C. H. FERGUSON.

PORTABLE ELECTRIC LIGHT AND POWER PLANT.

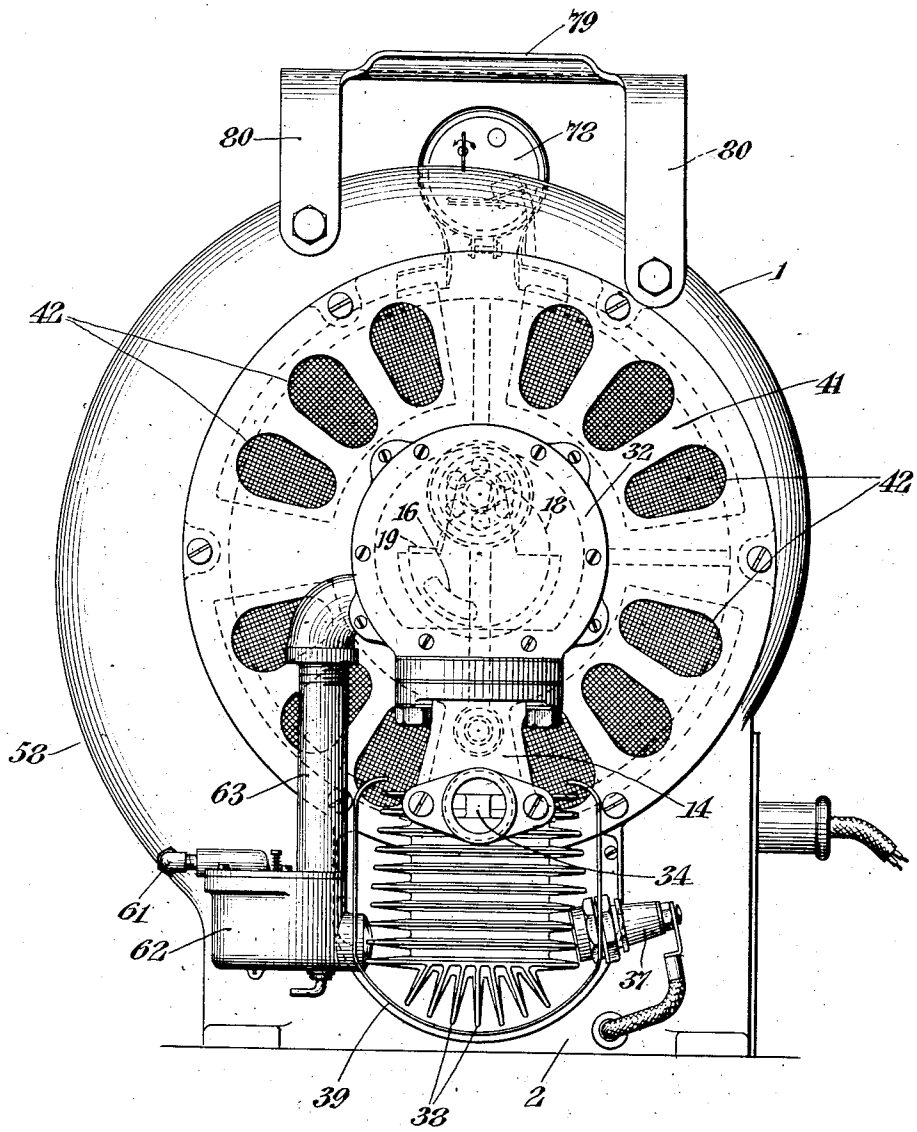
APPLICATION FILED DEC. 27, 1919.

1,399,853.

Patented Dec. 13, 1921.

7 SHEETS—SHEET 1.

Fig. 1



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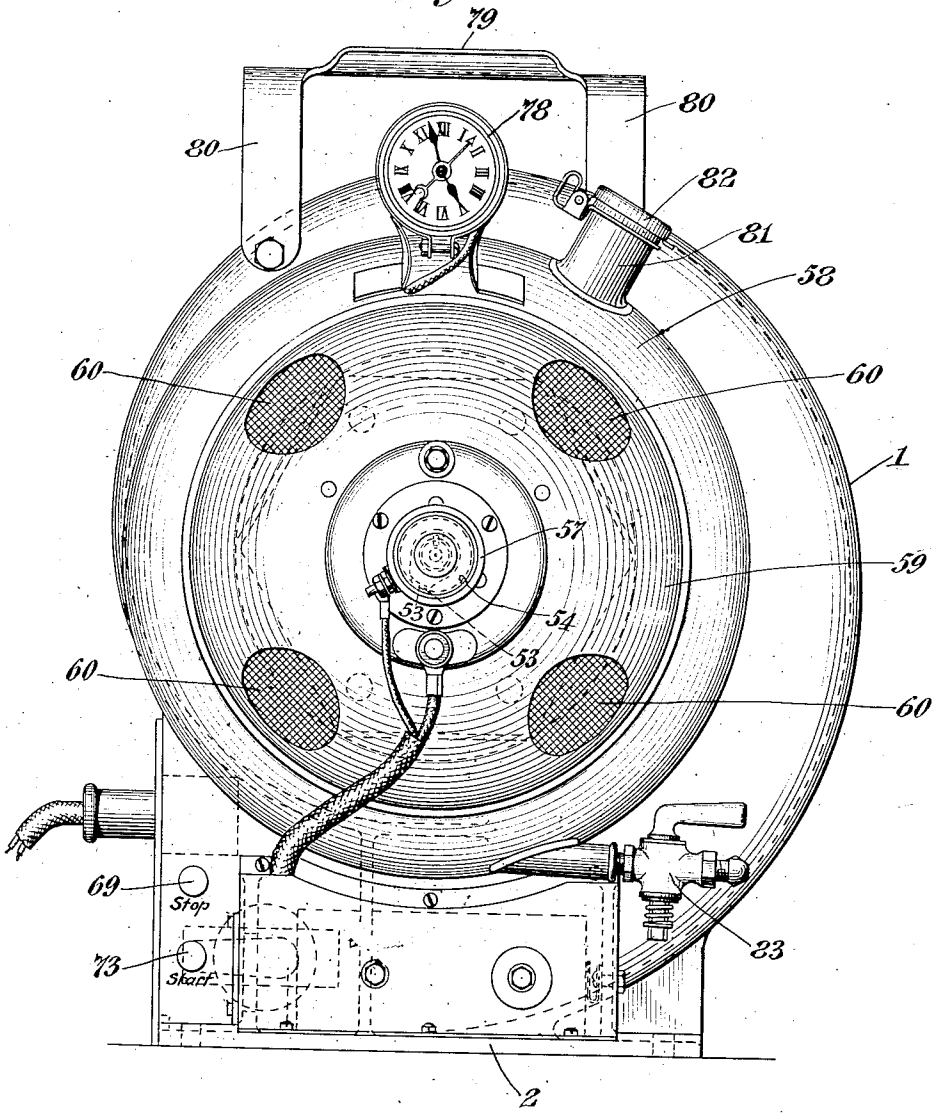
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7 SHEETS—SHEET 2.

