G. HONOLD.

MAGNETO-ELECTRIC GENERATOR.

APPLICATION FILED AUG. 28, 1906.

974,967.

Patented Nov. 8, 1910.

4 SHEETS—SHEET 1.

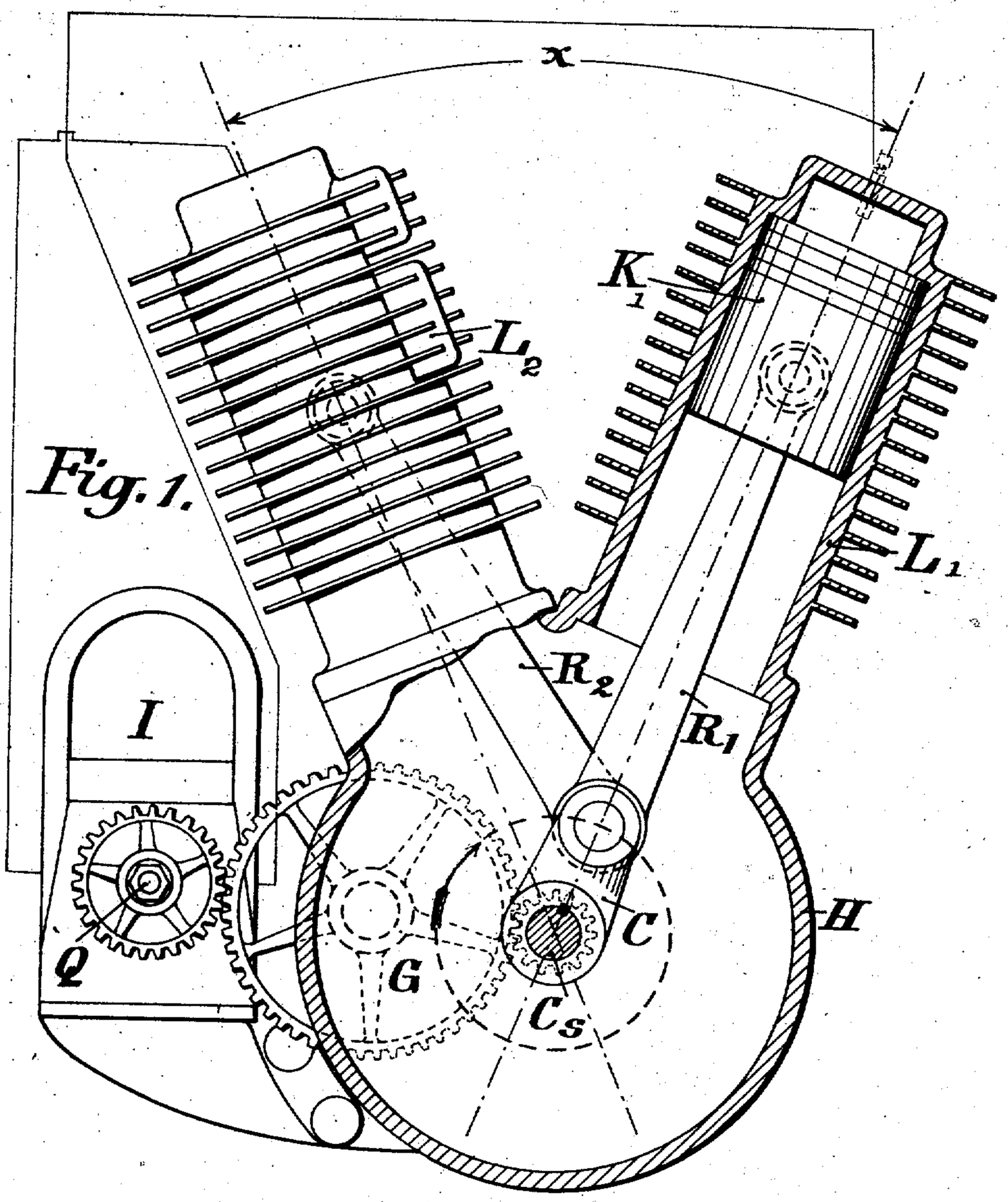

Fig. 1.

