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Nov. 23, 1926. 1,608,286

E. F. ANDREWS ET AL

SINGLE UNIT ELECTRIC GENERATING PLANT

Filed Feb. 12, 1917 3 Sheets-Sheet 1

FIG. 1.

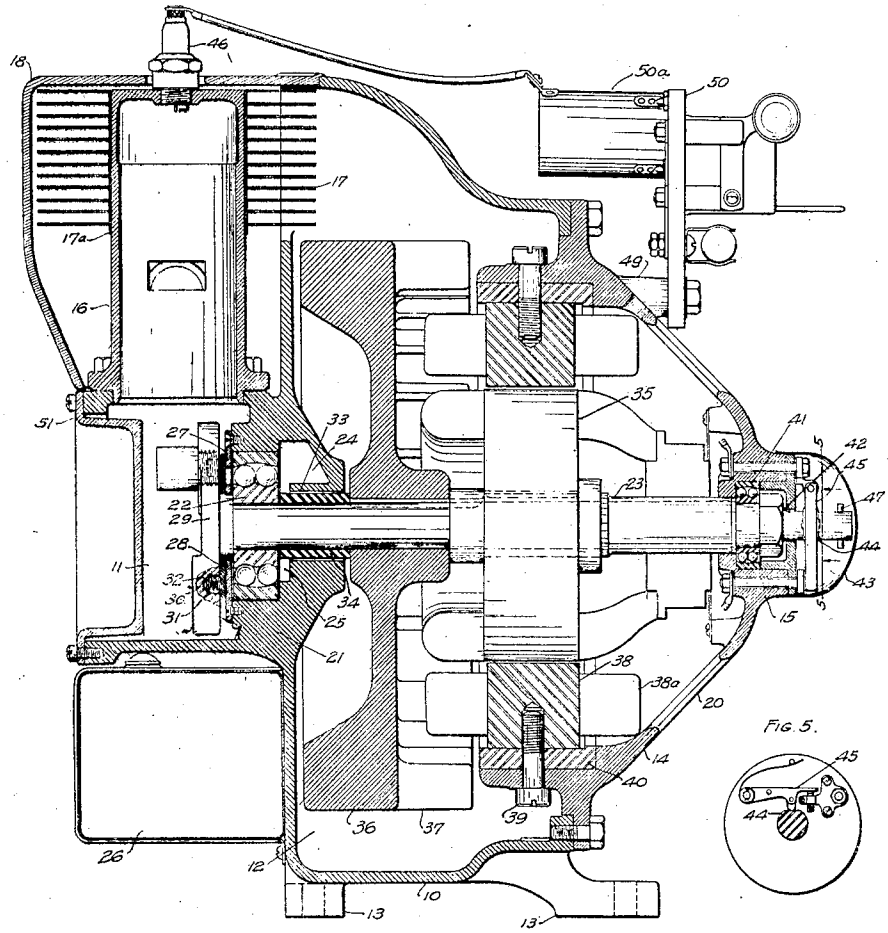
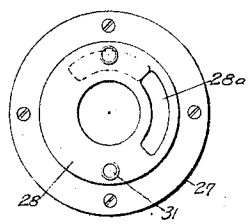


FIG. 5.

FIG. 4.



