March 31, 1931. D. J. ANGUS 1,798,394

TACHOMETER GENERATOR

Filed Oct. 13, 1928 2 Sheets-Sheet 1

Fig. 1.

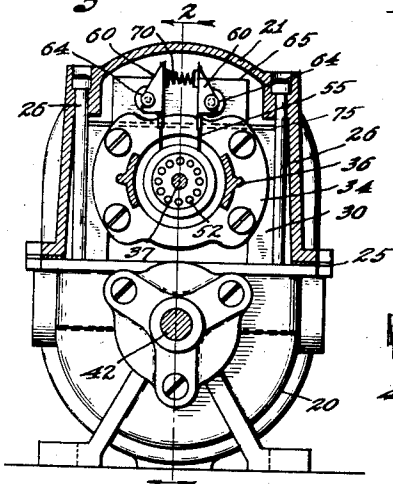


Fig. 2.

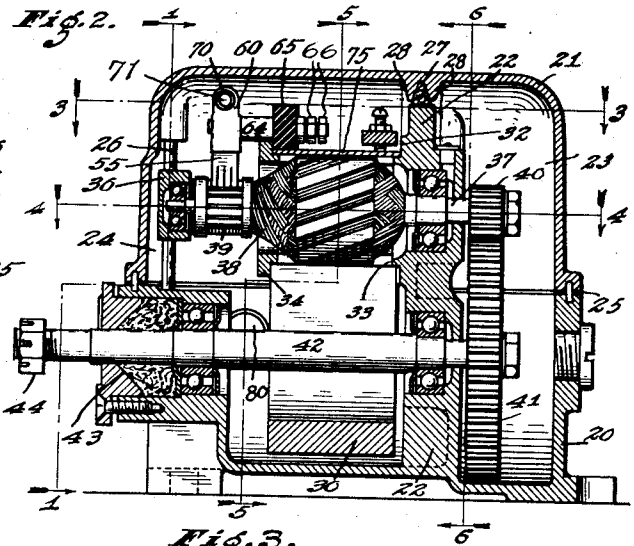


Fig. 5.

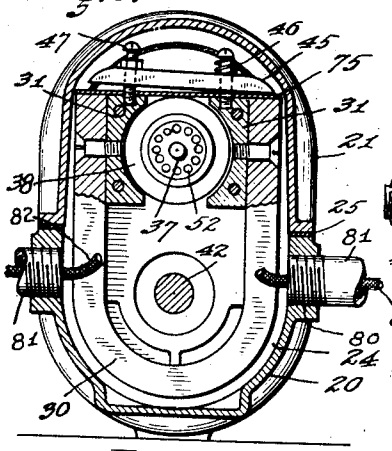


Fig. 3.

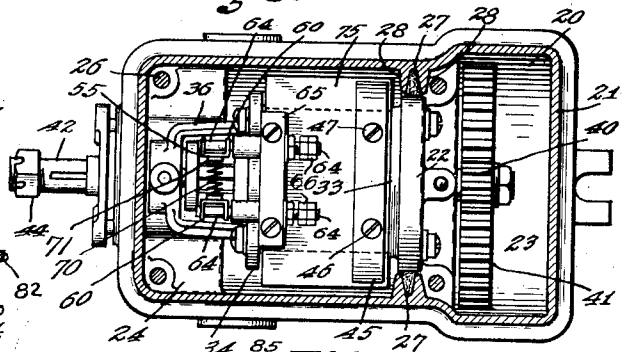


Fig. 6.