WITNESSES

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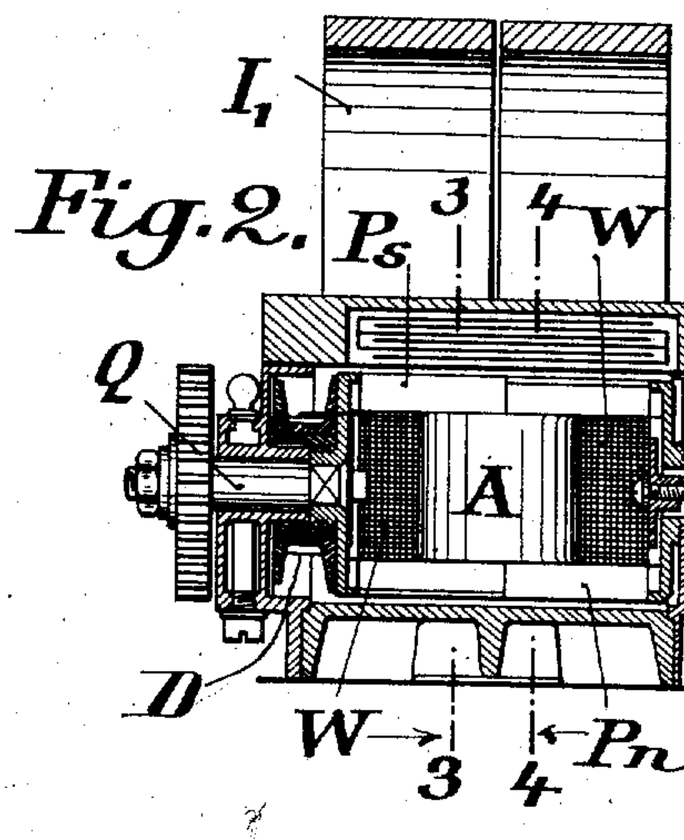

Fig. 2.

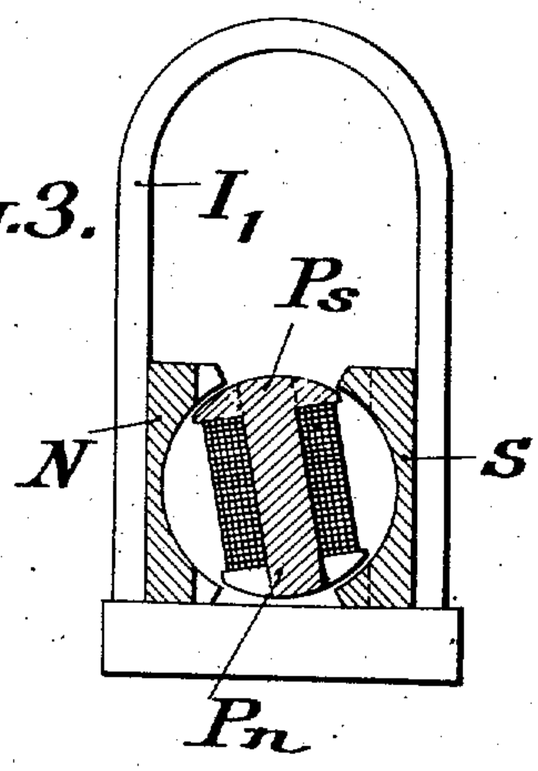

Fig. 3.

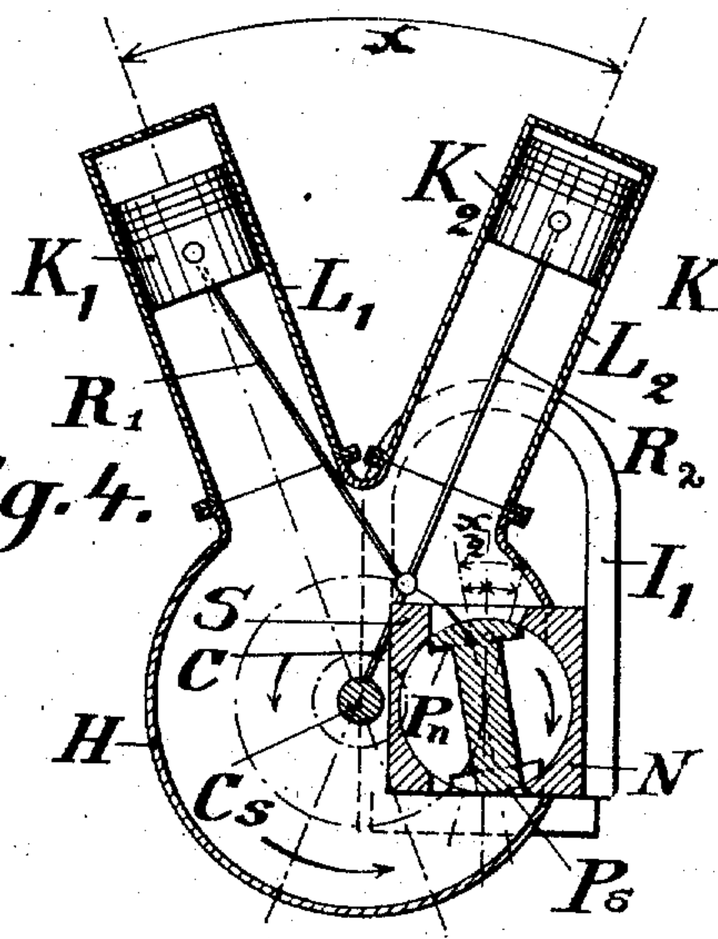

Fig. 4.