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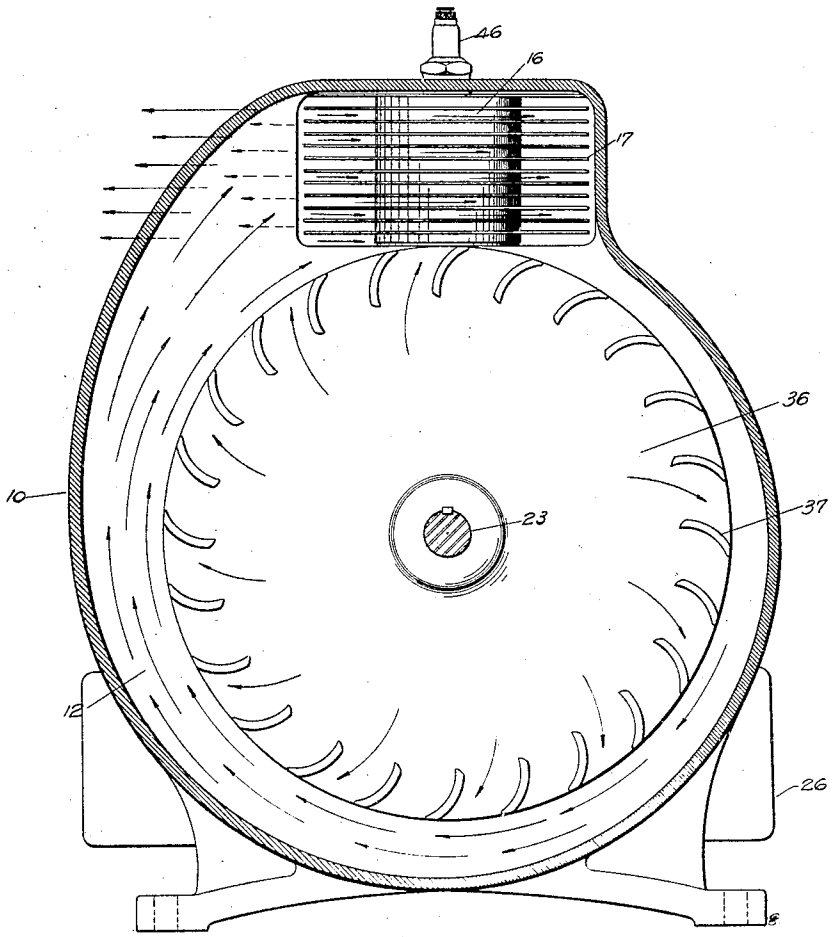
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SINGLE UNIT ELECTRIC GENERATING PLANT

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FIG. 2



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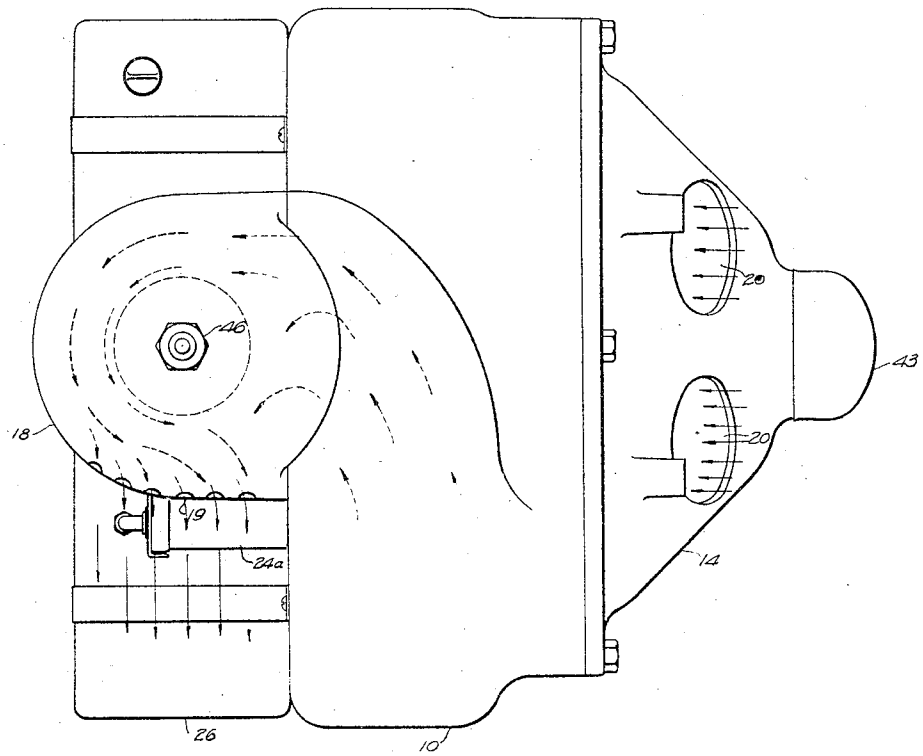
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SINGLE UNIT ELECTRIC GENERATING PLANT

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FIG. 3.



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1,608,286

UNITED STATES PATENT OFFICE.

EDWARD F. ANDREWS AND RAY E. ACRE, OF CHICAGO, ILLINOIS.

