Dec. 19, 1939. R. M. HEINTZ 2,184,236

PRIME MOVER DYNAMO PLANT

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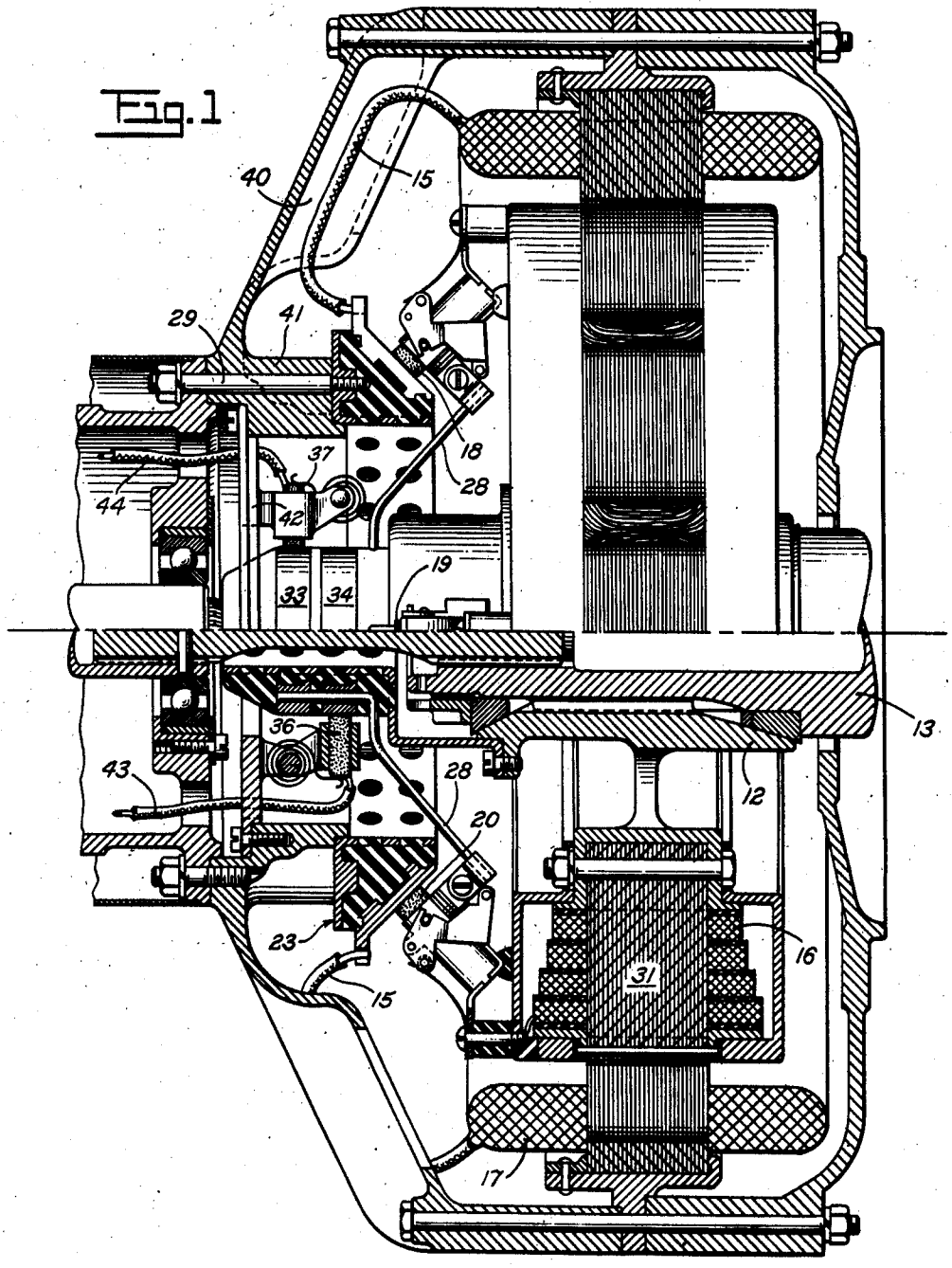
Fig. 1



INVENTOR.
Ralph M. Heintz
BY
Martin J. Finnegan
ATTORNEY.