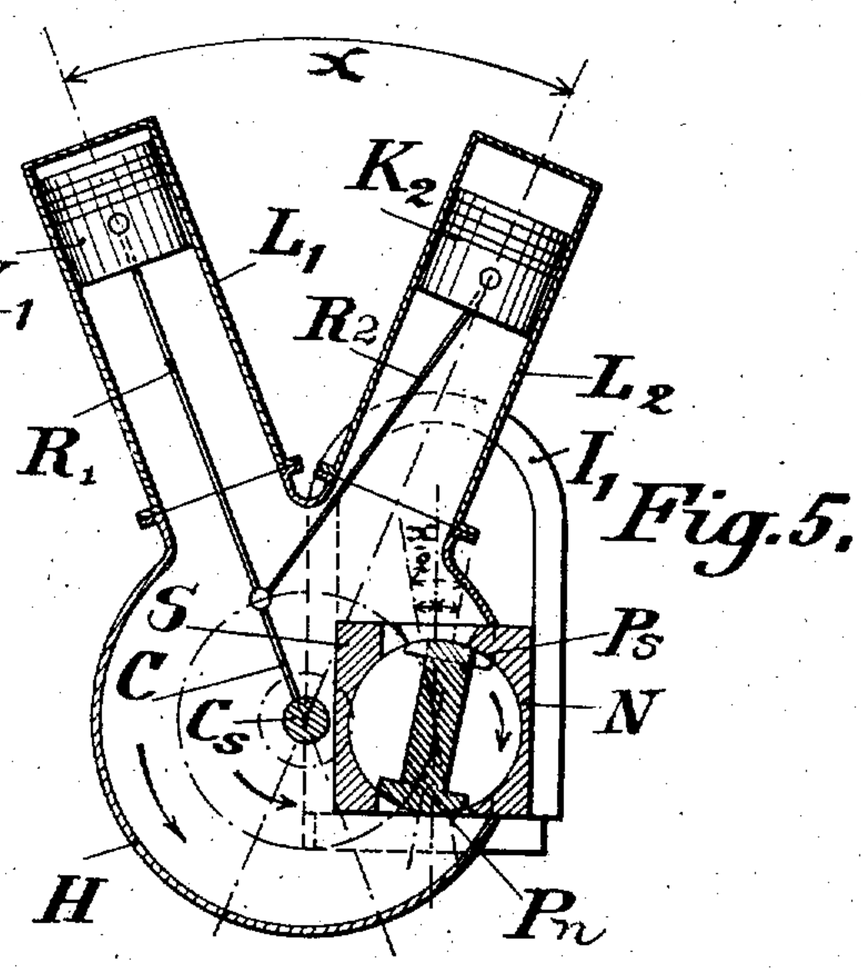

Fig. 5.

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4 SHEETS—SHEET 3.

Fig. 6.

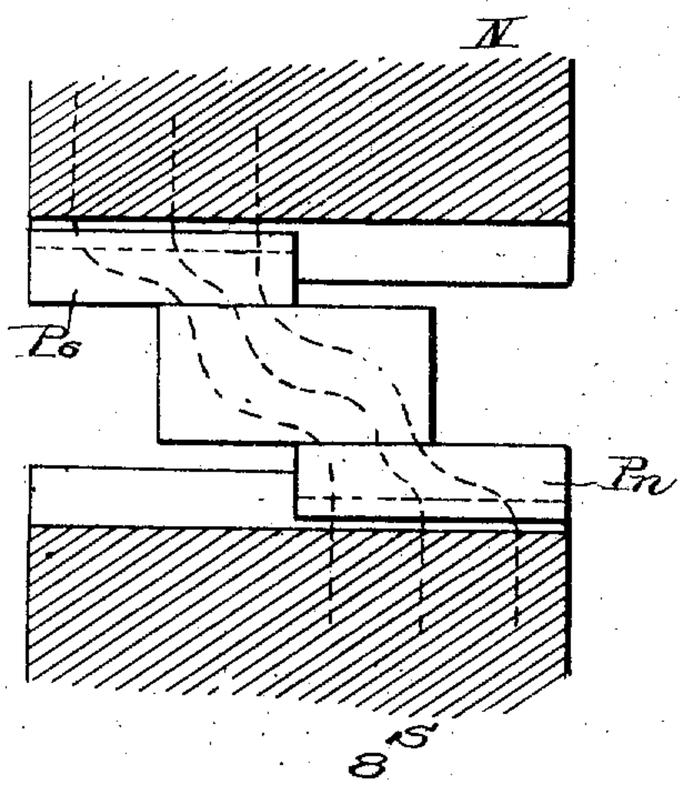


Fig. 7.