SINGLE-UNIT ELECTRIC-GENERATING PLANT.

Application filed February 12, 1917. Serial No. 148,015.

This invention relates to improvements in single unit electric generating plants of the type wherein an electric generator and an internal combustion engine are employed, and it relates more particularly to the cooling systems of such plants.

The primary object of the invention is the arrangement, construction and housing of the various elements which go to make up a generating plant of the type described, whereby a thorough and efficient cooling of all of said parts is effected by means of the same current of air.

Another object of the invention is the provision of a combined fly wheel and fan so arranged that both the internal combustion engine and the electric generator of the single unit plant are effectively cooled by the current of air set in motion thereby.

A further object of the invention is the provision of a single unit generating plant of the type described, wherein a common shaft is provided on which are mounted all of the rotary elements of said plant, including the crank and timing mechanism of the internal combustion engine, the combined fly wheel and fan and the armature of the generator, all of said parts being enclosed within a suitable housing so as to form a complete and compact unit which is simple and economical in construction and operation.

An additional object of the invention relates to the provision of a novel form of intake passage for the internal combustion engine, wherein the explosive charge mixed with a lubricant is drawn through or over one of the main bearings of the common shaft, thereby thoroughly lubricating said bearing, together with means whereby leakage of said mixture into other parts of said plant is prevented.

Other objects and advantages of the invention will be apparent from the following description, taken in connection with the accompanying drawings, wherein is illustrated the preferred embodiment of the invention; it being understood however, that the drawings are for purposes of illustration only and are not to be taken as defining the limits of the invention.

In the drawings:

Fig. 1 is a vertical longitudinal sectional view of the single unit generating plant.

Fig. 2 is a vertical transverse sectional view thereof.

Fig. 3 is a top plan view.

Fig. 4 is a detail view of the intake valve, and

Fig. 5 is a detail view of the timing mechanism.

The main casting 10 of the single unit generating plant is shown as comprising a crank case 11, a fly wheel and blower housing 12, and feet or supports 13, preferably three in number, in order that the unit may stand firmly even though the foundation upon which it rests is somewhat uneven. Bolted to the main casting 10 is a substantially circular generator frame 14 having cast integral with it a suitable bearing housing 15. Upon the crank case 11 is supported the cylinder 16 of the internal combustion engine, said cylinder being provided with cooling fins 17 about its upper end, and being encased in a suitable housing 18, which is shown slotted from top to bottom at one side thereof at 19 for the egress of air after the same has circulated around the cylinder 16 between the fins 17. The fins 17 are preferably in the form of copper disks, but may be made of any other good heat conducting material. These fins or disks are apertured centrally and are provided with depending annular flanges 17ª around their inner peripheries, as shown. In applying the fins or disks to the cylinder, they are heated and placed in position and then allowed to cool, thereby shrinking into firm frictional engagement with the outer wall of said cylinder. The normal diameter of the apertures in the disks is preferably less than the diameter of the cylinder, so that when they are shrunk into position, they will fit the cylinder very snug and thus be retained against accidental displacement.

The fly wheel and blower housing 12 is of substantially spiral configuration, and so connected with the housing 18 that the cooling air set in motion in the manner hereinafter set forth, is forced over the cooling fins 17 of the engine cylinder and out through the slots 19 formed in the housing

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18. The generator field frame or housing 14 is shown provided with suitable apertures 20 through which the cooling air enters; said housing cooperating with the blower housing 12 to form a continuous passage for said air in through the generator and out over the fins 17 of the internal combustion engine.