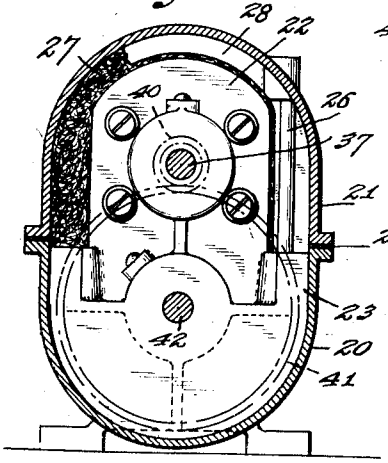
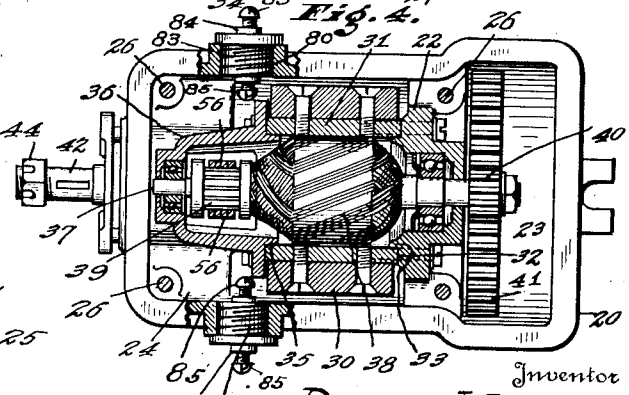


Fig. 4.



Inventor

DONALD J. ANGUS,

By Schley & Trask

Attorneys

March 31, 1931. D. J. ANGUS 1,798,394

TACHOMETER GENERATOR

Filed Oct. 13, 1928 2 Sheets-Sheet 2

Fig. 7.

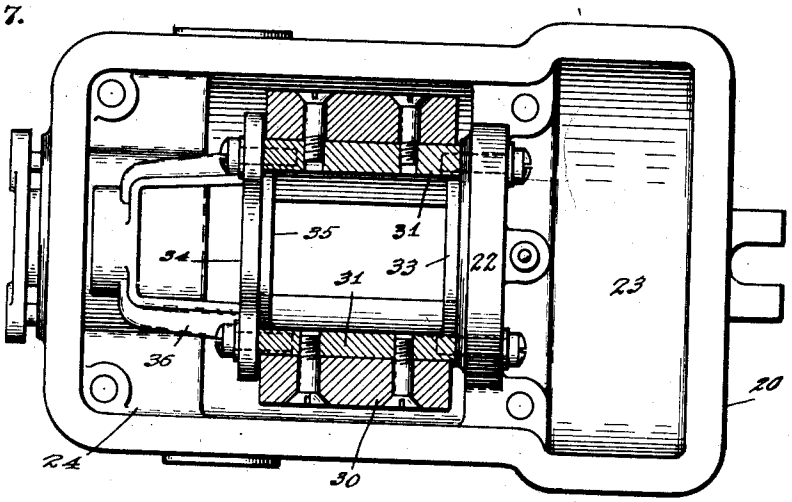


Fig. 8.

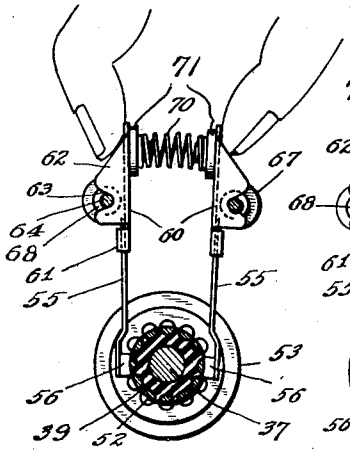


Fig. 9.

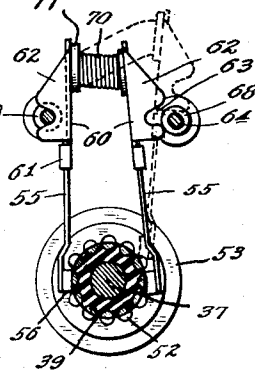


Fig. 10.

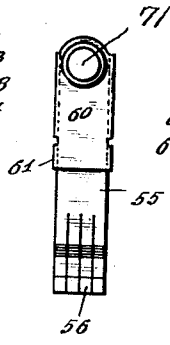


Fig. 11.