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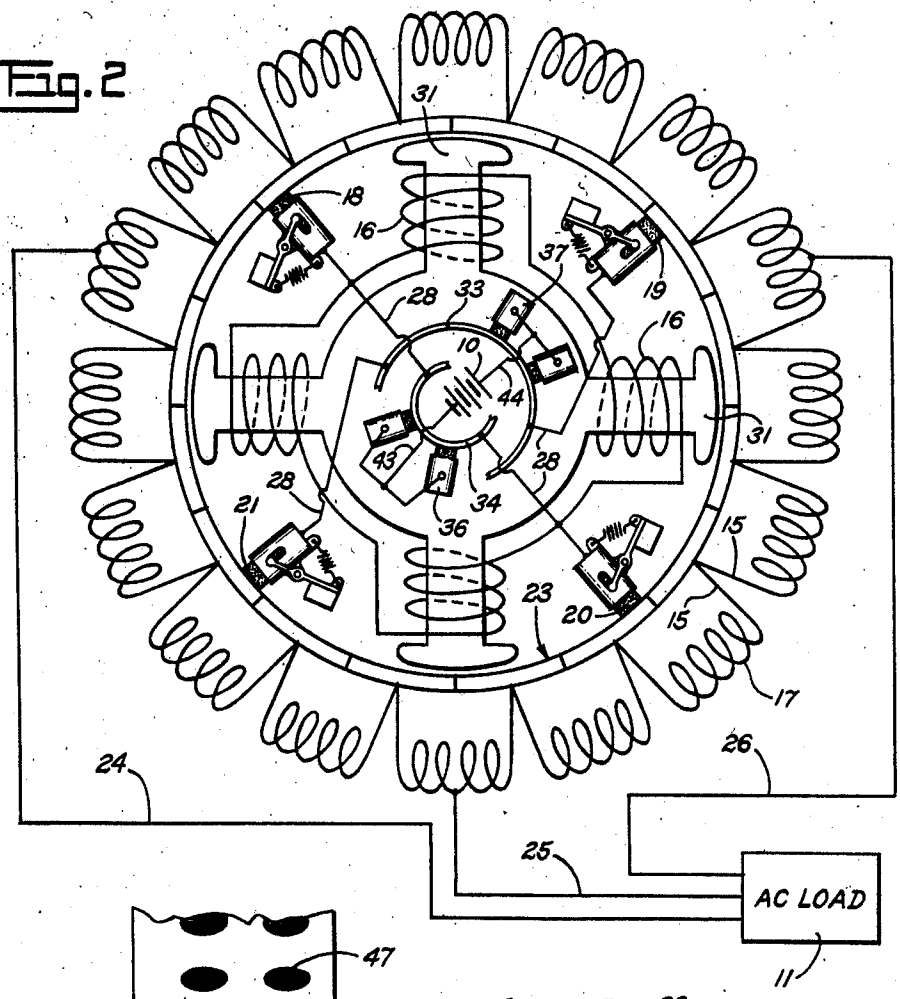
Fig. 2



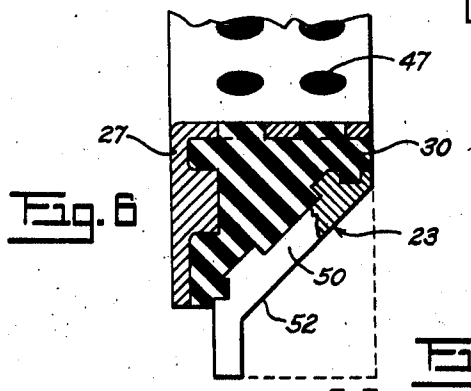


Fig. 6

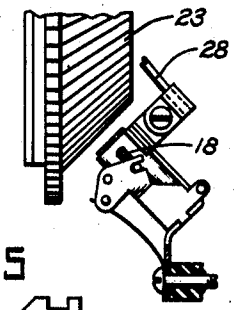


Fig. 3

Fig. 5

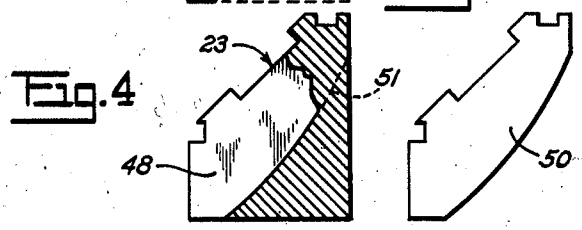


Fig. 4

INVENTOR.
Ralph M. Heintz
BY
Martin J. Finnegan
ATTORNEY.

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2,184,236

PRIME MOVER DYNAMO PLANT

Ralph M. Heintz, Montclair, N. J., assignor to Bendix Aviation Corporation, South Bend, Ind., a corporation of Delaware

Application November 5, 1938, Serial No. 239,091

13 Claims. (Cl. 290—31)

This invention relates to a combined starting and generating unit for use with internal combustion engines and capable of functioning, first, to start an internal combustion engine by application of torque thereto, and thereafter to convert the power developed in the engine into electrical energy available for radio transmission and other purposes requiring alternating current of high, low or intermediate frequency and/or potential.

An object of the invention is the provision of a dynamo-electric machine of novel construction permitting most advantageous use thereof for multiple purposes including, for example, the initial "turning over", or cranking, of an internal combustion engine, and the subsequent generation of alternating current of high frequency, by conversion of mechanical energy transmitted thereto by way of said internal combustion engine.