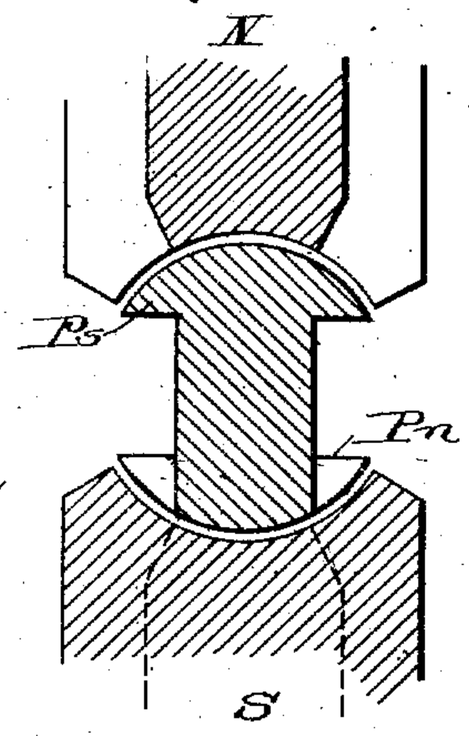


Fig. 8.

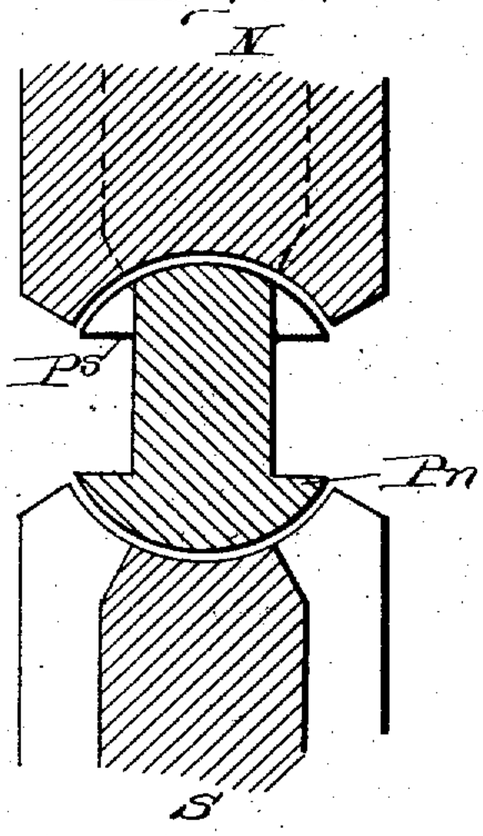
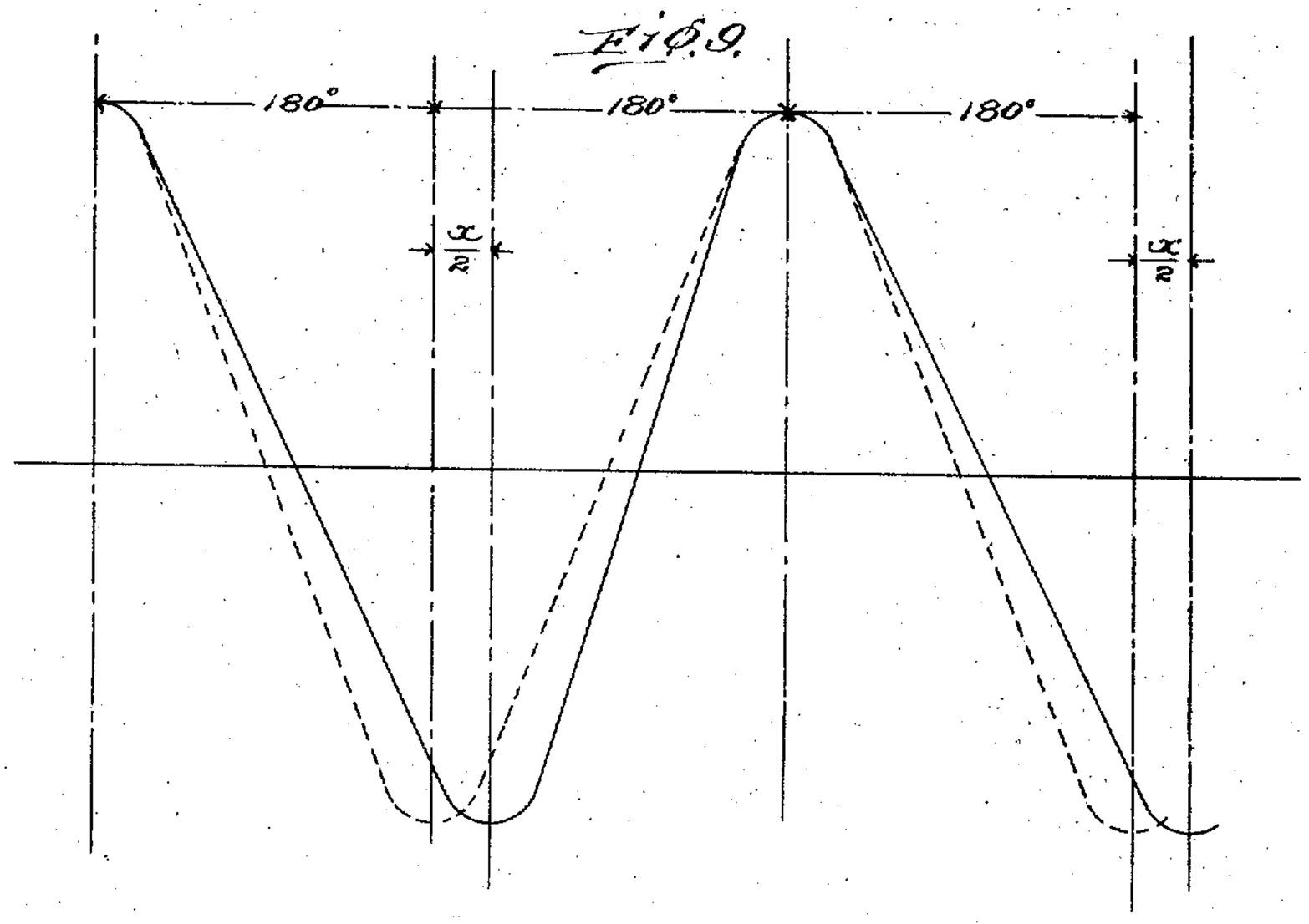