Fig. 2.



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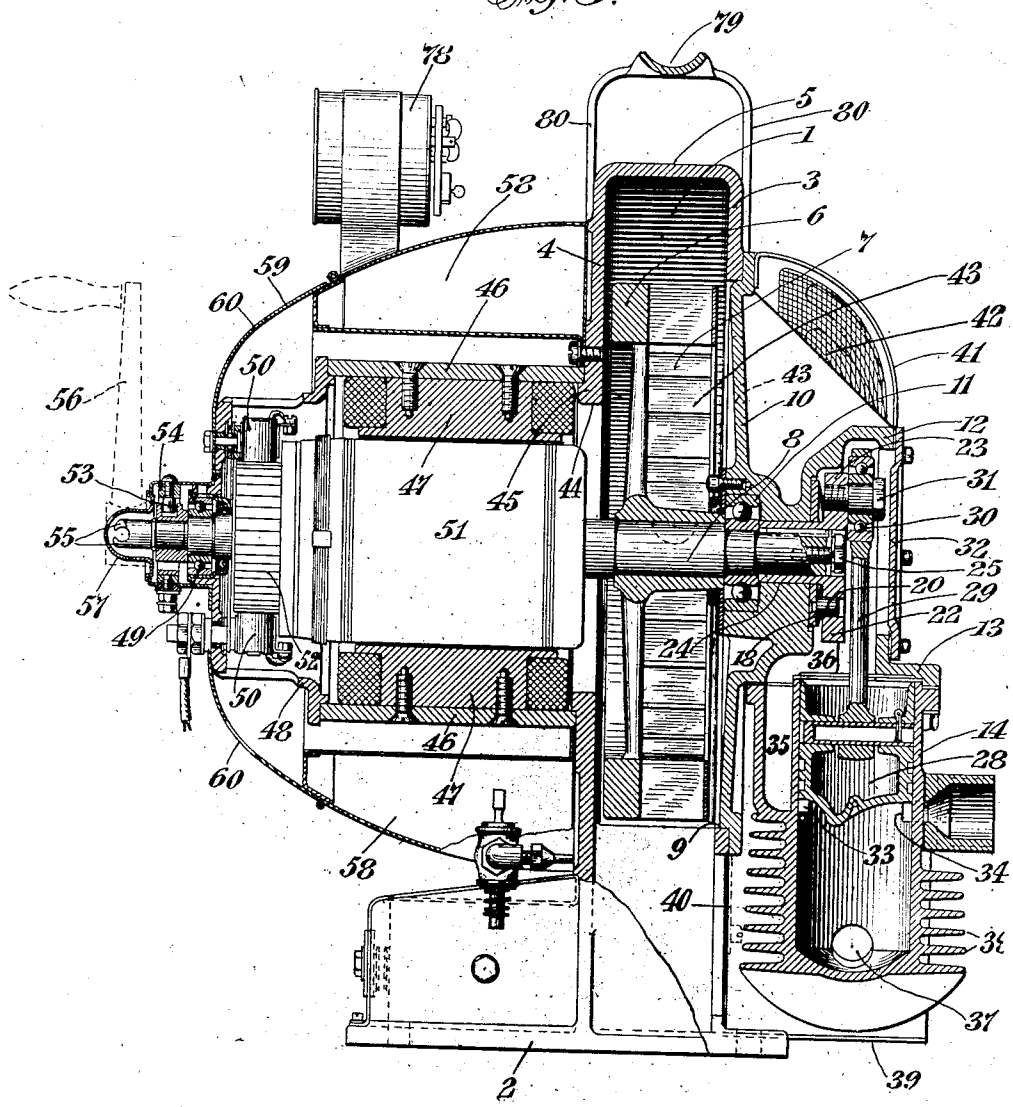
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7 SHEETS—SHEET 3.

Fig. 3.



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7 SHEETS—SHEET 4.

Fig. 4.