The inner wall 21 of the crank case 11 is apertured to receive a suitable bearing 22 adapted to support one end of the main or common shaft 23, said shaft in the present instance, serving as the crank shaft of the internal combustion engine. The inner wall 21 is further provided with a passage 24 terminating at one end in a substantially circular chamber 25 which lies adjacent to the bearing 22 and which communicates therewith. The other end of the passage 24 communicates with a carbureter or fuel vaporizing mechanism 24ª, which supplies a mixture of air, fuel and oil to the engine, as is customary in the operation of a two cycle engine, such as it is preferred to use in connection with single unit generating plants of this type. A fuel tank is illustrated at 26. Attached to the wall 21 or cast integral with it is an apertured plate 27, through the apertures of which said mixture of air, fuel and oil may pass from the chamber 25 over or through the bearing 22 and into the crank case 11. The bearing 22 is shown in the drawings in the form of a ball bearing, but it will be readily understood that any desired type of bearing may be used. The passage of the fuel through the apertured plate 27 is controlled by a disk valve 28. The disk valve 28 is also provided with an aperture preferably in the form of a slot, which is shown at 28ª and which is adapted to register with the slot or aperture in the plate 27, at regular intervals for the purpose of admitting the explosive charge to the crank case. Mounted on the crank shaft which as pointed out above, is part of the main or common shaft 23 and adjacent to the valve 28, is provided a crank and bob 29 shown provided with suitable recesses 30 adapted to receive the lugs 31 which are preferably cast integral with the said disk valve 28. These lugs are preferably hollow as shown and are adapted to house suitable springs 32 which act to hold said disk valve in contact with the apertured plate 27. The inner wall of the chamber 25 is apertured at 33 to permit of the passage therethrough of the main or common shaft 23, a suitable spacing element 34 being shown interposed between the walls of the aperture 33 and the outer circumference of the main or common shaft 23. This spacing element 34 is so mounted on the shaft 23 as to fit the same snugly and to turn therewith. The aperture 33 is preferably of such size as to provide a clearance between the spacing element 34 and the walls of said aperture 33, as shown in Fig. 1 of the drawings. This clearance, it will be noted, communicates at one end with the interior of the fly wheel and blower housing 12, and at its other end with the chamber 25. No fuel or oil can leak through this opening by reason of the fact that the disk valve 28 is so timed with relation to the cycle of the engine that a practically constant minus pressure is maintained within the chamber 25, thus effecting a slight flow of air from the fly wheel and blower housing 12 through the opening and into the chamber 25. Thus it will be noted that any leakage of the explosive charge or oil in the opposite direction is prevented.

At a point intermediate the ends of the main or common shaft 23 is positioned the armature 35 of the generator, and between the said armature 35 and the crank case 11 of the internal combustion engine, the fly wheel 36 is shown keyed upon said shaft 23. This fly wheel 36 as shown, is provided with a plurality of fan blades 37, preferably integral therewith. The pole pieces of the generator are illustrated at 38 with the field coils 38ª wound about them, said pole pieces 38 being secured by means of suitable bolts 39 to the inner surface of the field ring 40, the bolts 39 also passing through the field frame 14.

Any suitable bearing 41 may be provided within the bearing housing 15 of the field frame 14 for supporting the right hand end of the shaft 23 as shown in Fig. 1. The shaft 23 extends outwardly from the bearing 41 and is preferably reduced at 42 and projects into the timer casing 43. This casing 43 is preferably in the form of a suitable cap adapted to engage the outer walls of the bearing housing 15 in such manner that said cap may be readily removed if desired. Upon the reduced end 42 of the shaft 23 is formed a timing cam 44 integral with said shaft and adapted to cooperate with the breaker arm 45 to properly time the sparks emitted by spark plug 46 in the cylinder 16 of the internal combustion engine. By thus reducing the diameter of the shaft 23 as shown at 42, the peripheral speed of the timing cam 44 is reduced, the result being that the wearing away of the cam mechanism of the timer is greatly retarded as compared with what it would be if the end of the shaft were not so formed. While the timing cam 44 is shown formed by cutting a flat surface on the shaft 23, it is obvious that other forms may be used. For instance, the cam could be in the form of a collar fitted around said shaft. Preferably, this reduced end 42 of the shaft 23 extends outwardly from the timing mechanism and is shown provided with a dog 47. Normally it will be unnecessary to crank the internal combustion engine by hand, by reason of the fact that current from the storage battery

(not shown), may be used to operate the generator as a motor, thus forming an electric starter for the engine. Should this method of starting the engine be unavailable for any reason, a suitable hand crank may be engaged with the dog 47 on the reduced end 42 of the shaft 23, thus providing means whereby the engine may be cranked by hand. Bolted or otherwise secured to suitable lugs 49, preferably cast integral with the generator frame and housing 14, is a panel board 50 adapted to support the various electrical controlling devices. The ignition coil 50[a] of the internal combustion engine is also positioned on the panel 50, it being mounted on end and extending in a substantially horizontal plane rearwardly from said panel.

