No. 653,957. Patented July 17, 1900.

G. W. HENRICKS.

MAGNETO ELECTRIC GENERATOR FOR GAS ENGINE IGNITERS.

(Application filed Apr. 30, 1900.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

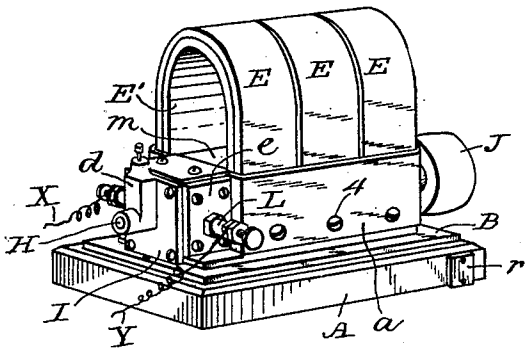


Fig. 2.

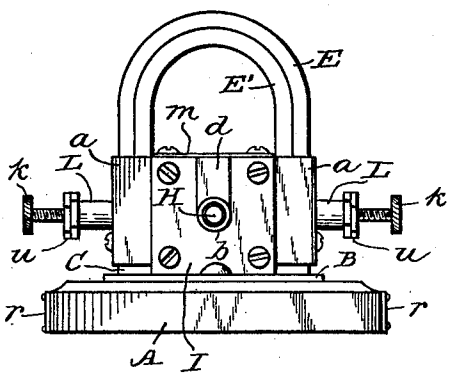
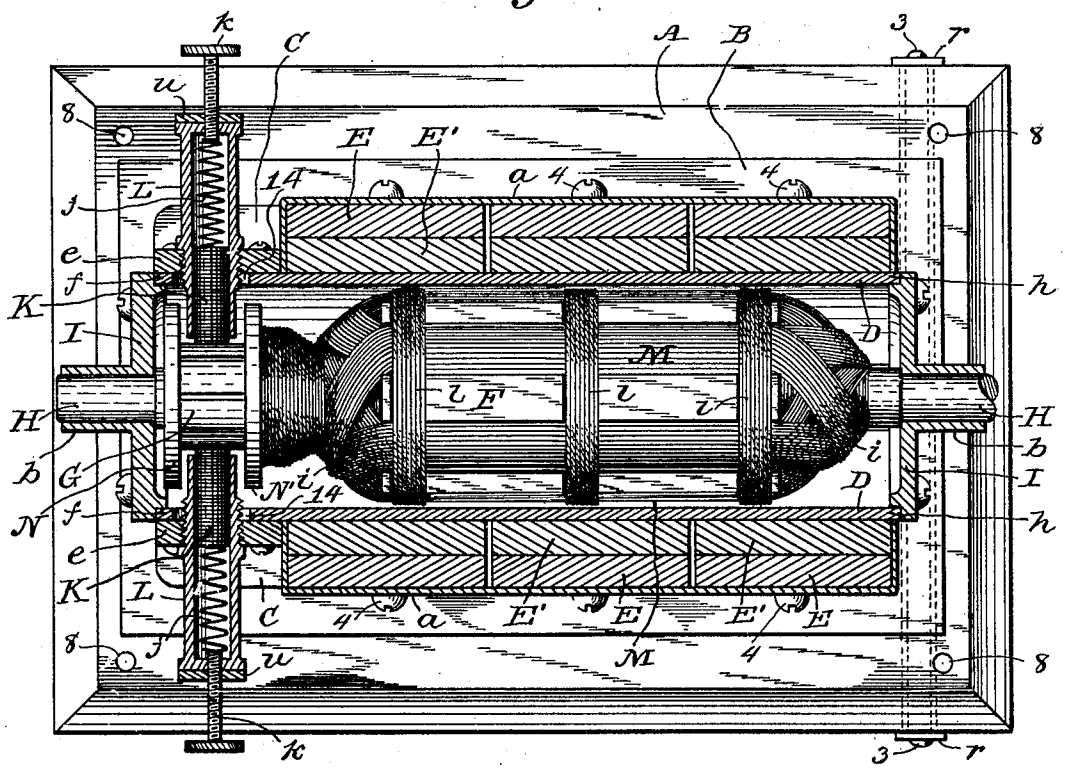


Fig. 3.