Among the novel features of the machine herein disclosed there is included that of a commutator adapted to be engaged by rotatable brushes, for transmission of current between the former and the latter at relatively low rotor speeds, the invention further including the concept of a novel method of manufacturing said commutator, and a novel mounting and mode of operation for said rotatable brushes, as a result whereof the said brushes remain in engagement with the commutator to feed low voltage direct current to the stator windings during the duration of the engine cranking operation, but move out of engagement and thereby discontinue such direct current flow as soon as the engine crank-shaft accelerates sufficiently to render further cranking unnecessary. Thereafter the stator serves solely as a supply of alternating current for outside points of distribution and consumption.

These and other objects and features of the invention will become apparent upon consideration of the following detailed description, and upon reference to the accompanying drawings illustrating the preferred embodiment of the invention. It is to be understood, however, that the drawings are illustrative only, and that the calims at the conclusion of the specification, rather than the drawings, measure the scope of the invention.

In the drawings, wherein like reference characters refer to like parts throughout the several views:

Fig. 1 is a longitudinal sectional view of a housing enclosing a machine embodying the invention, some of the enclosed parts being shown in section and some in elevation;

Fig. 2 is a diagram of the electrical connections for the machine of Fig. 1, and including a schematic representation of the speed responsive brush shifting means.

Fig. 3 is a view showing part of the commutator and one of the brushes disengaged therefrom (the engaged position being shown in Fig. 1);

Fig. 4 is a view of the metallic annulus that eventually becomes the commutator, as said annulus appears at an intermediate stage of manufacture;

Fig. 5 is a view of one of the insulating segments as it appears at the time of insertion into the metallic annulus of Fig. 4; and

Fig. 6 is a transverse view of a section of the completed commutator.

In the drawings reference character 10 designates a source of direct current (battery, for example) and 11 designates an alternating current receiving apparatus, such as radio transmitters, transformers, receivers, rectifiers, motors, etc., to which alternating current of high frequency may be supplied upon rotation, at relatively high speed, of an engine driven dynamo-electric machine whose rotor shaft 12 is shown as direct-connected to the crank-shaft 13 of an internal combustion engine (not fully shown). Engines of a character adapted to drive high frequency alternators are commonly employed on aircraft as a power supply means for operation of electrical equipment of which the units above enumerated may be taken as examples.

Such aircraft installations ordinarily include a battery such as that shown at 10, charged at sufficient capacity to energize the rotor and stator windings 16 and 17, respectively, for use as a starting motor in the initial cranking and acceleration of the engine crank-shaft 13 to self-sustaining speed. Attainment of this normal running speed produces a centrifugal force of sufficient magnitude to raise rotor brushes 18, 19, 20, and 21 out of contact with commutator 23, whereupon the passage of current therebetween is interrupted. Thereafter stator windings 17 serve solely as a source of alternating current, to be fed to the A. C. load 11 by way of multiphase conductors 24, 25, and 26.

In order that the machine may function as a direct current shunt motor for engine starting purposes, the rotor windings 16, located in step formation about rotor poles 31, are connected at their ends to brushes 18, 19, 20 and 21, two of said brushes being in turn connected with collector ring 33 of positive polarity while the other

two connect with collector ring 34 of negative polarity. Brushes 36, mounted in brush assemblies secured to the housing 41 by suitable means (of which that shown at 42 in Fig. 1 is an example) engage collector ring 34, while brushes 37, correspondingly mounted, engage collector ring 33. Conductors 43 and 44 complete the connections from battery 10 to the stationary brush sets, while a conductor 28 connects each of the rotating brushes 18 to 21 with its corresponding collector ring.

As hereinabove indicated, the stationary commutator assembly is made in a novel manner, including (as a step in the process) the union of two annular metallic members 23 and 27, of which the former eventually becomes the segmented commutator, per se, while the latter is the supporting core that is eventually secured to the housing by suitable means 29. A molding compound 30 is the uniting element for parts 23 and 27, the latter being provided, if desired, with compound receiving holes 47 to insure more complete union therebetween.

A preceding step in the process is to cut slots 48 (Fig. 4) extending part-way through the metallic annulus 23, and spaced around the inner periphery thereof, in accordance with a predetermined formula, to provide pockets for receipt of segments 50 (Fig. 5) of mica or equivalent insulating material. The annulus 23 (after union with core 27 in the manner above described) is machined down to finished shape, (Fig. 6) in which process all metal located beyond (and, if desired, additional material within) the radially outermost part of the mica segments 50 (see line 51, Fig. 4) is removed, thus exposing the mica edges to view, at the outer side, and likewise resulting in the creation of a corresponding number of spaced conducting segments to constitute the commutator. As shown each segment thereof has a final shape as indicated at 52 in Fig. 6, and each of said segments has now become electrically separate from every other metallic part.