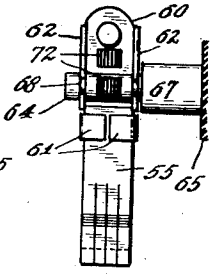


Fig. 12.

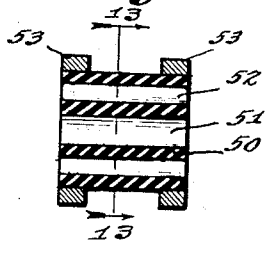


Fig. 13.

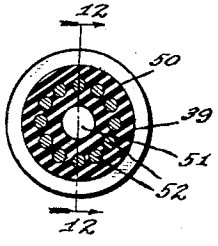
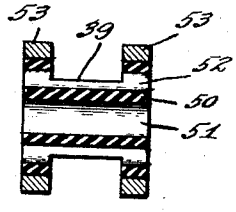


Fig. 14.



Inventor

DONALD J. ANGUS,

By Schley & Trush

Attorneys

Patented Mar. 31, 1931 1,798,394

UNITED STATES PATENT OFFICE

DONALD J. ANGUS, OF INDIANAPOLIS, INDIANA

TACHOMETER GENERATOR

Application filed October 13, 1928. Serial No. 312,321.

It is the object of my present invention to provide a rugged, reliable, and fool-proof tachometer generator.

It is more especially the object of the present invention to provide a tachometer generator in which:

1. The generator is free from danger of magnetic disturbances from being set on magnetic material.

2. The armature shaft is free from distortional strains from the driving connection.

3. The permanent magnets and pole-pieces are mounted so that they are free from torsional strains from the driving.

4. The electrical and magnetic mechanism and the gearing are kept apart, by having the two in separate compartments, so that the electrical and magnetic mechanism may be kept free from oil and grease.

5. All shafts are mounted so that the bearings for them may be prepared in a single operation, and accurate parallelism obtained.

6. The cover is removable and replaceable without affecting the relation of the working parts; and when in place makes a water-tight, oil-tight, and gas tight construction so that the generator may be safely used in places that would be impossible if working parts were exposed.

7. The commutator and brushes are substantially wear-proof.

8. The commutator and brushes are readily removable and replaceable, by a simple operation which it is practically impossible to perform incorrectly.

The accompanying drawings illustrate my invention: Fig. 1 is a partial end elevation and partial vertical section on the line 1—1 of Fig. 2 of a tachometer generator embodying my invention; Fig. 2 is a vertical longitudinal section substantially on the line 2—2 of Fig. 1; Fig. 3 is a horizontal section substantially on the line 3—3 of Fig. 2; Fig. 4 is a horizontal section substantially on the line 4—4 of Fig. 2; Fig. 5 is a vertical transverse section substantially on the line 5—5 of Fig. 2; Fig. 6 is a vertical transverse section substantially on the line 6—6 of Fig. 2; Fig. 7 is an enlarged plan of the lower casing member, with the shafts, armature, and gearing removed, and with the permanent magnets and pole-pieces in horizontal section substantially as in Fig. 4; Fig. 8 is an enlarged vertical section transverse to the armature shaft showing the commutator in section and the brushes in position, and illustrating how the brushes are gripped for removing and replacing them; Fig. 9 is a sectional view somewhat similar to Fig. 8, but showing how the brushes are manipulated in the process of their removal or replacement; Fig. 10 is an elevation of one of the brushes, showing the commutator-engaging side; Fig. 11 is a view of one of the brushes and its mounting, as viewed from the side away from the commutator; Fig. 12 is a longitudinal section through the commutator before it is ground, and is taken substantially on the line 12—12 of Fig. 13; Fig. 13 is a transverse section on the line 13—13 of Fig. 12; and Fig. 14 is a section generally similar to Fig. 12, but showing the commutator after it has been ground to its final form.