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Fig. 4.

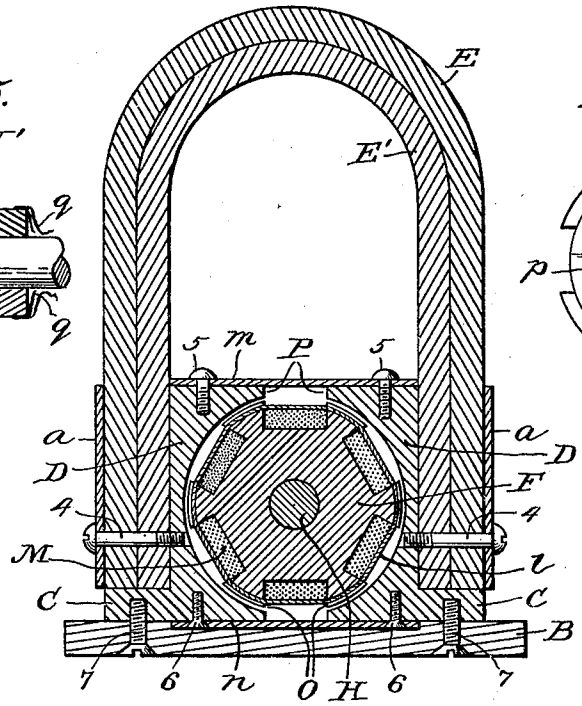


Fig. 5.

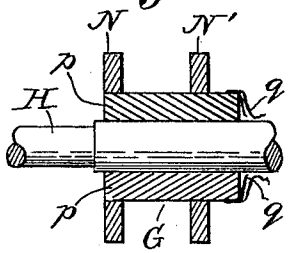


Fig. 6.

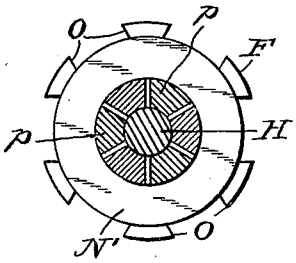
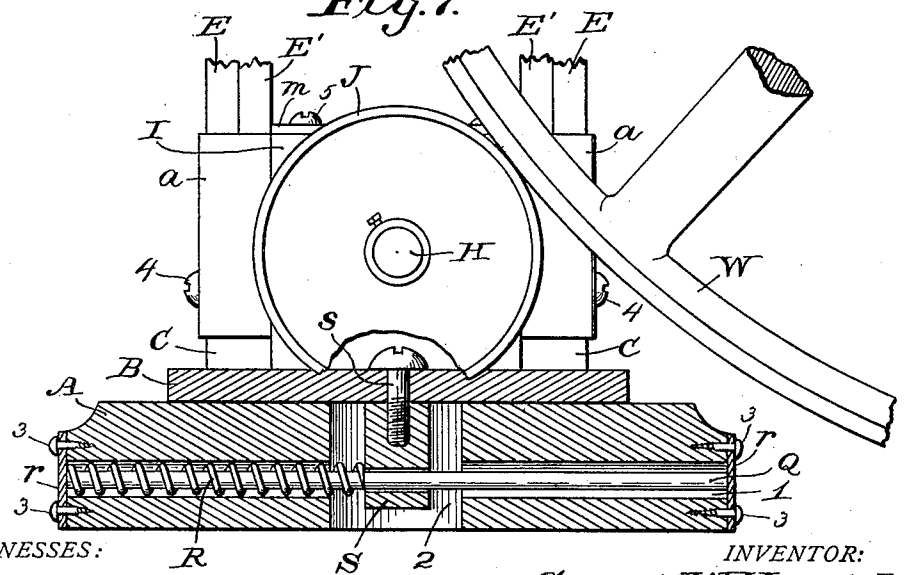


Fig. 7.



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Fig. 8.

