March 25, 1930. O. D. TREIBER 1,751,958

APPARATUS FOR GENERATING ELECTRIC CURRENT

Filed April 27, 1927 2 Sheets-Sheet 1

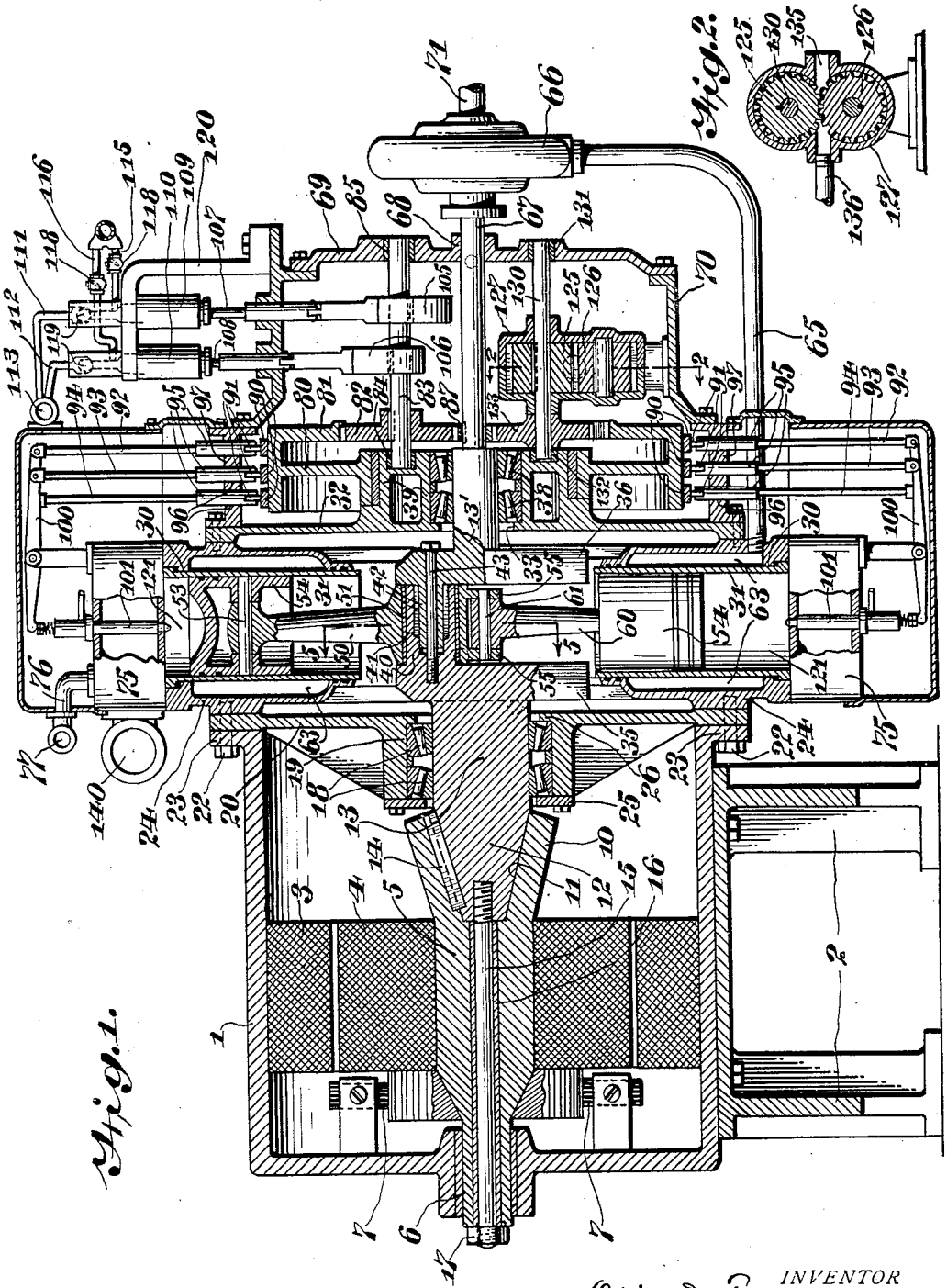


Fig. 1.

Fig. 2.

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Fig. 3.