Fig. 9.



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4 SHEETS—SHEET 4.

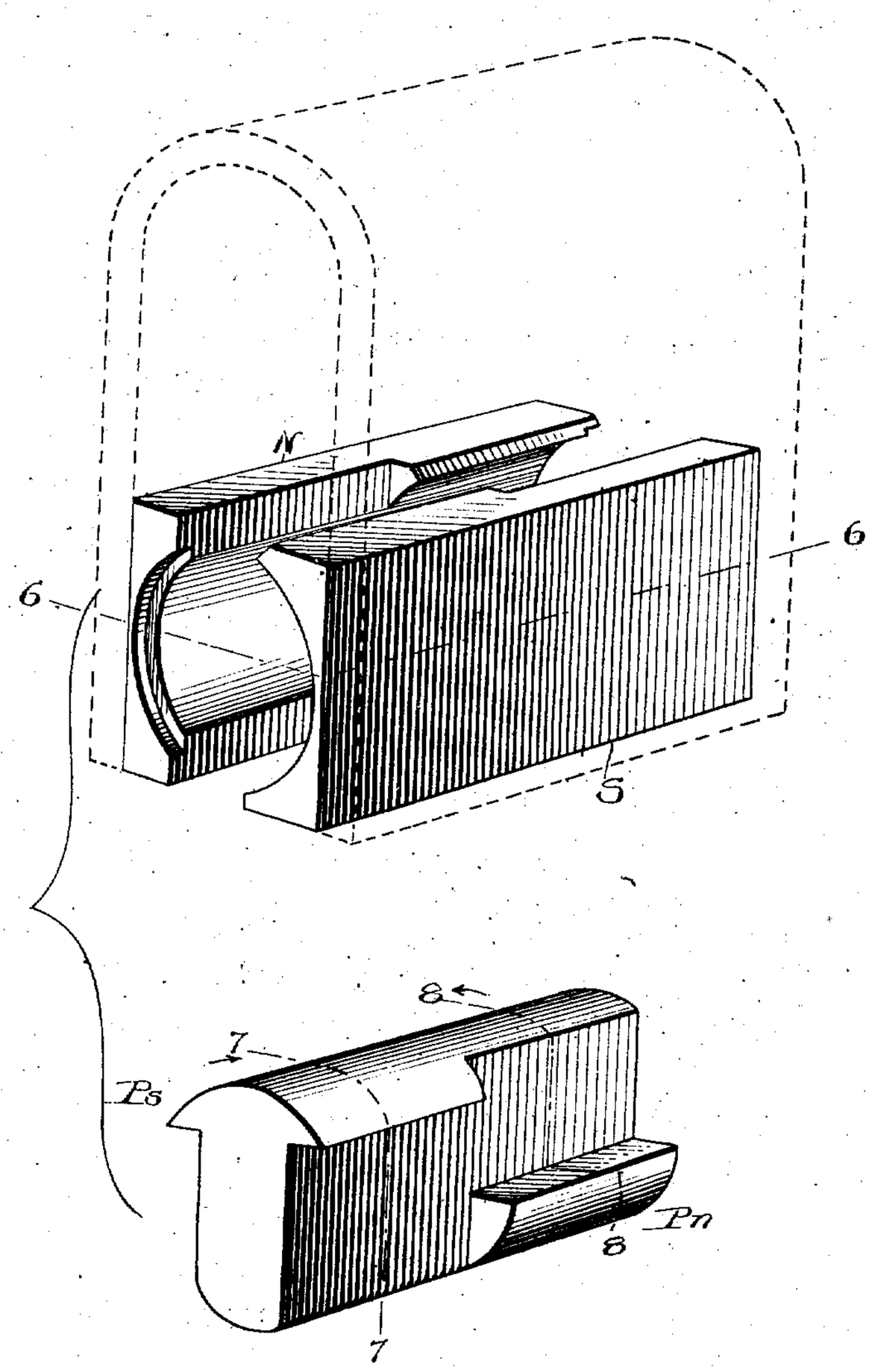

Fig. 10.

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UNITED STATES PATENT OFFICE.

GOTTLOB HONOLD, OF STUTTGART, GERMANY.

MAGNETO-ELECTRIC GENERATOR.

974,967. Specification of Letters Patent. **Patented Nov. 8, 1910.**

Application filed August 28, 1906. Serial No. 332,326.

To all whom it may concern:

Be it known that I, GOTTLOB HONOLD, engineer, a subject of the German Emperor, residing at 11 Hoppenlaustrasse, Stuttgart, Germany, have invented certain new and useful Improvements in Magneto-Electric Generators; and I do hereby 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.

My invention refers to ignition devices for explosion engines and more specifically to a special design of explosion engine that is frequently used for driving motor cars and motor bicycles. In such vehicles it is usual to employ motors in which two cylinders act upon a common crank, both cylinders being placed in the plane of the crank and converging toward the crank shaft. If in engines of this kind, the two cylinders are to act in turns, it is evident that consecutive ignitions must not follow each other at equal intervals of time, because in order to arrive at the point of maximum compression which is the point in which the ignition should take place, the crank must once pass through an angle of $360+x^\circ$ and the next time through an angle of $360-x^\circ$ if the angle inclosed by the axes of the two cylinders is called x.

My invention in its specific embodiment, consists in giving the armature and field iron of a sparking magneto such a shape that the maximum electric tension developed by the magneto is advanced and retarded in turns in every half revolution of the magneto armature so as to correspond with the requirements of the motor.