It will be noted by referring to Fig. 1 of the drawings, that the castings which house the entire plant are substantially four in number and comprise the main casting 10, the cylinder housing 18, the generator frame or housing 14, and the cover plate 51, which is bolted or otherwise secured to the main casting 10 adjacent the crank and bob 29, and which is adapted to form one of the walls of the crank case 11. The main or common shaft 23, as previously pointed out, is mounted at one end in a suitable bearing 41 positioned within the bearing housing 15 which forms an integral part of the generator frame or housing 14, and at its other end said shaft 23 is mounted in the bearing 22 housed within the wall 21, which is cast integral with the main casting 10. On this shaft 23 are mounted all of the rotary elements of the combined structure. Thus an extremely simplified structure is produced, the various parts of which are easily accessible.

In the operation of the invention, the storage battery (not shown), which is connected in circuit with the unit and which is adapted to receive its charge therefrom, is employed for the purpose of starting the internal combustion engine. This is accomplished by means of a suitable switch, the generator being temporarily converted into a motor, rotating the shaft 23, thereby imparting the starting impulse to the internal combustion engine. When the engine has been started, the motor is converted into a generator and the current generated thereby flows into the storage battery to charge the same. It is obvious that instead of conducting the current to a storage battery, it may be conducted directly to the translating devices. The apertures 20 in the generator frame 14 are provided for the intake of cooling air, and as the fly wheel 36 revolves, carrying with it the fan blades 37, air is drawn in across the field and armature of the generator through these apertures 20, then forced centrifugally outwardly into the fly wheel and blower housing 12 and thence tangentially with respect to said housing 12, through the casing 18 and across the cooling fins 17 and around the engine cylinder, whence it is discharged outwardly through the slots 19 at the side of the casing 18. In this manner, the combination fly wheel and fan creates a current of air which cools not only the cylinder of the internal combustion engine but also the armature and field coil of the generator. For this reason it is possible to employ a smaller generator than would normally be required in a system of this type, by virtue of the fact that the generator will be continuously cooled during its operation by the current of inrushing air created by the fan blades on the fly wheel. The provision whereby lubricating fluid is combined with the explosive mixture and passed over or through the bearing 22 provides for constant and perfect lubrication of said bearing and serves also to cool the same. The disk valve 28 rotating with the shaft 23 by virtue of the engagement of the lugs 31 with the crank and bob 29, accurately controls the intake of explosive mixture to the crank case, where the same is compressed by ordinary two-cycle methods and is bypassed around the piston from the crank case to the upper end of the engine cylinder, where it is ignited in the usual manner.

The arrangement of the timing mechanism upon the outer end of the common shaft 23 has several distinct advantages, one of which resides in the fact that the outer end of said shaft supports practically none of the load which is borne by the rest of said shaft and for this reason the end of said shaft may be reduced as previously pointed out, thereby shortening the radius of movement of the timing cam 44 to reduce the rubbing speed of said cam against its cooperating contacts. This greatly prolongs the life of the timer while at the same time it reduces the amount of lubricant normally necessary. Another advantage in locating the timer, as pointed out, resides in the fact that it is thereby rendered easily accessible, access thereto being had by the removal of the cap 43. An additional advantage lies in the fact that no gears whatever are necessary for transmitting power from the main or common shaft 23 to the timer, the timing mechanism being fixed directly upon said main shaft.

The position of the cranking dog 47 with which a hand crank may be engaged, is peculiarly advantageous, inasmuch as it eliminates the necessity of any gearing for transmitting power from the hand crank to the main shaft. As previously pointed out, the dog 47 is positioned on the end of the main shaft 23, in advance of the timing mechanism, it being accessible by removing the cap 43.

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While we have illustrated and described the preferred embodiment of our invention, it will be seen that one skilled in the art may make modifications therein without departing from the spirit of the invention. We do not wish, therefore, to be limited to the precise embodiment shown, except as the same is limited in the appended claims.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:—

1. In a single unit generating plant, a housing, an internal combustion engine, and an electric generator mounted therein, and means interposed between said generator and said internal combustion engine adapted to create a current of air through said housing to cool said generator and the cylinder of said internal combustion engine.