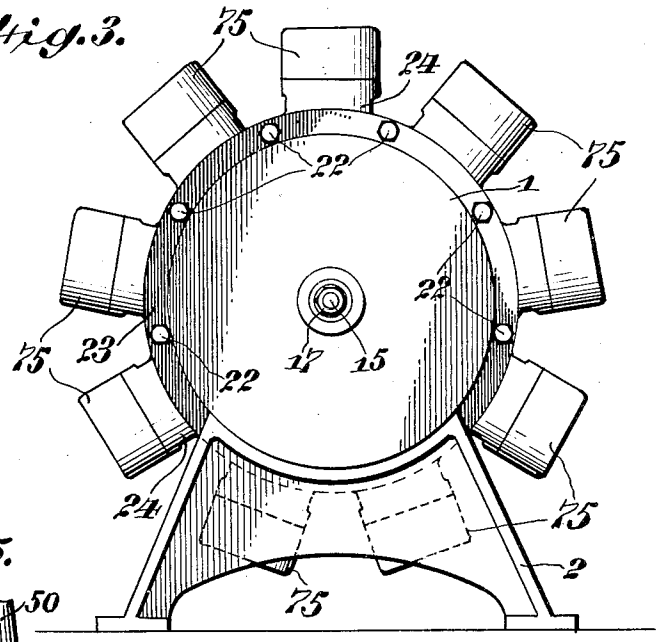


Fig. 5.

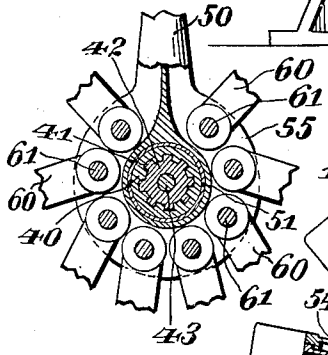


Fig. 4.

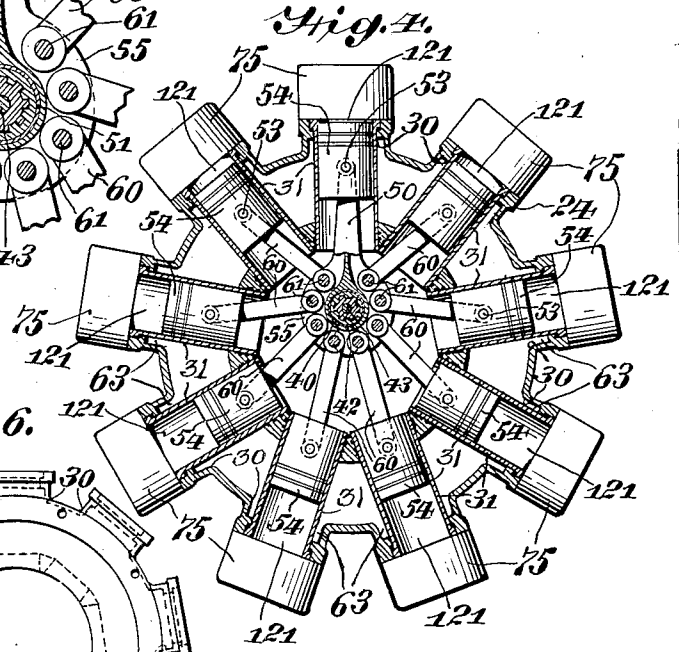


Fig. 7.

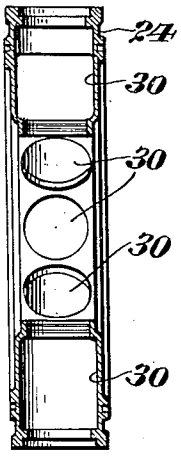
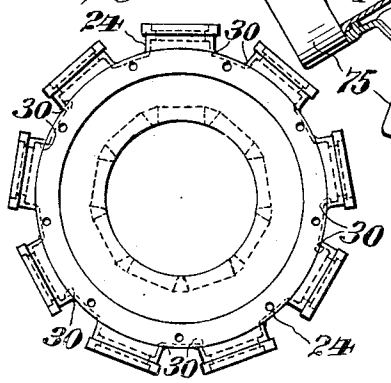


Fig. 6.



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UNITED STATES PATENT OFFICE

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APPARATUS FOR GENERATING ELECTRIC CURRENT

Application filed April 27, 1927. Serial No. 186,838.

My invention relates to apparatus for generating electric energy which apparatus comprises a generator the rotor or rotatable member of which is actuated by means of a radial internal combustion engine of the Diesel type.