In the drawings, Figure 1 is an end view of the main parts of the motor and igniting magneto showing the connections of the cylinders with the crank and of the crank shaft with the magneto shaft; Fig. 2 is a longitudinal section through the magneto alone; and Fig. 3 a section on line 3—3 of Fig. 2 looking in the direction of the arrow; Figs. 4 and 5 are diagrammatical sectional representations of the combined motor and magneto in the two positions corresponding to the moments of ignition, the plane of the section being indicated by the line 4—4 and arrow in Fig. 2; Fig. 6 is a diagrammatical longitudinal section laid through the magneto on line 6—6 of Fig. 10, the armature, however, having its opposite ends entirely cut away on opposite sides; Figs. 7 and 8 are diagrammatical sections laid through the field and armature iron of the magneto on lines 7—7 and 8—8 of Fig. 10, respectively, the armature appearing in approximately a horizontal position in Figs. 6, 7 and 8, and Figs. 7 and 8 showing an armature which is T-shaped at its opposite ends; Fig. 9 is a diagram illustrating the curve of electric tension produced by a magneto having an ordinarily shaped armature and the tension produced by the magneto having the field and armature iron shaped according to my invention, showing the displacement of the curve of electrical tension produced by the latter arrangement; Fig. 10 is a view showing the armature and the field pole pieces in perspective, and illustrating a T-shaped construction, the lines 6—6, 7—7, and 8—8 on this figure denoting the planes in which Figs. 6, 7 and 8, respectively, are laid.

The reference letters represent similar parts in all the figures.

On a casing H the two cylinders L_1 and L_2 are mounted in the usual manner, that is to say their axes are placed in a common plane and embrace an acute angle, which is hereinafter designated by x. In the cylinders the pistons K_1 and K_2 are arranged to slide up and down and by means of the piston rods R_1 and R_2 to transmit the force generated in the cylinders to the common crank C. The crank shaft *Cs* is connected by a suitable train of gearing G with the shaft Q of a magneto I, the gearing being in the usual manner dimensioned so as to make the magneto armature perform one revolution for every two revolutions of the crank shaft.