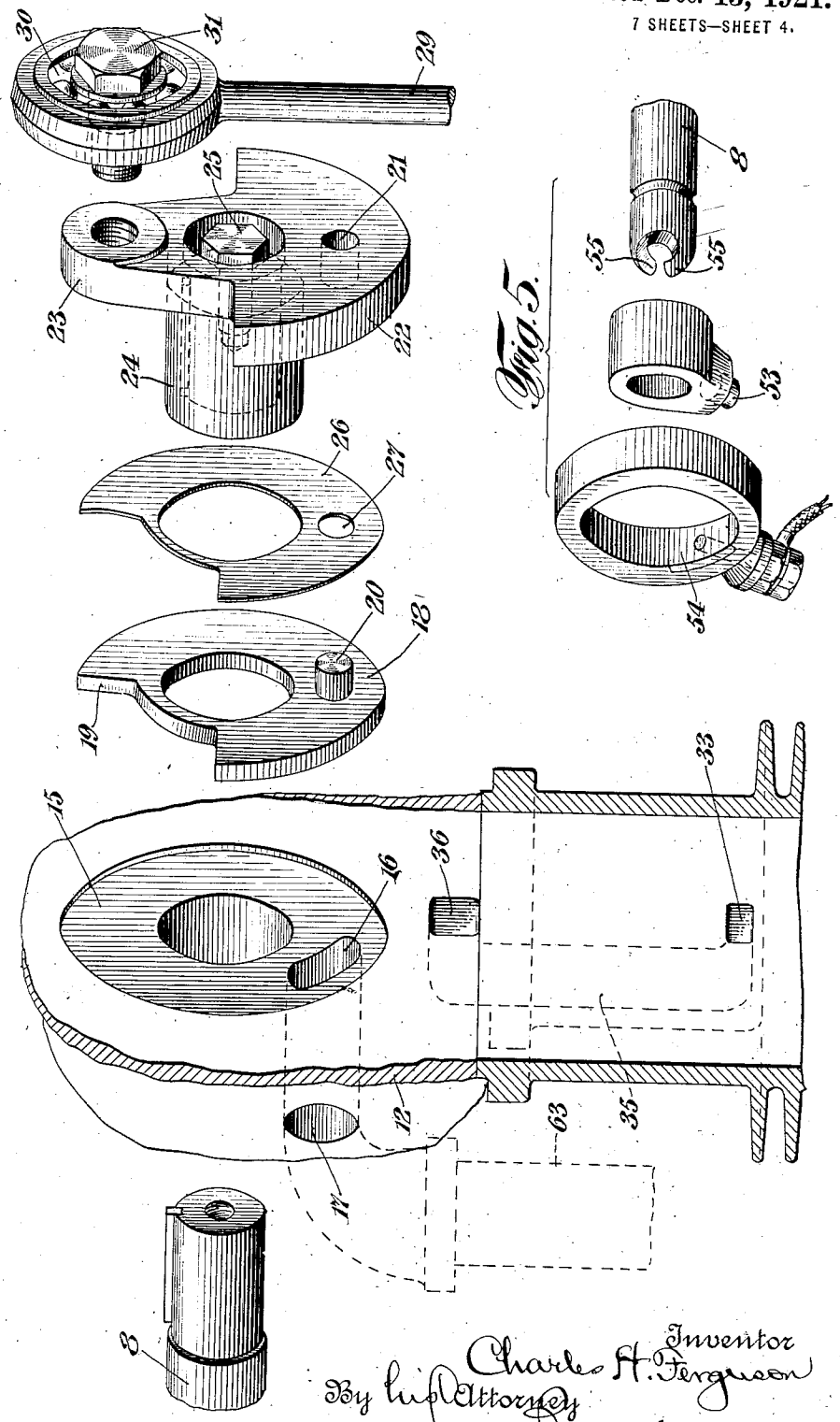


Fig. 5.

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7 SHEETS—SHEET 5.

Fig. 6.

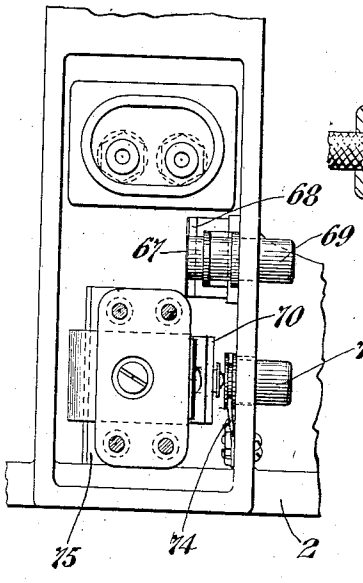


Fig. 7.

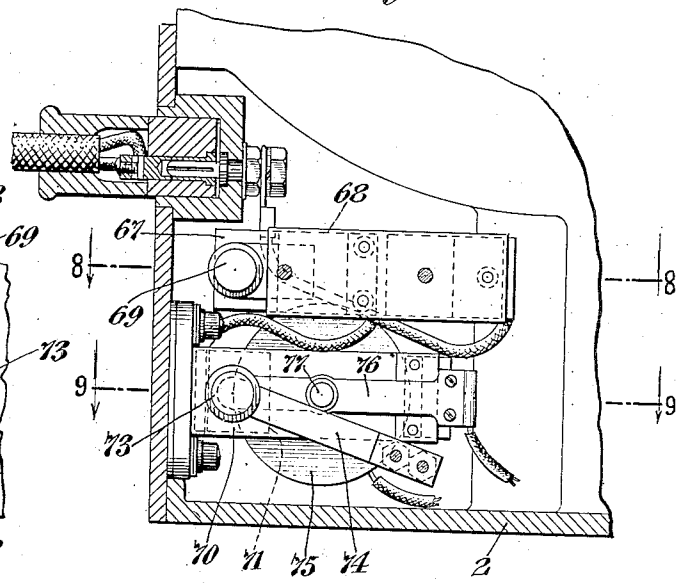


Fig. 8.

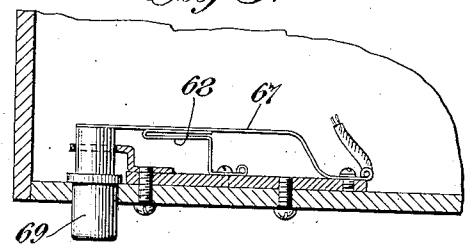
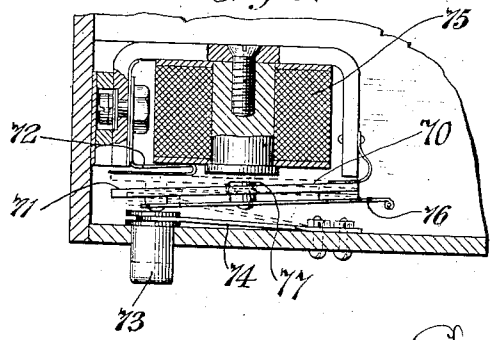


Fig. 9.