2. In a single unit generating plant, an internal combustion engine, an electric generator, a shaft common to both the engine and generator, a housing for said elements, said housing comprising a plurality of castings connected together to form a continuous passage therethrough, and means also mounted on said shaft for circulating air through said housing to cool both the generator and the engine.

3. A single unit generating plant comprising a housing, an internal combustion engine, an electric generator, a shaft common to both the generator and the engine, a fly wheel for said engine mounted on said shaft intermediate said engine and said generator, fan blades mounted on said fly wheel and being adapted to induce a current of air through said housing to cool both the generator and the engine.

4. The combination with an electric generator and an internal combustion engine, of a housing therefor, said housing being provided with a plurality of openings therein at opposite ends thereof, and means adapted to draw air through the openings at one end of said housing and over said generator, said air being then forced over said internal combustion engine by said means and out through the openings in the opposite end of said housing.

5. The combination with an electric generator and an internal combustion engine, of a housing therefor, said housing being provided with a plurality of openings therein at opposite ends thereof, and means adapted to create a current of air through said housing to first cool said generator and then said internal combustion engine.

6. The combination with an electric generator and an internal combustion engine, of a housing therefor, said housing being provided with a plurality of openings therein at opposite ends thereof, and means intermediate said generator and said internal combustion engine adapted to create a current of air through said housing to cool said generator and said internal combustion engine.

7. In a single unit generating plant of the type described, an internal combustion engine, a fly-wheel therefor, an electric generator, a housing for said elements, said housing comprising a main casting adapted to house said fly-wheel and to form the crank case of said internal combustion engine, another casting adapted to be secured to said main casting and to receive said generator, and means carried by said fly-wheel for creating a current of air through said housing to cool both the generator and the engine.

8. The combination with an electric generator and an internal combustion engine, of a housing therefor, said housing being provided with air inlet and outlet openings, and means adapted to draw air through said inlet and over said generator, said air being then forced out over the radiating element of said internal combustion engine by said means.

9. In a single unit generating plant of the type described, an internal combustion engine, an electric generator, a fly wheel interposed therebetween, a housing for said elements, said housing comprising a main casting adapted to form the crank case of said engine, another casting adapted to be secured to said main casting and to receive said generator, and means carried by said fly wheel for cooling both the generator and the engine.

10. In apparatus of the character described, the combination of a heat engine, an electrical generator having its armature directly connected to the crank shaft of said engine, a casing enclosing said generator and engine, a crank case for said engine connected to said casing, a fan mounted on such armature shaft of said generator and adapted to draw air through said generator and force the same over said engine.

11. In apparatus of the character described, the combination of a heat engine, an electrical generator having its armature directly connected to the crank shaft of said engine, a casing enclosing said generator, a crank case for said engine connected to said generator casing, a jacket enclosing said engine and communicating with said generator casing and a fan mounted on such armature shaft in said generator casing and adapted to draw air through said generator and force the same over said engine through said jacket.

12. In apparatus of the character described, the combination of an internal combustion engine, an electrical generator having its armature directly connected to the crank shaft of said engine, a casing connected to said generator casing but having sub-

stantially air tight connection therewith, a jacket for said engine having communication with said generator casing, and a fan mounted on such armature shaft in said generator casing and adapted to draw air through said generator and force the same over said engine through said jacket.

13. In a device of the class described the combination with a prime mover having a cylinder, a crank case provided with an extension, and a crank shaft, of an electric generator having a moving part driven by said shaft and a stationary part carried by said extension; a housing surrounding said cylinder and communicating with said crank case; a fly-wheel carried by said shaft within and entirely enclosed by said crank case, said fly-wheel being disposed intermediate said generator and housing; and means associated with said fly-wheel adapted to draw a current of air through said generator and discharge the same into said housing about said cylinder to cool both of said members.

In witness whereof, we hereunto subscribe our names this 5th day of February A. D. 1917.

RAY E. ACRE.
EDWARD F. ANDREWS.