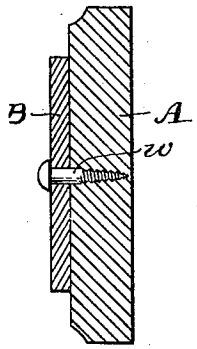


Fig. 9.

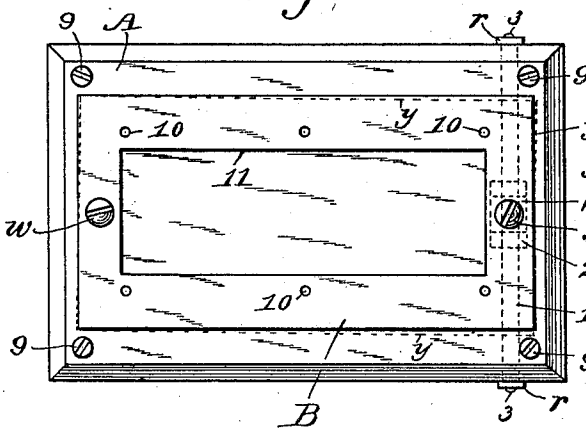


Fig. 10.

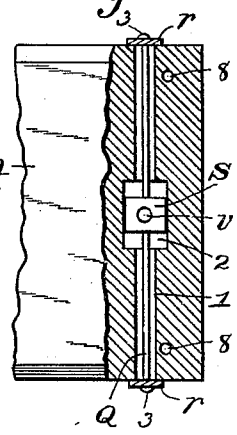
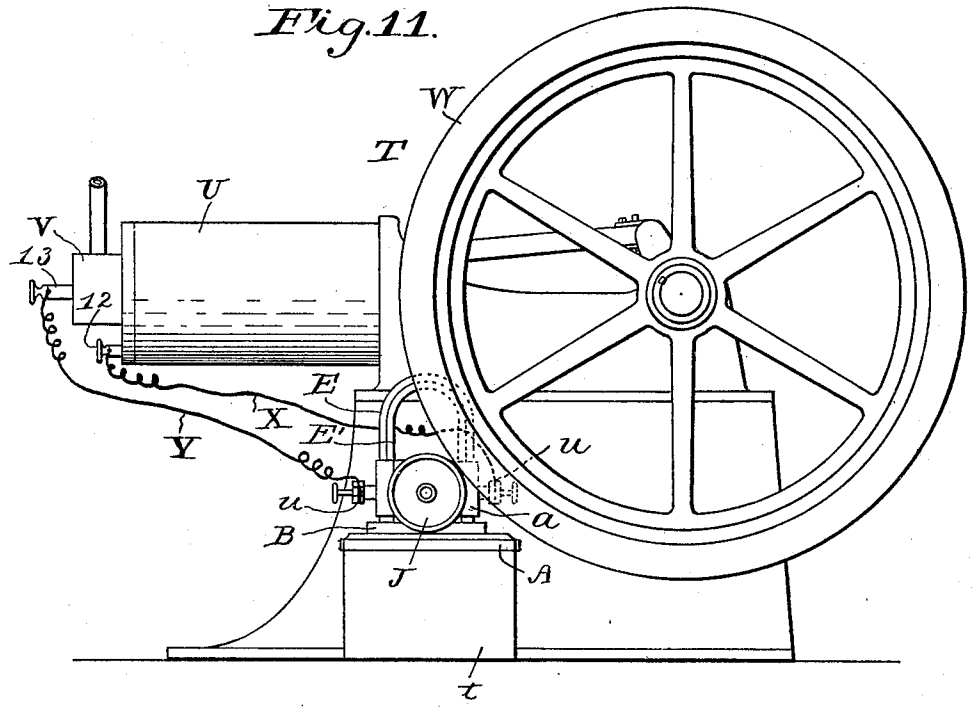


Fig. 11.



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UNITED STATES PATENT OFFICE.

GARRETT W. HENRICKS, OF INDIANAPOLIS, INDIANA, ASSIGNOR TO THE HENRICKS NOVELTY COMPANY, OF SAME PLACE.

MAGNETO-ELECTRIC GENERATOR FOR GAS-ENGINE IGNITERS.

SPECIFICATION forming part of Letters Patent No. 653,957, dated July 17, 1900.