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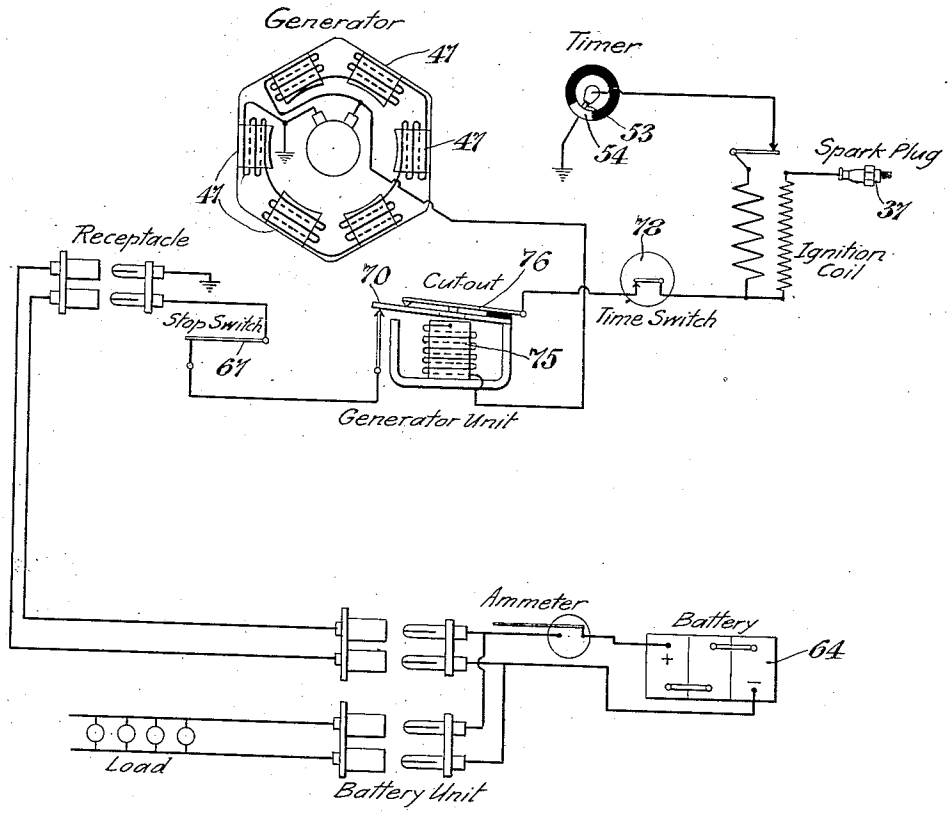
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7 SHEETS—SHEET 6.

Fig. 10.



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1,399,853.

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7 SHEETS—SHEET 7.

Fig. 11

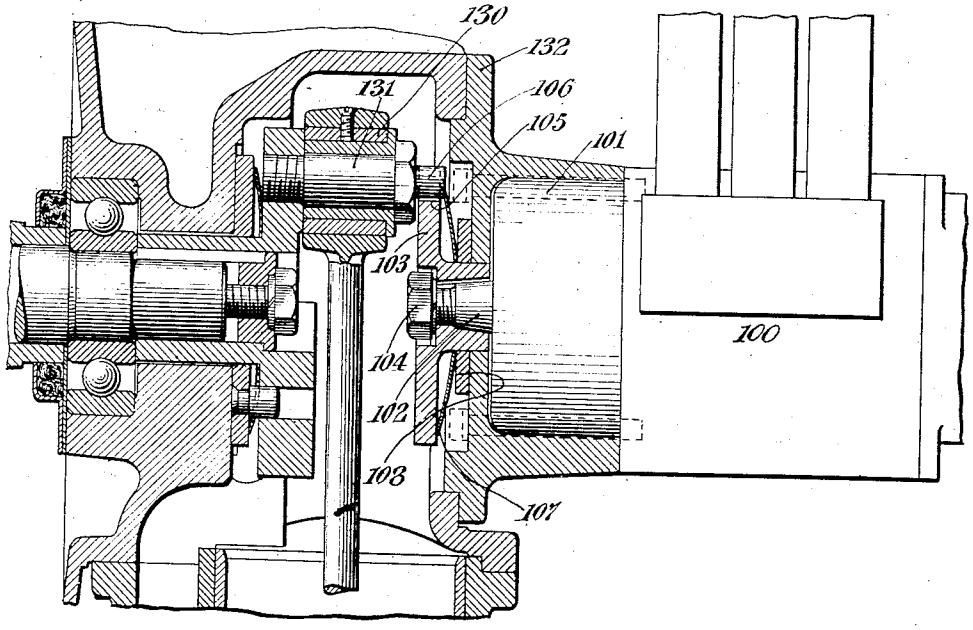
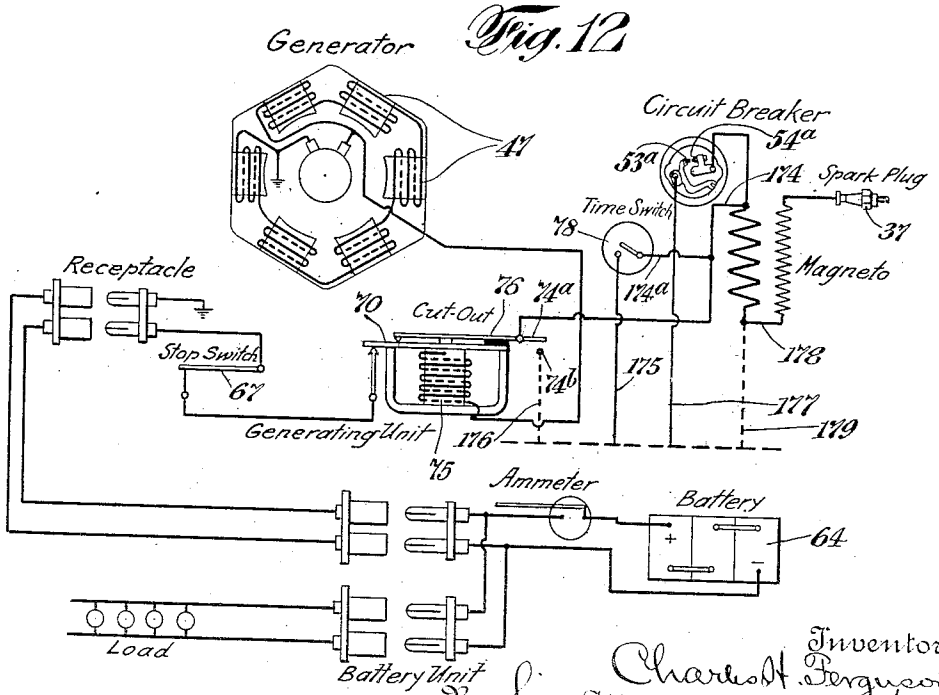


Fig. 12



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UNITED STATES PATENT OFFICE.

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PORTABLE ELECTRIC LIGHT AND POWER PLANT.

1,399,853. Specification of Letters Patent. Patented Dec. 13, 1921.