The general object of the invention is to provide a structure of the character indicated wherein the generator and the engine structure are combined in a novel manner not only to obtain efficiency but to effect economy in the space occupied by the structure.

It also is an object of the invention to provide a novel arrangement of means for combining the two structures, namely, the generator and the engine, in a single structure.

Another object of the invention is to provide an improved and novel construction of means whereby the connection of the engine crank shaft to the generator shaft is facilitated, the latter being partially supported by the former.

To these and other ends the invention comprehends the construction and arrangement of parts as hereinafter described in detail, particularly pointed out in the claims and as illustrated in the drawings in which I have shown a preferred embodiment of the invention. However, it will be understood that the invention is susceptible of embodiment in other forms of construction than that shown and that changes in the details thereof may be made within the scope of the claims without departing from the principle of the said invention.

In the drawings:

Fig. 1 is a view in vertical central longitudinal section of an apparatus embodying the invention;

Fig. 2 is a transverse sectional view taken on the line 2—2 of Fig. 1 showing a detail of the construction;

Fig. 3 is a view in end elevation looking toward the right in Fig. 1;

Fig. 4 is a view taken in a plane at right angles to that in which Fig. 1 is taken and showing portions of the cylinders in longitudinal section, and showing other portions of the structure associated therewith in elevation;

Fig. 5 is a transverse sectional view taken on the line 5—5 of Fig. 1;

Fig. 6 is a view in side elevation of the casing within which the piston or combustion cylinders are mounted; and

Fig. 7 is a transverse sectional view thereof.

In the drawings I have shown a generator casing 1 supported upon a frame structure comprising legs 2. The generator field windings are indicated generally at 3 and the rotatable armature at 4, the latter being mounted on a shaft 5 the outer end of which is reduced and is supported in a bearing 6 in the outer end of the casing 1. Current is taken from the generator by means of brushes 7 in the usual known manner. The inner end of the shaft 5 is flared as indicated at 10 so as to provide a truncated cone shaped seat or socket 11 within which the correspondingly shaped end portion 12 of a portion 13 of the engine crank shaft is seated. For the purpose of causing rotation of the generator shaft with the armature 4 mounted thereon with the engine crank shaft the two shafts are keyed together by means of a key 14. The generator shaft and the engine shaft are held in engagement with each other by means of a binding or tie rod 15 which extends through an axial opening 16 through the shaft 5. The inner end of the tie rod is in screw threaded engagement with the outer end of the crank shaft, and the outer end thereof is provided with a nut 17 which when screwed against the outer end of the shaft 5 draws the two shafts together and holds them united as shown in Fig. 1 of the drawings. The portion 13 of the crank shaft is supported in roller bearings 18 mounted in the flanged opening 19 provided in the plate 20 secured against the inner end of the casing 1 of the generator and held in place by bolts 22 which extend through a flange 23 upon the casing 1, through the outer edge portion of the plate 20 and into the adjoining side of the circular casing 24 to secure the latter to and support the same upon the generator casing. The roller bearings 18 are retained in place by means of the rim 25 secured to the outer end of the flange of the

opening 19 and by an inwardly extending flange-like portion 26.

The circular casing 24 is provided with radial openings 30 within which are mounted the combustion cylinders 31. The casing 24 is of annular structure and the central opening therethrough is closed by means of a plate 32 secured thereto, the said plate having a central opening as indicated at 33.

The inner end of the member 13 of the crank shaft terminates in a crosswise extending portion 35 which is in oppositely disposed relation to a similar part 36 secured upon the inner end of the portion 13′ of the crank shaft which portion is supported in roller bearings 38 mounted in a bearing support 39 carried upon the outer side of the plate 32 and surrounding the central opening 33 through said plate. The portions 35 and 36 when connected together constitute the crank arm of the crank shaft. The portion 35 is provided with a projection 40 which preferably is integral therewith, the axis of said projection being eccentrically located with respect to the axis of the shaft 13 13′. The outer end of the projection 40 is provided with an opening or socket 41 having grooves at intervals therein which extend longitudinally thereof. A projection 42 is provided upon the member 36 which is provided with ridges. The said projection with the ridges thereon fits into the opening 41. These parts together constitute the crank pin of the crank arm and are held in united relation with respect to each other as shown in Fig. 1 of the drawings by means of the binding or holding bolt 43. This bolt operates to unite and hold the parts 13 and 13′ of the crank shaft together.