Application filed April 30, 1900. Serial No. 14,907. (No model.)

To all whom it may concern:

Be it known that I, GARRETT W. HENRICKS, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented certain new and useful Improvements in Magneto-Electric Generators for Gas-Engine Igniters; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to a machine whereby an electric current may be generated, and has reference more particularly to a low-voltage generator.

The objects are to provide an electric generator which shall be adapted to be driven or operated by any of the various types of gas or gasolene engines and be effective at any degree of speed desirable up to, for instance, five thousand revolutions per minute without heating and generate a low regular force, as from ten to twelve volts, whereby the igniters or sparkers may be supplied with an electric current of reliable volume and force for exploding the gas charges in the engine, and to provide a machine of this type which shall be adapted to be connected operatively to the gas-engine by simply anchoring it in contact with any rotating wheel or pulley with which the engine may be provided, thus obviating the necessity of providing specially-designed connecting devices therefor.

One of the objects contemplates a mechanical generator which shall have permanent fields and be capable of furnishing an electric current of sufficient force for sparking immediately upon being set in motion without requiring velocity in so doing.

A further object is to provide a cheap, durable, and economical generator of this character.

The invention consists in a magneto-electric generator embodying certain improvements in the details of construction of the base or foundation, in the windings of the armature, in the forms and arrangement of the magnets and poles, in the form of the armature, and in the immersion of the armature in the magnetic field or in substantially surrounding the armature with lines of magnetic force, as well as practically inclosing the commutator within the influences of the magnetic poles.

The invention consists, further, in the parts and combination and arrangements of parts, as hereinafter particularly described and claimed.

The general features of the machine are constructed upon the principle well known that a conducting circuit of wire moved across a magnetic space generates an electric current in the wire, that the stronger the magnetism the more rapid the motion of the wire or the greater its length the stronger is the resultant current and the greater the resistance, and that the wire moved past the poles of the magnet with great rapidity generates in the wire a momentary current as it passes the poles, and the more rapid in succession the more nearly continuous will be the current. Such construction, however, in its simple forms is not adapted to attain the efficiency necessary in a machine-generator for the present purpose, and by experimenting I have discovered that which enables me to provide the desired character of generator, fulfilling the highest aims of the invention, as will appear hereinafter.

Referring to the drawings, Figure 1 represents a perspective view of a machine constructed in accordance with my invention; Fig. 2, an end elevation; Fig. 3, a horizontal sectional view longitudinally about on a line central with the armature-shaft bearings; Fig. 4, a vertical transverse sectional view at about the longitudinal center of the armature; Fig. 5, a longitudinal sectional detail view of the commutator; Fig. 6, a transverse sectional view of the commutator; Fig. 7, a fragmentary view showing a portion of the base in vertical section and the devices which adapt the machine to be operated directly by a fly-wheel frictionally; Fig. 8, a transverse sectional view of the base; Fig. 9, a top plan view of the base; Fig. 10, a detail view of one end of the base, and Fig. 11 a view in elevation showing my invention combined with a gas-engine.

Similar reference characters in the several figures of the drawings designate similar parts.

In carrying out my invention in all its practical details I provide a foundation member or base A, of rectangular form in plan, preferably of wood or other non-conductor of electricity, and upon this is a supplemental plate or base part B, preferably composed of vulcanized fiber or the like when the machine is adapted to be operated by direct frictional contact, but when operated by a belt the plate B may be dispensed with, and the superstructure may then be attached directly to the base A. One end of the base A when constructed for operation by direct contact preferably has a transverse horizontal bore 1, covered at its ends by plates *r r*, secured to the base by wood-screws 3. At the center of the length of the bore is an open area 2, extending to the top of the base A and covered by the plate B, to which is secured a traveling head S, as by a screw *s*, passing through a suitable hole in the plate and into a hole *v* in the head. The head S has a suitable aperture through which a guide-rod Q extends, which is placed in the bore 1 and bears at its ends against the plates *r r*. A coiled spring R encircles a portion of the guide-rod in the bore 1 and bears against one plate *r* and against the head S, and the tension of the spring may be increased by inserting washers against one end thereof. The base A has a suitable number of holes 8 to receive securing-screws 9. At the opposite ends of the base and the plate the plate B is pivotally secured to the base A, as by a wood-screw *w*, so that the plate may vibrate at its end opposite to the pivot against the pressure of the spring R, as indicated by the broken lines *y*. The plate has a suitable number of holes 10 to receive screws 7, whereby the superstructure may be secured to the plate, the latter having a recess 11 in its upper face when necessary to receive a connecting-plate *n*, which may be placed below the plane of the pole-bases.