Application filed December 27, 1919. Serial No. 347,775.

To all whom it may concern:

Be it known that I, CHARLES H. FERGUSON, a citizen of the United States, residing at Valhalla, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Portable Electric Lights and Power Plants; 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 consists in the novel features hereinafter described, reference being had to the accompanying drawings which illustrate one embodiment of the same, selected by me for purposes of illustration, and the said invention is fully disclosed in the following description and claims.

The object of my invention is to provide a simple, compact, and economical electric lighting system which can be readily transported to any desired point and set up and operated for the purpose of furnishing light, heat, and power, at points remote from the cities where commercial systems of electrical generation and distribution are not available. My improved installation or plant is particularly adapted to the lighting of suburban homes, camps, and summer cottages, garages, boats, boat houses, barns and out buildings, and other buildings or places where electric current for lighting, heating, or power purposes may be desired.

In carrying out my invention, I prefer to employ a motor generator operating at low voltage, preferably six or twelve volts, and directly connected with an internal combustion engine, and to combine therewith a storage battery floating in the electrical system between the generator and the line, so that the battery may furnish current to operate the motor generator as a motor to start the engine, after which the engine drives the motor generator, as a generator, to provide current for the line and for charging the battery. By employing the low voltage above indicated, the apparatus may be made very small and compact, so that it can be readily carried by hand or in a motor car, or other vehicle, thus enabling it to be readily transported to remote localities such as camps and summer homes where the installation of an electric lighting system would be otherwise extremely difficult of accomplishment. My invention also contemplates numerous features of construction and combination of parts, all of which are hereinafter fully described and pointed out in the claims.

Referring to the drawings,

Figure 1 represents a front elevation of a portable power unit of my improved electric lighting system.

Fig. 2 represents a rear elevation of the same.

Fig. 3 represents a vertical sectional view through the apparatus illustrated in Figs. 1 and 2.

Fig. 4 is a detail perspective view showing a portion of the engine cylinder, the main shaft, the crank and engine valve mechanism, the parts being illustrated in separate relation for greater clearness.

Fig. 5 is a detail view of a portion of the engine shaft, which is also the armature shaft, and the ignition timing mechanism for the engine, the parts being separated and illustrated in perspective for greater clearness.

Fig. 6 represents a hand operated switch for placing the apparatus in operation, and an electric switch control mechanism connected therewith for controlling the operation of the hand operated switch mechanism, also a hand operated cut-out switch for the ignition mechanism.

Fig. 7 is a sectional view through the switch mechanism in Fig. 6.

Fig. 8 is a detail section on line 8—8 of Fig. 7.

Fig. 9 is a detail section on line 9—9 of Fig. 7.

Fig. 10 is a diagram illustrating the circuits.

Fig. 11 is a sectional detail illustrating the manner of connecting the magneto for ignition purposes.

Fig. 12 is a modified wiring diagram illustrating the circuits where a magneto is employed.

Referring to the drawings and particularly to Figs. 1 to 5 inclusive, 1 represents what I term the fly-wheel housing which is supported upon a suitable base 2 and constitutes in effect the main frame of the apparatus, and also serves as a fan casing, as hereinafter described. This fly-wheel housing is provided with parallel vertical walls, 3 and 4, and a curved peripheral wall, 5, to completely inclose the fly-wheel, indicated at 6, which is provided with a plurality of fan blades, indicated at 7, the fly-wheel being carried on a main shaft 8, which serves both as the crank shaft of the engine and the armature shaft of the motor generator. In the organization of power plants in which an engine and generator are directly connected, much difficulty is usually experienced in securing the proper alinement of the crank shaft of the engine and the armature shaft of the generator. I obviate this difficutly entirely by providing accurately alined bearings for the armature shaft, and forming the engine crank separate from the armature shaft, and connecting the engine in accurate operative relation to the crank and the bearings for the armature shaft, so that the parts may be readily assembled, and will be positively held in accurate relative positions. To this end I provide the front wall 3 of the fly-wheel housing with an annular aperture, indicated at 9, which is accurately bored and faced to receive a shouldered bearing plate 10, which fits the aperture 9 and is secured to the fly-wheel housing by screws or bolts in any desired manner. This bearing plate 10 is provided centrally on its inner face with a bearing preferably of the ball bearing type, indicated at 11, for the shaft 8, and the said plate 10 has cast with it a downwardly extending crank case, indicated at 12, which provides an annular portion 13 to which the engine cylinder 14 is bolted, thus accurately determining the relation between the engine cylinder and piston, and the main shaft 8. The inner face of the crank case 12, as best shown in Fig. 4, is provided with an annular recess 15 surrounding the shaft 8 and provided with a port 16, communicating with a lateral aperture 17 connected, as hereinafter described, with the carbureter for supplying the explosive mixture to the engine. Within the recess 15 is located a rotary valve 18, see Fig. 4, which normally closes the port 16, while a cut-away portion, or port 19 in the valve, is adapted to open the port 16 once in each revolution of the valve. The valve is operated by means of an eccentrically located pin or stud 20 projecting from one face of the valve, and engaging an aperture 21 in a counter-weight portion 22 of the engine crank 23, which is formed separately from the shaft 8 and provided with a sleeve 24 fitting over a reduced portion of the shaft 8 and secured thereto by means of a spline or otherwise and held from longitudinal movement on the shaft by means of a set screw 25. In order to hold the rotary disk valve 18 firmly on its seat, I conveniently provide a disk or washer 26 (see Fig. 4) formed of thin spring material and shaped similarly to the disk valve and interposed between the disk valve 18 and the rear face of the crank 23, and counter-weight portion 22, said spring disk being provided with an aperture 27 to engage the stud 20 of the disk valve. 28 represents the piston mounted in the cylinder 14, and being of the usual type employed in a two cycle engine. 29 represents the piston rod which is connected to the piston at one end, and at the other end carries a ball bearing 30 surrounding the crank pin 31, which is screwed into a threaded opening in the crank 23. The outer end of the crank case is formed with an aperture to facilitate the assembly of the parts of the crank and engine valve, and this opening is closed by means of a plate 32 (see Fig. 3).