The inner end of a master connecting rod 50 is provided with a hub having an opening therethrough through which the crank pin formed of the parts 40 and 42 extends. It may be noted that the portion 40 of the crank pin is inserted through the opening in the hub of the connecting rod 50 before the two parts 40 and 42 are united. A sleeve 51 of suitable anti-friction metal is mounted upon the crank pin and constitutes a bearing for the inner surface of the opening through the hub of the master connecting rod 50. The outer end of the master connecting rod 50 is connected by means of a pin 53 with a piston 54 which is adapted to operate in one of the cylinders 31 of the engine structure.

The hub of the master cylinder is provided with oppositely disposed flanges 55. The inner ends of the remaining piston rods 60 project into the space between the said flanges and are connected thereto by connecting pins 61. The connecting rods 60 are connected at their outer ends by means of pins 53 to pistons 54 which operate in the remaining combustion cylinders of the engine structure.

The presence of the cylinders 31 provides spaces as indicated at 63 within the casing 24. All of these spaces 63 are in communication with the casing 24 and for the purpose of cooling the cylinders 31 during the operation of the engine water is caused to circulate therethrough. The water is supplied through a pipe 65 the outer end of which is in communication with a centrifugal water pump 66 operated by means of an extension 67 of the outer end of the member 13′ of the crank shaft. The outer end portion of the extension 67 is supported in a bearing 68 upon the outer side 69 of a casing 70 supported indirectly from the casing 24, as is apparent from Fig. 1 of the drawings. Water is supplied to the pump 66 by means of a pipe 71. Within the casing 70 various mechanisms are shown to which reference will be made hereinafter.

The water flows from the casing 63 into the cylinder heads 75 and from the latter through the outlets 76 to a manifold 77 and from the latter to the waste pipe or line (not shown). The cylinder heads 75 are of usual or of any preferred construction.

A cam wheel or ring 80 is mounted upon the support 39 previously referred to. The said ring is provided upon its outer side with an inwardly extending annular flange 81 the inner edge of which is provided with gear teeth which are in engagement with the teeth of a spur gear 82 mounted upon a countershaft 83 supported at its inner end in a bearing 84 provided in the support 39. The outer end of the said shaft 83 is mounted in a bearing 85 provided in the outer plate 69 of the casing 70. The gear 82 is in engagement with and is driven by a pinion 87 upon the extended portion 67 of the crank shaft. Rotation of the gear 82 drives the cam ring or wheel 80. The latter is provided upon its peripheral surface with groups of cam projections 90 two of which groups are shown. There are four groups, however, upon the said cam ring located at intervals of 90° in order to obtain the proper firing order in the cylinders and consequently an even torque on the crank shaft. These cam projections contact in the proper order with rollers 91 upon the lower ends of valve actuating rods 92, 93 and 94. The inner end portions of each of these rods is enlarged, as indicated at 95 in Fig. 1 of the drawings, and the said enlarged portions are mounted and guided in openings 96 in a circular or annular rim portion 97 which projects laterally or outwardly from the plate 32. The rim portion 97 is concentric with the axis of the crank shaft.

There is one group of rods 92, 93 and 94 associated with each cylinder of the engine structure and the upper ends of the said rods are connected to the outer ends of levers designated collectively as 100. Rotation of the cam ring 80 causes reciprocation, by reason of the presence of the cam projections 90, at timed intervals of the rods 92, 93 and 94 and by reason of the fact that the outer ends of

the said rods are connected to the outer ends of the levers 100 of the respective groups of levers the latter are pivotally actuated so that their inner ends operate to actuate valves which control feeding of fuel into the engine cylinders to control the admission of air thereinto, and also to control the exhaust of gases and air therefrom. The speed at which the cam ring rotates is approximately one-eighth engine speed which causes explosions to occur in each of the cylinders at the proper time to produce an even torque on the crank shaft.

I have shown in Fig. 1 of the drawings nozzle structures 101 by means of which fuel is introduced into the two cylinders illustrated in said Fig. 1. However, it will be understood that a nozzle structure is associated with each of the cylinders of the engine structure. I have not shown in detail the nozzle structure for supplying fuel to the cylinders, nor the valves for controlling the admission of air into the said cylinders, nor for controlling the discharge of gases therefrom, because any known constructions of nozzle and valves may be employed.