The two pole-pieces D D have each a base C and together provide supports for the magnets and armature and are composed of soft cast-iron, being designed particularly so as to avoid employing any surplus or unnecessary amount of iron that would require to be saturated. The two pieces are substantially alike as cast, the base C extending as a flange from the outer vertical plane side; but when assembled as a pair the flanges extend outwardly in opposite directions laterally and the full length of the poles. At an end of each piece, so as to be in alinement when assembled, are apertures 14, through which the brushes are inserted. The inner faces of the pole-pieces are bored true, so that each presents a segment of a circle, the extremities or poles P P of which are situate somewhat close together or those of one piece relatively to those of the other piece, the distance between two opposing poles being about equal to the width of a longitudinal slot O in the armature F, which receives the circuit-wire M. Each pole-piece is comparatively thin at the center and ends of the segment—that is, transversely at the vertical center and vertically at the poles or upper and lower inner projections. Each piece D is of suitable length to accommodate the armature and extend somewhat beyond the same at each end thereof. The pair of pieces are coupled together mechanically only by means of a non-magnetic horizontal plate *m* at the top, secured by screws 5, and a like plate *n* at the bottom, secured by screws 6, and at the ends *f* and *h* by non-magnetic heads I I, each having a journal-housing *b*, provided with a suitable oiler *d*, thus inclosing, as it were, the magnetic field about the armature and commutator.

A laminated compound magnet connects the two pole-pieces D D and is composed of a series of separate U-shaped magnets E′, having their ends or poles resting upon the bases C C and a portion of their inner faces near the ends bearing against the outer vertical side faces of the pole-pieces D D, and a series of separate diametrically-larger U-shaped magnets E, fitting over the others in pairs, as shown, and having their ends also in contact with the bases C C and their inner faces throughout in contact with the outer faces of the smaller magnets E′, each of which separate magnets is composed of a bar of steel having an oblong rectangular cross-sectional area and hardened to the greatest degree possible. Plates *a a* are placed against the outer sides and edges of the magnets and bind the magnets together and to the pole-pieces by means of screws 4, inserted into suitable holes. The pole-pieces extend at the ends, having the apertures 14 beyond the magnet.

The armature F is constructed in a manner and form somewhat similar to those in general use, but, as will be seen, is adapted specially for the purposes of the present invention. It includes a shaft H, mounted in the housings *b b*, and a soft-iron core attached to the shaft centrally in the bored pole-pieces, and on the shaft near one end of the core is a commutator G, built upon and secured so as to rotate with the shaft and core. The core has a length approximately equal to two-thirds of the length of a pole-piece portion which is covered by the magnet and has longitudinal slots O or grooves of suitable depth to accommodate the desired amount of wire and having each a width preferably equal to the distance between two opposing poles P. The periphery of the core is turned true to a diameter but slightly less than the diameter to which the pole-pieces have been bored, so that the two are very nearly in contact when assembled. Six slots are preferably made, so as to provide that but small portions of the core are exposed between the slots. In winding the bobbins M, I find that the best results are attained for the purpose designed by employing No. 23 insulated wire

in two hundred and fifty-two ampere turns to produce twelve volts and three amperes, and the whole length of the armature, including the end windings *i i*, is less than the length of that portion of a pole-piece which is covered by the magnet. The bobbin-wires are secured to the core by means of threads *l*, wound about the core and the wires in circumferential grooves.