The engine cylinder 14 is provided with an inlet port 33 and exhaust port 34 which may be connected to a muffler of any desired or useful form. The inlet port 33 communicates with a passage 35 alongside of the cylinder and connecting with a port 36 in the crank case, as shown in Figs. 3 and 4, so that the charge drawn into the crank case when the disk valve opens the port 16, and compressed by the outward or power stroke of the piston, will be transferred through the port 36 and passage 35 to the inlet port 33, to constitute the next succeeding charge for the cylinder. It will be understood that the cylinder will also be provided with the usual spark plug or other ignition means, indicated at 37, and the lower end of the cylinder, which constitutes the head of the cylinder, is preferably provided with radially disposed flanges, spikes, or other form of projections, indicated at 38, for the purpose of rapidly radiating heat to facilitate the cooling of the cylinder. The lower end of the cylinder is also surrounded by a casing, indicated at 39, and communicating with a discharge orifice 40 from the fan casing or fly-wheel housing 1, so that the air drawn in to the casing 1 by the fan and discharged therefrom will pass out through the aperture 40 and casing 39 directly over, around, and past, the lower end of the cylinder, with its radiating projections, and thereby assist in cooling the engine. I also prefer to provide the crank case with an exterior metal shell 41 which is provided with air apertures 42, and the bearing plate 10 is also provided with apertures, indicated at 43, so that air may be drawn in around the crank case, thereby

keeping the crank case and the crank and the adjacent bearing for the shaft 8 cool, these parts not being so highly heated as the engine cylinder, and the air is then delivered, as before stated, to the exterior of the engine cylinder, where it takes up additional quantities of heat. As hereinafter explained, I also provide for drawing the air in part into the fly-wheel housing or fan casing 1 from the portion of the apparatus inclosing the motor generator, so as to maintain it cooled also, and prevent the heating thereof.

The rear wall 4 of the fly-wheel casing is provided with an aperture, indicated at 44, the marginal portions of which are turned and planed coaxially with the aperture 9 in the wall 3, and said marginal portions are preferably provided with an annular bead 45 which receives an annular casing 46 carrying the field magnets 47 of the motor generator. The annular casing 46 carries on its outer end a bracket or casting 48 which carries the outer bearing 49 of the main shaft 8, and also the brushes 50 of the motor generator. The shaft 8 as will be clearly seen, carries the armature 51 and commutator 52, the outer end of the shaft extending through the bearing 49 and being provided beyond said bearing with a brush 53 for engaging a segment 54 connected with the igniter 37 of the engine, and the outer end of the shaft 8 is provided with the usual means, as projections 55, see Fig. 5, for receiving a hand crank 56, indicated in dotted lines in Fig. 3, a detachable cover or cap 57 being placed over the end of the shaft 8 when the crank is not in use. It will be seen by the construction herein shown and described that the main shaft 8, which is both the armature shaft of the motor generator and the crank shaft of the engine, is supported in exact position with respect to the engine cylinder, and the crank, so that the correct operation of the respective parts for starting the engine and also for generating current is secured and maintained.

I conveniently employ an annular tank, indicated at 58, which surrounds the field magnets 47 and field magnet casing 46 and which will contain the supply of gasolene or other motor fuel, and I prefer to add the lubricating oil for the engine cylinder directly to the motor fuel, and feed it therewith, although the engine may be lubricated in any other desired manner. I also provide a shell or casing, indicated at 59, surrounding the armature 52 and brushes 50, and provided with ventilating apertures 60. It will now be seen that, as before stated, when the apparatus is in operation, the air will not only be drawn into the fan casing or fly-wheel housing 1 from the apertures 42 adjacent to the crank case, but a portion of air, which I prefer to limit by regulating the size of the openings 60 will be drawn into the shell 59 and will pass around the commutator 52 and brushes, and between the armature and field magnets, to the fan casing 1, thereby keeping all parts of the generator cool, and as these parts do not become very highly heated, this air, as well as the air drawn in around the crank case, is discharged through the aperture 40 against the engine cylinder, and is still capable of taking large quantities of heat therefrom.

The motor fuel is taken from the tank 58 by means of a pipe 61 which delivers it to the carbureter 62, which may be of any usual or desired construction. From the carbureter a pipe 63 leads to the passage 17 in the crank case communicating with the valve port 16 before described for supplying explosive mixture to the cylinder.

As before stated, I prefer to employ, in connection with my improved apparatus a storage battery, indicated at 64, in the circuit diagram Fig. 10, and this battery is floated in the line between the generator circuit and the lamps or other devices carried on the line, as indicated in Fig. 10. I also provide in the system a cutout switch for breaking the main circuit, a hand operated switch for closing the main circuit to start the engine, and provided with electromagnetic means for holding the switch closed after the generator has been brought into operation by the engine, and I also prefer to provide, as herein shown, a time control means for throwing the parts out of operation altogether at any time desired, and for which the time mechanism may be set, such time control mechanism being located preferably in the ignition circuit as shown in Fig. 10. The switch mechanism I find it convenient to locate in a housing supported on the base of the apparatus, as indicated in Figs. 2, 6, 7, 8, and 9. 67 represents a switch arm in the main generator circuit normally engaging a contact 68 and provided with a button 69 by which the contacts 67 and 68 may be separated to break the circuit when the apparatus is in operation, and it is desired to manually stop it. 70 represents a pivoted switch lever carrying a contact 71 which may be forced against a contact 72 to complete the circuit through the motor generator, by means of a push button 73, which I preferably mount on an independent spring arm 74. Adjacent to the lever 70 I provide an electromagnet 75, the core of which is adapted to attract the lever 70 and hold it in circuit closing position, in which the parts are represented in dotted lines in Fig. 9. I prefer to provide a separate and independently movable switch lever 76 in the ignition circuit which is interposed between the push button 73 and the lever 70, and which also

carries an armature 77 extending through an aperture in the switch lever 70 and cooperating with the core of the magnet 75.

