivity, tending to prevent heading resulting from the limited friction of the two cooperating parts made of the materials stated.

The importance of the adjustment described effected by the part, 73, rotating the pivot stud, 55, and the connected gear train, may be understood upon considering that this adjustment is equivalent to raising and lowering the centrifugal unit or the element, 29^a, thereof with respect to the registering unit, and the lever unit, F, thereof, or, the centrifugal unit with the part, 29^a, being unchanged in position, the adjustment described is equivalent to adjustment of the center of the entire assembly which comprises the pivot stud, 55, and the shoe-carrying lever elements and shoe, 58.

I claim:

1. A shaft speed-indicating instrument having a centrifugally actuated element and a speed-indicating element, and lever means communicating movement from the centrifugally actuated element to the speed-indicating element, said lever means comprising a lever unit having an actuated lever arm and an actuating lever arm having a pivot-in-common constituting the pivot of the lever unit, whereby said lever arms are angularly adjustable relatively to each other, said manually operable means comprising means for holding said two arms at positions to which they are progressively adjusted, and additional means for securing said arms rigidly together in angularly adjusted relation, said means being manually accessible and adapted for manual operation to effect said adjustment while the instrument is running for centrifugal actuation of the registering element.

2. A shaft speed indicating instrument having a centrifugally actuated element and a speed-indicating element, and lever means communicating movement from the centrifugally actuating element to the speed-indicating element, said lever means comprising a lever unit having an actuated lever arm and an actuating lever arm having a pivot-in-common, said pivot-in-common being the pivot of the lever unit, and manually operable means for adjusting said lever arms angularly with respect to each other about the pivot axis of the lever unit, comprising means securing said arms rigidly to each other, whereby they are maintained in adjusted relation to

each other throughout the range of movement of the lever unit about said pivot-in-common.

3. A shaft speed indicating instrument having a centrifugally actuated element and a speed-indicating element, and lever means communicating movement from the centrifugally actuated element to the speed-indicating element, the centrifugally actuated element being a flat faced part having its movement for actuating the lever means directly transverse to said flat face, said lever means consisting of a lever unit comprising an actuated lever arm and an actuating lever arm having a pivot-in-common constituting the pivot of the lever unit, said lever arms being angularly adjustable relatively to each other about the pivot axis of the lever unit, to vary the position of the actuating arm and the parts actuated thereby for operating the registering element, at the position of the actuated arm at which it extends parallel to said flat face of the centrifugally actuated element, comprising means securing said arms rigidly to each other, whereby they are maintained in adjusted relation to each other throughout the range of movement of the lever unit about said pivot-in-common.

FRED G. SCHWEISTHAL.