The commutator G is situate within the influence of the pole-pieces, but beyond the magnets, and comprises the usual copper segments *p*, each insulated from each other and from the shaft H and bound together by heads N N′, preferably composed of vulcanized fiber and are connected in the usual manner by the ends *q* of the bobbin-wires, which are bound in the customary manner near the head N′. The opposite end of the shaft H outside the journal is provided with a suitable pulley J, preferably having a crowning face, so as to be adapted either for belting or for being driven by frictional contact with a similar wheel or pulley.

The portions of the pole-pieces D D which extend beyond the magnet are faced at the outer sides by insulating-plates *e e*, preferably composed of vulcanized fiber, in which are suitably-threaded holes into which the brush-holders L L are screwed in alinement at opposite sides of the commutator. Each holder L consists of a tube having an open inner end projecting through the aperture 14 and a closed outer end having a threaded hole into which is inserted a threaded adjusting-screw *k*, bearing against a coiled spring *j*, which is seated also against the outer end of a brush K, the latter being formed, preferably, of a section of wire-netting closely woven and wrapped into a cylindrical roll of suitable diameter and length to move freely in the holder. A binding-nut *u* is suitably threaded and fitted on the screw *k* for binding the conducting-wire to the brush-holder, which is composed of electric conducting material.

It will be understood that the magnet is to be highly magnetized, each section separately, the whole producing a powerful magnetic field, the binding-plates *a* aiding in equalizing the forces, as they increase the contacts, which would otherwise be less perfect by reason of the somewhat uneven surfaces of the bars from which the magnet-sections are formed, without machining the bars after bending and hardening.

In extending the magnet beyond the ends of the armature (including the end windings thereof) an advantage is gained in that the end windings also cut the magnetic fields and assist the longitudinally-disposed bobbin-wires in inducing the current, thus securing the best results with a given amount of resistance.

The connection of the generator with a gas-engine is illustrated in Fig. 11, where U designates the explosion-cylinder of the engine, and V is supposed to be an ignition chamber or box, and W is a fly-wheel. The igniter-electrode is indicated by 13, and 12 designates a binding-post, which may be either attached to the cylinder or connected with an opposing electrode. The generator may be anchored to a floor or to a suitable bench *t* or a bracket conveniently supported in proximity to a rotating wheel or pulley, and the pulley J placed so that its periphery is in contact with the periphery of the engine-wheel, which, as is well known in practice, never describes a true circle at the periphery when rotating, and hence it is necessary that the shaft H be mounted so as to slightly yield in order that the pulley J may have constant elastic contact with the driving-wheel, and this is suitably accomplished by means of the pivoted plate B and spring R; but other equivalent forms of construction may be employed to accomplish the desired object. A conducting-wire X is connected to one of the holders L and also to the post 12, and a similar wire Y is connected to the opposite holder and also to the electrode 13, so that an electric ignition-circuit is thus formed between the machine and the engine-igniter, and either wire may have a spark-coil.

In practical use it is only necessary to start the engine in the usual manner, and when the engine shall have received an explosive charge electric current will have been generated of sufficient power to produce a spark for exploding the charge, because, as will be seen, the generator is designed particularly for producing a strong current immediately upon revolving the armature, and a greater velocity thereof simply produces a greater volume, which will be required for operation due to increasing speed of the engine. The armature will move with so little resistance that no slipping will be experienced. In this construction no detriment will follow should the machine be placed in a dead short circuit, and no loss of magnetism will follow an indefinite period of inactivity.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. A low-voltage electric generator for gas-engine igniters, including a rotative armature and a commutator mounted on a shaft, a pair of opposing pole-pieces having a greater length than the length of the armature, a pulley secured to the armature-shaft, a magnet attached to the pole-pieces and extending beyond the ends of the armature, and commutator-brushes engaging the commutator between the pole-pieces.

2. A low-voltage generator for gas-engine igniters, including an armature and a commutator mounted on a rotative shaft, a pulley secured to the shaft, a pair of opposing pole-pieces extending over the commutator and to and beyond the end of the armature opposite the commutator, a magnet at-

tached to the pole-pieces and extending beyond the ends of the armature, a head secured to and connecting each pair of ends of the pole-pieces and supporting the armature-shaft, and commutator-brushes engaging the commutator between the pole-pieces.