When it is desired to start the apparatus, the operator will push the button 73 inwardly into the position shown in dotted lines in Fig. 9, thereby effecting a contact between the switch levers 76 and 70 and between the contacts 71 and 72, thereby placing the motor generator in electrical connection with the battery, as will be seen from an examination of Fig. 10, and also connecting the ignition mechanism with the battery. The current from the battery will thereupon energize the generator and cause it to rotate the armature and crank shaft and start the engine. It is necessary for the operator to hold his finger on the button 73 for a sufficient interval to permit the engine to get under way and operate the motor generator, so as to generate a current which will begin to flow toward the battery, passing through the magnet 75 in the reverse direction from the original battery starting current. If the operator did not retain his finger on the button 73, the magnet 75 would release the switch levers 70 and 76 at the instant of the reversal of the current, but by holding the button until the current reverses, the magnet will assume control of the switch levers 70 and 76 and hold them in position until the circuit passing through the magnet 75 is broken. This can be accomplished by simply pressing the button 69, thereby separating the contacts 67 and 68, whenever desired. I also prefer to provide a clock control mechanism, indicated at 78, in Figs. 2 and 10, which is constructed to operate a switch and break the ignition circuit at any time for which the clock actuated mechanism may be set. The apparatus is intended ordinarily to be used for the lighting of houses and camps and the like dwellings, whether of a temporary or permanent character, and it will ordinarily be known to the user at about what time the necessity for the operation of the apparatus will cease. The user may therefore conveniently set the time control apparatus to break the ignition circuit at, for example, 11.30 p. m., at which time the ignition circuit will be broken by the time mechanism, thereby stopping the engine, and as the voltage from the generator decreases, the magnet 75 will release the switch levers 70 and 76, thereby restoring the apparatus to a condition of rest, from which it may be started up again at any time by simply pressing the button 73. As before stated, if the time mechanism is in control, and it should be desired to shut off the operation of the engine and generator at an earlier time, before the operation of the time mechanism, this can be done, at any time by manually operating the push button 69, and separating the contacts 67 and 68.

It will be noted that this apparatus is extremely compact, and in practice it is of such small size, that it may be readily carried by hand, and I have shown it provided with a handle 79 formed of sheet metal and connected by straps 80 with adjacent portions of the casing, so that it can be conveniently carried. The fuel tank 58 is also provided with a filling aperture 81 provided with a closing cap 82 of any desired type, and the tank 58 will also be provided with a drain cock 83, as indicated in Fig. 2, for cleaning it.

In some instances I prefer to employ a magneto for ignition purposes instead of taking the current from the battery. This has a number of advantages in that the apparatus can be employed if desired without using the battery at all, by cranking the engine for starting purposes, and many instances will be found where this use of the apparatus is desirable and convenient, although I prefer to employ a battery for the purpose of starting the engine and for accommodating variations in the load. In Fig. 11 I have shown a sectional detail of the crank case illustrating, in connection therewith, a convenient arrangement for applying and operating the magneto. In this instance the closing plate for the crank case, illustrated at 132, is preferably provided with a socket to receive the end of a magneto, indicated at 100, which is secured to the plate 132 by bolts or screws 101, or otherwise. 102 represents the shaft of the magneto armature, which is held by the plate 132 in axial alinement with the shaft of the engine, and is provided with a crank plate 103, secured in place by a nut 104 and provided with a peripheral aperture or recess 105 which engages a crank stud 106 on the crank pin 131 of the engine, which in this instance is shown as engaging a sleeve bearing 130 in the crank. 107 represents a spring washer which I preferably employ between the rear face of the crank disk 103 and a plain washer 108. It is obvious that as the crank is rotated by the engine the stud 106 on the crank pin will cause the armature of the magneto to rotate in timed relation with the engine, and the magneto will be so constructed as to furnish a spark at every revolution of the armature. In case access to the crank is desired, it is only necessary to remove the screws or other securing means holding the closing plate 132 in position, when the said plate, together with the magneto, can be removed and replaced, so as to maintain the magneto in timed relation with the engine.

In case the magneto is employed, the wiring diagram will be slightly altered, as the ordinary means of throwing a magneto out of operation is to short-circuit or ground it instead of breaking the circuit, as would

be the case in a battery circuit. Fig. 12 illustrates a wiring diagram which may be found convenient for use where the magneto is employed in the ignition circuit. In this diagram the primary and secondary coils of the magneto are illustrated, the latter being connected to the spark plug, and both coils being connected to ground at 179. 53ª and 54ª represent the separable contacts of the periodic interrupter or circuit breaker, one of which is connected to the primary coil, and the other to ground as at 177. A wire 174 is shown leading from a point in the primary circuit of the magneto between the primary coil and the circuit breaker, to the ignition cut-out switch 76 of the hand operated electromagnetically controlled switch mechanism previously described. In this instance the ignition cut-out switch 76 is shown provided with a projection 74ª adapted, when the switch is in open position, to make contact with a contact 74ᵇ connected to ground, as indicated at 176, thereby short-circuiting the circuit breaker and grounding the magneto. In order that the magneto may also be grounded by the time mechanism, or clock actuated mechanism previously described, which is indicated at 78, this time mechanism is so arranged as to close a circuit at the predetermined time instead of opening one, as in the form shown in Fig. 10, and the separable contacts of the time mechanism are connected to the wire 174 by a wire 174ª and to ground by wire 175 respectively. In order to start the apparatus where the magneto is employed, the time switch will be opened and the operator will close the cut-out switch 70, thereby breaking the ground circuit by separating the projection 74ª and contact 74ᵇ, and holding the cut-out switch in this position until the generator attains normal speed. Where the battery is employed, as indicated at 64 in Fig. 12, the battery current will actuate the generator as a motor to start the engine, thereupon driving the magneto and providing the necessary current for the spark plug. As soon as the engine starts, it will drive the generator as a generator and the current flowing from the generator back through the magnet of the cut-out switch to the battery and line, will energize the magnet and hold the cut-out switch 70 and ignition cut-out switch 76 in such position as to maintain the ground circuit of the magneto broken, and the generating circuit closed. The operator can then remove his finger from the push button as before described. The engine can be stopped at any time as in the apparatus indicated in Fig. 10 by opening the stop switch 67 and breaking the generating circuit, the effect of which will be to release the cut-out switch 70 and ignition cut-out switch 76, the latter grounding the magneto at 74ª, 74ᵇ, and stopping the engine, or if the stopping of the engine is left to the control of the timing switch, it will operate at a predetermined time to close the circuit and ground the magneto through the wire 175, thereby stopping the engine and generator, and as soon as the generating current ceases, the magnet of the cut-out switch will be deënergized, thereby releasing the switches 76 and 70 and breaking the generating circuit.