For supplying fuel oil to the nozzles 101 I have provided upon the shaft 83 eccentrics 105 and 106 which operate to actuate pump plunger rods 107 and 108 which operate in chambers 109 and 110 to force therefrom oil through the pipes 111 and 112 into the manifold pipe 113. There are connections, not shown, from the latter to the nozzle structures 101 by means of which the fuel is supplied to the said nozzle structures and by the latter to the cylinders. The fuel is supplied under pressure in known manner to the pump cylinders 109 and 110 from a source, not shown, through pipes 115 and 116 controlled by check valves indicated at 118. Check valves 119 also are provided in the passageways leading from the pump cylinders 109 and 110 to the manifold 113. The pump cylinders 109 and 110 are supported on a bracket 120.

The details of construction of the pumps for forcing fuel into the nozzles 101 and from the latter into the combustion chambers 121 of the respective cylinders are not shown, because any suitable pumping structure may be employed for the purpose.

For the purpose of lubricating the moving parts of the structure I have provided a gear pump comprising the meshing gears 125 and 126 mounted within a casing 127 supported upon the inner side of the bottom part of the casing 70. The gear 125 is mounted upon a shaft 130 supported at its outer end in a bearing 131 provided in an opening in the side 69. The inner end of the shaft 130 is mounted in a bearing at 132 in the support 39 previously referred to. A gear 133 mounted upon the shaft 130 is in engagement with the pinion 87 and is driven thereby. Upon driving of the shaft 130 the gear 125 is driven to drive the gear 126. The liquid lubricant enters the casing 127 from one side and leaves from the other. It may be assumed, for example, that it enters through the opening 135 and leaves through the opening and pipe 136.

It may be noted that the exhaust gases are discharged from the cylinders into a manifold 140 and are lead therefrom through a pipe, not shown.

No attempt has been made to illustrate or describe in detail certain features of the construction, for example, the valves for controlling the inlet of air into the cylinders, the valves for controlling the exhaust of gases from the said cylinders, the nozzles for supplying fuel to the said cylinders, the pumping means for supplying fuel to the manifold 113, the connections between the latter and the nozzles for supplying fuel to the cylinders (the said connections having been omitted), and other details or features of construction which are not essential to the present invention.

The present invention, as has been indicated hereinbefore, has particular relation to the combination of an electric generator and a radial internal combustion engine of the Diesel type, and the adaptation of the one to the other whereby there is produced a single unitary structure in which the combined parts of the structure cooperate in a manner to obtain the result sought most efficiently.

To facilitate the uniting and combining of these two structures, namely, an electric generator and a radial internal combustion engine structure, I have provided a circular casing of a character such that it is adapted to be secured readily to the frame structure of the generator, which casing provides suitable and convenient means whereby water or other cooling medium may be caused to flow about and in contact with the combustion cylinders of the engine. By the means embodying my invention I am enabled to produce a structure which is compact and which for the power capable of being generated thereby occupies a minimum of floor space.

It may be noted that in the operation of the structure the armature 4 operates as a fly wheel for the engine.

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

1. In apparatus for generating electric current, the combination of an electric generator comprising a casing and a shaft, an internal combustion engine supported by said generator casing, said engine comprising cylinders radially arranged, pistons located within and operating in said cylinders, a two-part crank shaft supported in alinement with said generator shaft, said crank shaft having a crank arm provided with a crank

pin which constitutes means for securing the said two parts together, and a plurality of piston rods respectively connected to said pistons, one of said piston rods having a hub provided with an opening through which the crank pin extends and the other of said piston rods having pivotal connection with said hub, the said crank shaft projecting into the casing of said generator, and means for connecting said crank shaft to the shaft of the generator.

2. In apparatus for generating electric energy, the combination of a generator having a casing and a rotatable shaft, a radial internal combustion engine supported in contiguous relation to the said generator, the said engine also having a rotatable shaft, and means for connecting the said shafts together within the casing of the generator.

3. In apparatus for generating electric energy, the combination of an electric generator having a rotatable shaft, an internal combustion engine comprising a plurality of combustion cylinders radially arranged and a hollow annular casing adapted to receive the cylinders of said engine therein, means for mounting the said casing upon the said generator, the said engine comprising a crank shaft located in axial alinement with the said rotatable shaft, and means for connecting the said generator and crank shafts together.