3. A low-voltage electric generator for gas-engine igniters, including a base, a supplemental plate pivoted to the base, a spring acting against the supplemental plate, a pair of pole-pieces mounted upon the supplemental plate, a pair of heads binding the pole-pieces and having journal-housings, a rotative shaft mounted in the journal-housings, an armature and a commutator attached to the rotative shaft between the pole-pieces, a magnet attached to the pole-pieces, and commutator-brushes engaging the commutator between the pole-pieces.

4. A low-voltage electric generator including a rotating armature and a commutator, a pair of opposing pole-pieces having each an aperture near one end registering with the commutator, said pole-pieces having poles extending in length over and beyond the combined length of the armature and the commutator; a magnet covering the armature and extending beyond the ends thereof; and commutator-brushes projecting through the apertures in the pole-pieces.

5. A low-voltage electric generator including an armature and a commutator mounted on a shaft, a pair of pole-pieces having a greater length than the combined length of the armature and the commutator, a head secured to and connecting each pair of ends of the pole-pieces and rotatively supporting the armature-shaft, a magnet covering the armature and extending beyond the ends thereof, and commutator-brushes provided with compensating-springs having tension-adjusters.

6. A low-voltage electric generator comprising a base, a supplemental plate pivoted at one end to the base and free to move laterally at its opposite end, a spring acting against the movable end of the supplemental plate, a pair of pole-pieces mounted upon the supplemental plate, a magnet attached to the pole-pieces, and an armature and a commutator mounted within the pole-pieces.

7. The combination, with a gas-engine having a rotative wheel and having also igniters or sparking-electrodes, of a low-voltage electric generator including a fixed base, a supplemental plate pivoted to the base, pole-pieces mounted upon the supplemental plate, a pair of heads attached to the ends of the pole-pieces, journal-housings supported by the heads, a rotative shaft mounted in the journal-housings, an armature and a commutator attached to the rotative shaft, a pulley secured to the rotative shaft and having its periphery in contact with the periphery of the rotative wheel of the engine, a spring suitably supported and acting so as to force the pulley against the rotative wheel and compensate for inaccuracies of the periphery thereof when rotating, a magnet, poles attached to the pole-pieces, brushes engaging the commutator between the pole-pieces, and conducting-wires connecting the brushes with the sparking-electrodes.

8. In a magneto-electric generator, the combination with a rotating wheel of a gas-engine, of a base, a plate slidingly mounted upon the base, pole-pieces mounted on the plate, journal-housings mounted upon the pole-pieces, the armature-shaft in said housings, the pulley attached to the armature-shaft and having its periphery in contact with the periphery of the rotating wheel of the gas-engine, a spring suitably supported and acting to force the pulley against the engine-wheel and compensate for inaccuracies of the periphery of the engine-wheel, the armature, the magnet, the poles, the commutator, the brushes, and the conducting-wires.

9. In a magneto-electric generator, the combination of the gas-engine; the generator-base supported in proximity to the gas-engine; the pole-pieces supported by the generator-base and having outwardly-turned base-flanges and the lateral apertures; the heads attached to the pole-pieces and having the journal-housings; the armature and the commutator having the shaft journaled in said housings and mounted between said heads; the pulley on the shaft and driven by the gas-engine; the magnet attached to said pole-pieces and in contact with said base-flanges, said magnet extending from one pair of ends of said pole-pieces to near the opposite pair of ends thereof and over and exceeding the length of the armature; the brushes projecting through the apertures in said pole-pieces, the brush-springs, the tension-screws, and the circuit-wires connecting the brushes electrically with the electrodes of the gas-engine, substantially as set forth.