The casing comprises a lower part 20 and an upper part 21, and the lower part 20 of the casing has a vertical partition 22 which divides the casing into a gearing compartment 23 and an electro-magnetic compartment 24. The two casing parts 20 and 21 meet on a horizontal plane 25, where there is a gasket which provides a water-tight oil-tight, and gas-tight joint when the two parts are fastened together by the clamping screws 26. The partition 22 extends upward beyond the parting plane 25 into the upper casing-part 21, and forms with the latter a substantially oil-tight joint by reason of packing 27 which lies between two internal flanges 28 on the upper casing part or cover 21. All the working parts are carried by the lower casing-part 20; so that the cover 21 may be removed without affecting such working parts.

The magnetic field of the generator is furnished by a permanent magnet 30, which is of the usual horseshoe shape but has its poles upward. This position of the magnet 30 is important; for it prevents magnetic interference with the field of the permanent magnet from magnetic material on which the generator may be set. The poles of the magnet

30 are fastened by screws to pole-pieces 31. The pole-pieces 31 are fastened by screws to the adjacent side of the partition 22, near the upper end of the latter; the partition being faced on the surface 32 to receive accurately the machined end faces of the pole-pieces, and such surface 32 having a circular rib 33 projecting therefrom just inside of the pole-pieces to position them on the partition. The opposite ends of the pole-pieces 31 abut against and carry a plate 34, which is also faced and provided with a positioning ring 35 to fit in accurate position against such pole-pieces. The plate 34 carries a bearing yoke 36, which is integral therewith, for supporting one end of the shaft 37 which carries the armature 38 and commutator 39.

The permanent magnet 30 is hung entirely from its upper end, and by the pole-pieces 31, and is spaced from all other parts, such as the lower casing-part 20 and the partition 22. This relieves the permanent magnet 30 from all stresses, and thus prevents the transmission therethrough of mechanical stresses to the pole-pieces 31; because said pole-pieces are desirably ground internally to a definite clearance from the armature, and such mechanical stresses would tend to get them out of true.

The armature shaft 37 is mounted in ball bearings in the yoke 36 and in the partition 22; and projects through such partition, and carries a pinion 40 on its end in the gearing compartment 23. Such pinion 40 meshes with the gear 41 on the end of a jack shaft 42, which is mounted in ball bearings in the end of the casing part 20 and in the partition 22. Thus the gearing 40—41 is located entirely in the compartment 23; and any oil or grease therefrom is kept away from the electrical and magnetic apparatus.

The jack shaft 42 projects beyond the left-hand end (Fig. 2) of the casing 20—21, and is provided with a packing gland 43 between the adjacent ball-bearing and the exterior. The exposed end of the jack shaft 42 receives power, in any suitable manner, from the device whose speed is to be measured; as shown being provided with a shoulder against which a gear or pulley may be clamped by a nut 44.

In assembling the parts, the holes for both the ball bearings and the gland of the jack shaft 42 may be machined in one operation, and the surface 32 may be faced and the hole for the right-hand ball bearing (Fig. 2) of the armature shaft 37 may be machined in one operation, all in the same machine without changing the setting of the casing-part 20; for all these machined surfaces are on that casing-part, and all of them are machineable about parallel axes. This makes for accurate parallelism between the shafts 42 and 37.

However, all strains from the driving are carried by the jack shaft 42, so that the armature shaft 37 and the whole electro-magnetic mechanism are free from strains from the driving.

In order to control the flux in which the armature 38 rotates, I desirably provide an adjustable magnetic shunt 45 extending between the two magnet poles with a variable air gap between it and one of them. For this purpose, the magnetic shunt 45 has one end resting on one pole of the magnet 30, held there by a compression spring 46 acting between the head of an attaching screw and said magnetic shunt; and the other end is adjustably held away from the other pole of the magnet, as by a thrust screw 47.

The exterior of the armature is desirably ground accurately, to get an accurate air gap between it and the ground pole-pieces 31.