By this process of fashioning the commutator segments in situ, and from a single piece of metal, there are eliminated all problems of accurate fitting and positioning of segments individually; each segment is automatically caused to appear in its proper relative position, since all remain unshiftable from start to finish of the process.

In order to offset any tangling tendency, as between the conductors 15 and the rotating brush assemblies, I provide radially extending ribs forming pockets 40 in the housing 41, along which pockets the conductors 15 are run, and to which they may be secured, thus preventing their dropping inwardly into contact with the brush assemblies 18 to 21.

For claims to the construction of the commutator and other parts of the dynamo-electric machine, per se, reference may be had to my divisional application No. 276,197, filed May 27, 1939.

What I claim is:

1. In an internal combustion engine power plant, a dynamo-electric machine having a stator winding to deliver alternating current and a rotor integrated with the engine crank-shaft to impart initial rotation to said crank-shaft when current is fed to the rotor and stator windings from an external source, and means for interrupting the feeding of current from said external source to said stator windings, said means being responsive to acceleration of said crank-shaft to a predetermined speed.

2. In an internal combustion engine power plant, a dynamo-electric machine having a stator winding to deliver alternating current and a rotor integrated with the engine crank-shaft to impart initial rotation to said crank-shaft, means including a commutator and brushes engageable therewith to feed direct current to said stator windings during the engine cranking period, and means for interrupting the feeding of current to said stator windings, said means being responsive to acceleration of said crankshaft to a predetermined speed.

3. The combination with an internal combustion engine of an alternating current generator rotatable therewith, and means for converting said generator into a continuous current shunt motor by which to impart initial rotary movement to the engine.

4. The combination with a dynamo-electric machine of the alternator type, of an external source of direct current, and means including brushes rotatable with said machine to convert it into a shunt motor receiving energy from said external source during low speed rotation of said brushes.

5. The combination with a dynamo-electric machine operable as an alternating current generator at high speeds, of means including centrifugally shiftable brushes for operating said machine as a direct current receiving shunt motor at low speeds.

6. In a dynamo-electric machine having stationary and rotatable windings, means including a stationary commutator and liftable brushes engageable therewith to feed current to one of said windings at low speeds, and means responsive at a higher speed to lift said brushes away from said commutator.

7. In a dynamo-electric machine having cooperating windings, means including a stationary commutator and liftable brushes engageable therewith to feed current to one of said windings at low speeds, and means responsive at a higher speed to lift said brushes away from said commutator.

8. In a dynamo-electric machine having stationary and rotatable brush sets, and stationary and rotatable windings, means for feeding current to both the stationary and the rotatable windings at relatively low speeds, said means including both said stationary and said rotatable brush sets, and means mounted adjacent said rotatable brush sets for interrupting the circuit to said stationary windings as soon as the machine attains a predetermined speed.

9. In a dynamo-electric machine having stationary and rotatable brush sets, and stationary and rotatable windings, means for feeding current to both the stationary and the rotatable windings at relatively low speeds, said means including both said stationary and said rotatable brush sets, means mounted adjacent said rotatable brush sets for interrupting the circuit to said stationary windings as soon as the machine attains a predetermined speed, and a current consuming device in circuit with both said stationary windings and said rotatable brush sets, during low speed rotation, and also remaining in circuit with said stationary windings during high speed rotation.

10. In a dynamo-electric machine having stationary and rotatable brush sets, and stationary and rotatable windings, means for feeding cur-

rent to both the stationary and the rotatable windings at relative low speeds, said means including both said stationary and said rotatable brush sets, means mounted adjacent said rotatable brush sets for interrupting the circuit to said stationary windings as soon as the machine attains a predetermined speed, and a current consuming device in circuit with both said stationary windings and said rotatable brush sets, during low speed rotation, and also remaining in circuit with said stationary windings during high speed rotation, said current consuming device being of sufficient resistance to prevent substantial short-circuiting of said stationary windings, during such low speed rotation, and being further adapted to receive full energization from said stationary winding during such high speed rotation.

11. In a dynamo-electric machine having stationary and rotatable windings, means including a stationary commutator and rotatable brushes engageable therewith to feed current to said stationary windings at low speeds, and means responsive at a higher speed to lift said brushes away from said commutator.

12. In a dynamo-electric machine having stationary and rotatable windings, means including a stationary commutator and liftable brushes engageable therewith to feed current to said stationary windings at low speeds, and means responsive at a higher speed to lift said brushes away from said commutator.

13. In a dynamo-electric machine having stationary and rotatable windings, means including a commutator and liftable brushes engageable therewith to feed current to said stationary windings at low speeds, and means responsive at a higher speed to lift said brushes away from said commutator.

RALPH M. HEINTZ.