While I have shown herein a wiring diagram illustrating the course of the circuits when the battery is used for ignition purposes, and also where the magneto is employed, it will be understood that these diagrams are merely illustrative, and that the parts may be wired in other ways if desired to produce the same results, and I do not limit myself to these particular arrangements.

What I claim and desire to secure by Letters Patent is:—

1. In a device of the character described, the combination with the supporting housing, provided with parallel walls having coaxial apertures therein, of a bearing plate engaging one of said apertures, and provided with a crank-shaft bearing, said plate being provided with means for attaching an engine cylinder thereto and supporting it in proper relation to the crank shaft, a casing fitting the other of said coaxial apertures, generator field magnets carried by said casing, a crank shaft bearing carried by said casing, a crank shaft engaging said bearings, an armature carried by said shaft within said field magnets, an engine cylinder and piston carried by said bearing plate, and operative connections between said piston and said crank shaft.

2. In a device of the character described, the combination with the supporting housing provided with parallel walls having coaxial apertures therein, of a bearing plate engaging one of said apertures and provided with a shaft bearing, and having formed integrally therewith a crank case provided with a cylinder receiving face, a casing fitting the other of said coaxial apertures of the casing and provided with generator field magnets, and a crank shaft bearing carried by said casing, a crank shaft engaging said bearings and provided with a rotary armature mounted in said shaft bearings, an engine cylinder connected to said crank case, and a piston in said cylinder operatively connected to said crank shaft, whereby the perfect alinement of the armature shaft with respect to the crank and engine cylinder and piston is secured.

3. In a device of the character described, the combination with the supporting housing, provided with parallel walls having coaxial apertures therein, of a bearing plate

engaging one of said apertures, and provided with a crank-shaft bearing, said plate being provided with means for attaching an engine cylinder thereto and supporting it in proper relation to the crank shaft, a casing fitting the other of said coaxial apertures, generator field magnets carried by said casing, a crank shaft bearing carried by said casing and located adjacent to the outer end thereof, a crank shaft mounted in said bearings, an armature carried by said shaft within said casing, a fly wheel on said shaft between the parallel walls of said housing, said flywheel and armature being located between said bearings, an engine cylinder connected to said bearing plate, and a piston in said cylinder, operatively connected to the crank shaft.

4. In a device of the character described, the combination with the supporting housing, provided with parallel walls having coaxial apertures therein, of a bearing plate engaging one of said apertures, and provided with a crank-shaft bearing, said plate being provided with means for attaching an engine cylinder thereto and supporting it in proper relation to the crank shaft, a casing fitting the other of said coaxial apertures, generator field magnets carried by said casing, a crank shaft bearing carried by said casing, a crank shaft mounted in said bearings, an armature carried by said shaft, a fly wheel provided with a fan carried by said shaft, and located in said housing between the parallel walls thereof, an engine cylinder carried by said bearing plate, a piston in said cylinder, operative connections between said piston and the crank shaft, said housing being provided with an air discharge adjacent to the outer end of the cylinder for directing the current of air produced by the fan directly upon the cylinder.

5. In a device of the character described, the combination with the supporting housing, provided with parallel walls having coaxial apertures therein, of a bearing plate engaging one of said apertures, and provided with a crank-shaft bearing, said plate being provided with means for attaching an engine cylinder thereto and supporting it in proper relation to the crank shaft, a casing fitting the other of said coaxial apertures, generator field magnets carried by said casing, a crank shaft bearing carried by said casing, a crank shaft mounted in said bearings, an armature carried by said shaft, a fly wheel provided with a fan carried by said shaft, and located in said housing between the parallel walls thereof, an engine cylinder carried by said bearing plate, a piston in said cylinder, operative connections between said piston and the crank shaft, said housing being provided with an air discharge adjacent to the outer end of the cylinder for directing the current of air produced by the fan directly upon the cylinder, and said casing being provided with air inlet apertures, in communication with the fan casing through the adjacent one of said coaxial apertures in the housing, whereby air is drawn in around the armature to cool it, and is discharged against the cylinder to effect a further cooling action.

6. In a device of the character described, the combination with the supporting housing, provided with parallel walls having coaxial apertures therein, of a bearing plate engaging one of said apertures, and provided with a crank-shaft bearing, said plate being provided with means for attaching an engine cylinder thereto and supporting it in proper relation to the crank shaft, a casing fitting the other of said coaxial apertures, generator field magnets carried by said casing, a crank shaft bearing carried by said casing, a crank shaft mounted in said bearings, an armature carried by said shaft, a fly wheel provided with a fan carried by said shaft, and located in said housing between the parallel walls thereof, an engine cylinder carried by said bearing plate, a piston in said cylinder, operative connections between said piston and the crank shaft, said housing being provided with an air discharge adjacent to the outer end of the cylinder for directing the current of air produced by the fan directly upon the cylinder, said bearing plate being provided with a crank case surrounding the crank and having air inlet apertures in said plate adjacent to the crank case for cooling the same, whereby the same air is employed in cooling the crank case, and is then discharged against the cylinder to effect a further cooling action.

7. In a device of the character described, the combination with the supporting housing, provided with parallel walls having coaxial apertures therein, of a bearing plate engaging one of said apertures, and provided with a crank-shaft bearing, said plate being provided with means for attaching an engine cylinder thereto and supporting it in proper relation to the crank shaft, a casing fitting the other of said coaxial apertures, generator field magnets carried by said casing, a crank shaft bearing carried by said casing, a crank shaft mounted in said bearings, an armature carried by said shaft, a fly wheel provided with a fan carried by said shaft, and located in said housing between the parallel walls thereof, an engine cylinder carried by said bearing plate, a piston in said cylinder, operative connections between said piston and the crank shaft, said housing being provided with an air discharge adjacent to the outer end of the cylinder for directing the current of air produced by the fan directly upon the

cylinder, said bearing plate being provided with a crank case and having air inlet apertures adjacent thereto and said casing being provided with air inlet apertures communicating with the housing, whereby air is drawn into the housing through both of said coaxial apertures to cool the crank case and the armature and is discharged directly upon the cylinder to effect a further cooling action.

In testimony whereof, I affix my signature.

CHARLES H. FERGUSON.