10. In a magneto-electric generator, the combination with the gas-engine having the igniters or sparking-electrodes and the rotating wheel; of the generator-base supported in proximity to the rotating wheel of said engine, the spring mounted in said base; the supplemental plate pivoted at one end thereof to said base at the end opposite said spring; the traveling head attached to said plate and bearing against said spring; the pole-pieces having the flanged bases and secured to said plate; the magnet consisting of the separate sections resting upon said flanged bases and secured to said pole-pieces; the binding-plates for said magnet-sections; the heads secured to said pole-pieces and having the journal-housings; the armature-shaft journaled in said housings; the armature mounted within said pole-pieces and said heads; the pulley on said shaft and in contact with the rotating wheel of said engine; the brushes; the brush-holders, and the circuit-wires connected to the brush-holders and to the igniters of said engine; substantially as set forth.

11. In a magneto-electric generator, the

combination of the base; the pole-pieces bored to true radii and connected by heads rigidly attached thereto; the armature-shaft mounted in said heads; the armature-core having the longitudinal slots therein; the opposing poles attached to the pole-pieces; said poles being set apart a distance equal to the transverse width of one of said slots; the armature-windings arranged within the influence of the said poles, said poles extending beyond the end windings of the armature whereby eddy-currents are avoided; the commutator within the influence of the poles; the compound laminated magnet attached to said pole-pieces and having the binding-plates attached thereto; the brush-holders; the brushes; and the conducting-wires; substantially as set forth.

12. In a magneto-electric generator, the combination of the base; the pole-pieces each consisting of an oblong bar having an outer plane face from the bottom of which a flange extends laterally and an inner face concave in transverse section terminating in the poles, one end of each of said pole-pieces having the aperture therein; the heads attached to the ends of said pole-pieces whereby the concave faces are maintained in parallel alinement; the armature mounted in said heads and turned true to a diameter nearly as great as the distance between the opposing concave faces of said pole-pieces; the magnet attached to said pole-pieces and bearing against the flanges thereof, said magnet extending beyond either end of said armature; the commutator in the range of said pole-pieces; the brush-holders extending through the apertures in said pole-pieces and having each the coiled spring therein and the adjusting-screw; the brushes in said holders; and the conducting-wires attached to said holders; substantially as shown and described.

13. The combination, with a gas-engine having igniters or sparking-electrodes, of a low-voltage electric generator for igniting explosive charges and comprising a base, a pair of pole-pieces, a pair of heads attached to the ends of the pole-pieces and having journal-housings, a rotative shaft mounted in the housings, an armature and a commutator attached to the rotative shaft and within direct influence of the poles of the pole-pieces, a magnet attached to the pole-pieces and extending beyond the ends of the armature, a pulley attached to the rotative shaft having operative connection with the gas-engine, brushes engaging the commutator between the pole-pieces, and conducting-wires connecting the brushes with the sparking-electrodes.

14. In a magneto-electric generator, the combination of the gas-engine, the generator-base supported in proximity to the gas-engine; the pole-pieces mounted on said base; the heads attached to the pole-pieces and having the journal-housings; the rotative shaft mounted in said housings; the pulley attached to said shaft and operatively connected with the gas-engine; the armature and the commutator attached to said shaft; the magnet attached to said pole-pieces and extending from one pair of ends of said pole-pieces to near the opposite pair of ends thereof, and exceeding the length of the armature; the brushes engaging said commutator between said pole-pieces; the brush-springs; and the circuit-wires connecting said brushes with the gas-engine, substantially as set forth.

15. In a magneto-electric generator, the combination of the base; the pole-pieces, each comprising an oblong bar having an inner face bored to a true segment of a circle; the heads attached to the ends of said pole-pieces whereby the inner faces thereof are maintained in parallel alinement; the armature mounted in said heads and turned true to a diameter nearly as great as the distance between the opposing inner faces of said pole-pieces; the magnet attached to said pole-pieces, and extending beyond either end of said armature; the commutator in the range of said pole-pieces; the brush-holders; the brushes engaging said commutator; and the commutator-springs, substantially as set forth.

16. In a magneto-electric generator, the combination of the base, the pole-pieces, the magnet, the heads attached to the pole-pieces, the armature, the commutator, the insulating-plates secured to the pole-pieces adjacent to one of said heads, the brush-holders secured to said plates, the brushes and the brush-springs in said holders, and the wires connected to said holders, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

GARRETT W. HENRICKS.

Witnesses:
WM. C. THOMPSON,
E. T. SILVIUS.