The commutator 39, which is also mounted on the shaft 37, has a peculiar construction. It can perhaps best be described by describing how it is made. A ring 50 of insulating material, conveniently bakelite, has an axial hole 51, which is of such size that it has a driving fit on the armature shaft 37. It also has a circular series of holes, equiangularly spaced apart, around the axis of the hole 51 as a center, for receiving a series of glass-hard high-carbon steel rods 52. Two binding rings 53, of metal, desirably fit over the end portions of the ring 50, to reinforce it in construction and operation. The construction so far described is shown in Figs. 12 and 13, and is a unit of manufacture. This unit is driven on to the desired position on the armature shaft 37; and then the middle part of the unit, between the two rings 53, is ground away about to the middles of the rods 52, to produce a spool-like shape. This exposes the middle portions of such rods, although they are still set in insulating material, but leaves the end portions of the rod wholly embedded in insulating material under the rings 53; and it leaves the end portions of such rods round, while reducing the middle portions to approximate half-rounds. The exposed external surface of the commutator is accurately ground round, about the axis of the shaft 27, and consists of metal bars alternating with the intervening and embedding insulating material. The glass-hard steel rods which thus constitute the commutator bars are found to withstand wear most effectively, even without any lubrication; especially in conjunction with the special commutator brushes 55 which co-operate with them.

These commutator brushes 55 consist of spring-metal strips, slitted at their commutator-engaging ends to provide a plurality of separately resilient fingers; and the free ends of those fingers are provided with blocks 56 which are the actual commutator-engaging portions. These blocks 56 may be soldered to the spring strips 55; and are made of an alloy of silver and lead, with the lead forming be-

tween five (5) and twenty per cent (20%), and most desirably about ten per cent (10%), and the silver forming substantially all the remainder of the alloy.

This arrangement of commutator and brushes, with the glass-hard high-carbon steel commutator bars 52 and with brushes of the silver-lead alloy, is found to be exceedingly long-lived, and exceedingly quiet even without lubrication.

While the relative amounts of silver and lead in the blocks 56 are not definitely limited to any one percentage, they are desirably within the range given; for it is found that silver brushes with no lead are subject to much more wear and produce a singing noise, and that brushes with too heavy a proportion of lead or made entirely of lead produce rather heavy wear on the steel bars 52, strange as that may seem. However, the singing noise is substantially eliminated, and the wear both on the commutator bars and on the blocks 56 is made exceedingly small, if the proportions of silver and lead in the alloy are kept within the range above indicated as preferable.

Each brush 55 at its end away from the commutator is fastened to a clip 60, which is conveniently of sheet-metal bent into U-shape cross-section with the base of the U on that side of the brush which is toward the other brush. The legs of the U-section of such clip are divided into two parts, the narrower parts providing fingers 61 which are bent over the strip 55 to clamp firmly, and the wider parts constitute ears 62 which project substantially perpendicularly to the plane of the strip and have outwardly opening notches 63 for cooperating with a brush-supporting rod 64.

There are two such brush-supporting rods 64, which are mounted in and extend through an insulating supporting block 65 attached to the pole-pieces 31. The projecting ends of the brush-supporting rods 64 on the opposite side of the insulating supporting block 65 are threaded and carry nuts 66 to form binding posts. On the side toward the commutator, the brush-supporting rods 64 may be surrounded by insulating spools 67 for part of their length, if desired, to leave exposed only the portions which co-operate with the ears 62; and where the rods 64 co-operate with such ears they are provided with circumferential notches 68 into which such ears 62 project. Thus by the co-operation of the notches 68 and the notches 63, the brushes are quite accurately positioned on the rods 64 and on the commutator.

The two brushes 55 are spring-pressed apart by a compression spring 70 at their ends remote from the commutator. This spring is so attached to the two clips 60, in any suitable manner, that the spring and the two brushes constitute a unit which can be handled as such; but the spring is of course insulated from one or both brushes, as by buttons 71 interposed between the spring-ends and the brushes and attached to both.