Referring to Fig. 2, Q is the shaft of the magneto supporting an iron core A. The core A is provided with pole-pieces *Ps* and *Pn* and to the shape of these pole-pieces more especially my invention refers. In a section taken on the lines 3—3 of Fig. 2, the upper pole piece *Ps* will present a complete segment in cross-section, while the points of the lower pole piece *Pn* will appear cut away, as shown in Figs. 3 and 7. With the parts in the same position, a section taken on the line 4—4 of Fig. 2 will show the lower pole piece *Pn* as a complete segment, while the points of the upper pole piece *Ps* will appear cut away as shown in Fig. 8. This peculiar outline is due to the fact that the

pole pieces are each reduced in width at one end, as shown very clearly in Fig. 10, the narrow half of one pole piece being arranged opposite the wide half of the other pole piece. In the preferred construction, as shown in Fig. 10, one half of each pole piece has its projecting edges entirely removed. The corresponding portions of the opposite pole pieces are on opposite sides of a plane extending through the center of the armature axis, and the winding W is common to both poles. The armature rotates between the pole-pieces N and S of a field magnet I_1 and these pole-pieces are likewise mutilated or cut away on opposite sides of a plane laid through the middle of the armature and perpendicular to its axis, as is shown in Figs. 3, 7, 8 and 10. In Fig. 6 the lines of force are indicated by dotted lines and it will be seen that owing to the mutilation of the pole-pieces they pass obliquely through the armature, the travel, of course, being from one complete pole-piece to the opposite one. As the maximum of induction will take place at the moment in which the lines of force change their direction in the armature, or in other words, at the moment in which the active pole-pieces of the armature are in the center of the air gap between the pole pieces of the field magnet, it will be seen that, by this arrangement, the two moments of maximum induction which take place during one revolution of the armature will not be distributed equi-distantly around the circumference as with pole-pieces of the usual shape, but will be either retarded or advanced as the case may be.

Figs. 4 and 5 represent sections of the motor combined with the magneto on line 4—4 of Fig. 2 in the two positions in which the maximum of induction is obtained. In the drawings, the motor illustrated is of the four-cycle type, but it will be understood, of course, that the invention may be applied to an engine having a different cycle of operations, the particular engine cycle being a mere matter of choice. In the position shown in Fig. 4, the piston K_2 is at full compression and the armature is at a point of maximum tension. The charge in the cylinder L_2 being exploded, the crank shaft will be rotated in the direction indicated by the arrow in Fig. 4 to effect a discharge of the burned gas from the cylinder L_1 and draw a fresh charge into the same. When the crank shaft has rotated 180°, the piston K_2 will be at the end of its working stroke and the magneto armature will be at a point of inaction, having made one-fourth of a revolution. A further advance of the crank shaft through $x°$ will complete the suction stroke and begin the compression stroke of the piston K_1, and a still further advance of the crank shaft through 180° will cause the said piston to complete its compression stroke whereupon the cylinder L_1 will be ready for ignition. The magneto armature will simultaneously have advanced an additional

$$90° + \frac{x°}{2}$$

from the point of induction and will again be at a point of maximum tension as shown in Fig. 5, so that the charge in the cylinder L_1 will be exploded. The cylinder L_2 will in like manner be cleared and charged and the charge therein will be exploded when the crank shaft has made a further advance of $360° - x°$. It will thus be seen that the pistons are operated alternately and that the intervals between successive explosions will be equal to the time required for the crank shaft to rotate $360° + x°$ and $360° - x°$ respectively, the armature passing correspondingly through

$$180° + \frac{x°}{2}$$

and

$$180° - \frac{x°}{2}$$

In the first position, Fig. 4, it will be seen that the complete part of the pole-piece P*n* is just registering with the forward air gap between the pole-pieces N, S of the field magnet I_1. Since the air gap between the pole pieces of the field-magnet on the other half of the magneto, placed in Figs. 4 and 5 away from the observer, are shifted to the right from the center by the mutilation of the pole-pieces indicated by dotted lines in the drawing, the complete part of the other pole-piece P*s* of the armature is also at this point bridging the back portion of the lower air gap. The complete parts of the armature pole-pieces are, therefore, in a position to induce a maximum of tension in the armature winding, the lines of force passing obliquely from the upper front pole piece to the lower rear pole piece, as will be readily understood. As will be seen in Fig. 4, this position of the armature corresponds to the position of maximum compression in the cylinder L_2. As the armature now rotates in the direction indicated by the arrow in Figs. 4 and 5, the tension induced in the winding will first decrease and then again increase, until the armature has reached the position shown in Fig. 5, pole-piece P*n* registering with the lower air gap of the side of the magneto facing the observer and pole-piece P*s* registering with the upper air gap of the side turned away from the observer. This, therefore, is again a position of maximum induction corresponding to the position of maximum compression of cylinder L_1, as shown in Fig. 5, the lines of force now running obliquely from the upper rear pole piece to the lower front pole-piece. It

is also seen that, in order to proceed from the position shown in Fig. 4 to the position shown in Fig. 5, the armature has to traverse an angle

$$\left(180+\frac{x}{2}\right)^{\circ}$$

corresponding to a march of the motor crank, C, through an angle of $(360+x)^{\circ}$ and in order to return from the position shown in Fig. 5, to the position shown in Fig. 4, the armature has to cover an angle of only

$$\left(180-\frac{x}{2}\right)^{\circ},$$

corresponding to angle of $(360-x)^{\circ}$ traversed simultaneously by the crank.