To remove or replace the brushes, the upper ends thereof are pushed together against the spring 70, as is illustrated in Fig. 9, and first one clip and then the other is either removed or put in place by suitable movements of the operator's thumb and finger. This facilitates inspection and repair. When the brushes are put back, after having been removed, they go accurately to their proper position, and in the same accurate co-operation with the commutator, that has been produced by their grinding, by the positioning effected by the ears 62, notches 63, and notches 68. To lessen the chance of reversing the brushes, one of the brushes and the corresponding rod 64 are provided with similar identifying marks 72, such as colored dots, indicated as red.

Each particular pair of brushes is associated with a particular commutator, and the two ground together, to make an accurate fit of brush against commutator; and by the arrangement that has just been described, this ground fit is made possible of preservation.

A flat non-magnetic shield 75 may be placed above the commutator, extending from one pole-piece 31 to the other.

The two brush-supporting rods 64 may be connected to an external circuit, and thence to any suitable current-measuring instrument such as a recording volt-meter, in any suitable manner. To make such connection without its interfering with the removal of the upper casing-part 21, the lower-casing part is provided on each side with a threaded hole 80, through which the lead-in wire may be suitably connected to the binding posts formed on the ends of the brush-supporting rods 64. The manner of such connection by way of the holes 80 may be anything desired, but is desirably by some sort of water-tight and gas-tight arrangement. For instance, there may be conduits 81, which carry the lead-in wires 82, of both of which fragments are shown in Fig. 5; or there may be screw-plugs 83 of insulating material, with conducting rods 84 through them, as is indicated in Fig. 4, with such rods 64 provided at both their inner and outer ends with suitable binding screws 85 for connection of wires leading internally to the brush-supporting rods 64 and externally to the electrical measuring instrument.

I claim as my invention:

1. A tachometer generator, comprising a casing having a partition, pole-pieces attached to said partition, a permanent horseshoe magnet hung wholly from said pole-pieces and having its poles upward, and an armature co-operating with said pole-pieces.

2. A tachometer generator, comprising a

casing having a partition, pole-pieces attached to said partition, a permanent horseshoe magnet co-operating with said pole-pieces and having its poles upward, and an armature co-operating with said pole-pieces.

3. A tachometer generator, comprising a casing having a partition, pole-pieces attached to said partition, a permanent horseshoe magnet hung wholly from said pole-pieces, and an armature co-operating with said pole-pieces.

4. A tachometer generator, comprising upper and lower casing parts, said lower casing part having an upwardly projecting partition, a magneto generator hung wholly from said partition and having an armature shaft, and a jack shaft mounted in the lower casing part and geared to said armature shaft.

5. A tachometer generator, comprising upper and lower casing parts, said lower casing part having an upwardly projecting partition, a magneto generator hung wholly from said partition and having an armature shaft, and a jack shaft mounted in the lower casing part and geared to said armature shaft, said lower casing part having bearings for the two shafts and a facing for the attachment of the magneto generator that can all be machined with a single setting of that casing part.

6. A tachometer generator, comprising a casing, a magneto generator mounted wholly within said casing and having the ends of its armature shaft also within such casing, and a jack shaft separately mounted in said casing and projecting therefrom, and gearing between said two shafts within the casing, said casing having a unitary removable part the removal of which by itself exposes all of the generator in operation position.

7. A tachometer generator, comprising a casing, a magneto generator mounted wholly within said casing and having the ends of its armature shaft also within such casing, and a jack shaft separately mounted in said casing and projecting therefrom, and gearing between said two shafts within the casing, said casing being provided with an internal partition which separates the magneto generator and the gearing.

8. A tachometer generator, comprising a casing, a magneto generator mounted wholly within said casing and having the ends of its armature shaft also within such casing, and a jack shaft separately mounted in said casing and projecting therefrom, and gearing between said two shafts within the casing, said casing being made in two parts which have a substantially tight joint between them, and said shafts, gearing, and magneto generator being wholly supported by one of said parts so that the removal of the other part does not affect their relation.

In witness whereof, I have hereunto set my hand at Indianapolis, Indiana, this 1st day of October, A. D. one thousand nine hundred and twenty-eight.

DONALD J. ANGUS.