In Fig. 9, the curve representing the electric pressure produced by an armature core of the usual I-shaped section is shown by a dotted line and the pressure curve produced by an armature core and field magnet mutilated according to my invention is shown by a full line, the angle of displacement of the point of maximum induction being indicated.

It will be understood, of course, that an igniter is provided in the end of each cylinder and these igniters are electrically connected with a distributer disk D which is carried by but insulated from the armature shaft. This distributer is in circuit with the armature and directs the current alternately to conductors leading from its opposite sides, so as to energize the ignition circuits alternately, the return of each circuit being through the metal parts of the engine and magneto.

Having thus fully described my invention, what I claim is:—

1. The combination with a dynamo electric generator having means for producing a plurality of substantially equal maximum rates of change of flux at alternately longer and shorter intervals, of ignition circuits arranged to be energized by said changes of flux, and two explosive engines having igniters within the ignition circuits and arranged in intersecting planes.

2. The combination with two explosive engines having the axes of their cylinders inclined to each other, said engines being provided with igniters, of an electric generator having its armature driven by and at a fixed speed with relation to the engine, and having generator windings, means for producing an intermittent maximum rate of change of flux through the generator coils at alternately longer and shorter angular intervals corresponding to the angular intervals between the times of ignition and ignition circuits including the generator windings and the respective ignition devices of the engine, whereby a maximum voltage is produced at the igniter of each engine at the time of ignition.

3. In a magneto electric generator, the combination with a rotatable armature having pole-pieces reduced on opposite sides of a plane perpendicular to the axis of the armature, the reduced portions of the pole pieces being on diametrically opposite sides of the axis, of a field magnet having pole-pieces reduced on opposite sides of a plane perpendicular to the axis of the armature, the reduced portions of the pole-pieces being on opposite sides of the axis, and an armature winding on said armature.

4. In a magneto electric generator, the combination with a rotatable armature having pole-pieces reduced on opposite sides of a plane perpendicular to the axis of the armature, of a field magnet having pole pieces reduced on opposite sides of a plane perpendicular to the axis of the armature, the reduced portions of the pole-pieces being on opposite sides of the axis, an armature coil, and means for taking off the current as set forth.

5. In a magneto electric generator, the combination with a rotatable armature having pole-pieces with parts of unequal width, forming wide and narrow portions disposed on opposite sides of a plane perpendicular to the axis of the armature, the wide portion of one pole-piece being diametrically opposite to the narrow portion of the other pole-piece, of a field magnet having pole-pieces with parts of unequal width, forming wide and narrow portions disposed on opposite sides of a plane perpendicular to the axis of the armature with the wide portion of one pole-piece facing the narrow portion of the other pole-piece, an armature winding, and means for leading off the current therefrom.

6. In a magneto electric generator, the combination with a rotatable armature having pole-pieces with reduced and non-reduced portions disposed on opposite sides of a plane perpendicular to the axis of the armature, the reduced portions of each pole-piece being respectively diametrically opposite to the non-reduced portions of the other pole-pieces, of a field magnet having pole-pieces with T-shaped faces, the wide portions of the faces which form the heads of the T's being disposed on opposite sides of a plane perpendicular to the axis of the armature and on diametrically opposite sides of the axis, an arinature winding, and means for leading off the current.

7. In a magneto electric generator, the combination with a rotatable armature having pole-pieces reduced on opposite sides of a plane perpendicular to the axis of the armature, the reduced portions of the pole-pieces being on diametrically opposite sides of the axis, of a field magnet, having pole-

pieces reduced on opposite sides of a plane perpendicular to the axis of the armature, the reduced portions of the pole pieces being on diametrically opposite sides of the axis, the relative disposition of the armature pole pieces and the field magnet pole pieces being such that the maximum electric effect takes place at intervals which are alternately relatively longer and shorter, an armature winding, and means for leading off the current therefrom.

8. In a magneto electric generator, the combination with a rotatable armature having pole pieces reduced on opposite sides of a plane perpendicular to the axis of the armature, of a field magnet having pole-pieces reduced on opposite sides of a plane perpendicular to the axis of the armature, the reduced portions of the pole-pieces being on diametrically opposite sides of the axis, the relative disposition of the armature pole-pieces and the field magnet pole pieces being such that the maximum electric effect takes place at intervals which are alternately relatively longer and shorter, an armature coil, and means for taking off the current.

In testimony whereof I have hereunto affixed my signature in the presence of two witnesses.

GOTTLOB HONOLD.

Witnesses:
RUDOLF KLEIN,
ERNST ENTEMANN.