4. In apparatus for generating electric energy, the combination of an electric generator comprising a rotatable shaft having ends, an internal combustion engine having an annular casing mounted upon the said generator, combustion cylinders mounted within said casing and extending radially therein, a crank shaft for the engine located centrally with respect to the said radially arranged cylinders, said crank shaft having ends and a crank arm, and being in alinement with the rotatable shaft of the generator, one end of the crank shaft being in adjoining relation to one end of said rotatable shaft, pistons located in said combustion cylinders and adapted to operate therein, piston rods between said pistons and the crank arm of the said crank shaft, and means for connecting together the said adjoining ends of the said shafts.

5. In apparatus for generating electric energy, the combination of an electric generator having a casing and a rotatable shaft having ends, an annular casing, means for supporting the said annular casing upon the casing of the generator, combustion cylinders mounted within said annular casing and radially arranged therein, a crank shaft supported centrally with respect to the said radially arranged combustion cylinders and having a crank arm and ends, one end of said crank shaft terminating in adjoining relation to an end of the said rotatable shaft of the generator, pistons mounted within said combustion cylinders, a piston rod having inner and outer ends and having direct connection at its inner end with the crank arm of the said crank shaft and at its outer end with a piston in one of the said cylinders, piston rods each having an inner and an outer end, the outer end of each piston rod having connection with a piston in one of the other of said combustion cylinders, and the inner end of each piston rod having pivotal connection with the inner end of the first named piston rod, and means for detachably connecting the said adjoining ends of the said rotatable shaft and the crank shaft.

6. In apparatus for generating electric energy, the combination of an electric generator comprising a casing and a shaft, an internal combustion engine comprising combustion cylinders radially arranged, a hollow annular casing within which the said combustion cylinders are mounted, and a crank shaft, and means for securing the said annular casing upon the casing of the said generator.

7. In apparatus for generating electric energy, the combination of an electric generator comprising a frame structure and a rotatable shaft having inner and outer ends, the inner end of the said shaft terminating within the said frame structure in a flared opening, a radial internal combustion engine structure mounted upon the frame structure of the generator, the said engine structure comprising a crank shaft having inner and outer ends, the inner end of which projects into the flared opening in the inner end of the rotatable shaft, and means extending axially of the said shafts for connecting them together.

8. In apparatus for generating electric energy, the combination of an electric generator comprising a casing and a rotatable shaft having inner and outer ends, the inner end of said shaft terminating in a flared portion having a socket therein, a radial internal combustion engine structure mounted upon the casing of the said generator, the said engine structure comprising a rotatable crank shaft having inner and outer ends, the inner end of which terminates in a tapered portion which projects into the socket of the said rotatable shaft, means for preventing relative rotation between the crank and rotatable shafts, and means for securing the engaged ends of the said shafts together.

9. In apparatus for generating electric energy, the combination of an electric generator comprising a casing and a rotatable shaft having inner and outer ends, the inner end of which terminates within said casing, a radial internal combustion engine structure supported by said generator casing, the said engine structure comprising a crank shaft having inner and outer ends and being in axial alinement with said rotatable shaft, the inner end of the said crank shaft terminating in adjoining relation to the inner end of the said

rotatable shaft, means for causing rotation of the said crank shaft, and means for connecting the inner end of the crank shaft to the adjoining inner end of the said rotatable shaft whereby rotation of the said crank shaft causes rotation of the said rotatable shaft.

10. In apparatus for generating electric energy, the combination of an electric generator comprising a casing, a rotatable element within the said casing, a rotatable shaft for supporting the said rotatable element, said shaft having inner and outer ends, the inner end terminating within the said casing, a radial internal combustion engine supported in contiguous relation to the said generator, said engine having a crank shaft in alinement with said rotatable shaft, said crank shaft having inner and outer ends, the inner end extending into the casing of the generator and being in engagement with the inner end of the said rotatable shaft, and means for holding the said rotatable and crank shafts in united relation to each other whereby upon rotation of the said crank shaft rotation of the rotatable shaft is effected.

11. In apparatus for generating electric energy, the combination of an electric generator having a casing, a rotatable element, and a rotatable shaft for supporting the said rotatable element, said shaft having inner and outer ends, the inner end terminating within said casing, a radial internal combustion engine structure located in contiguous relation to the said generator, said structure comprising a crank shaft in alinement with the said rotatable shaft, said crank shaft having inner and outer ends, the said inner end projecting into the casing of the said generator, a bearing provided in the said casing for supporting the inner end of the said crank shaft, the inner end of the said rotatable shaft engaging with the inner end of the crank shaft, and means for fastening the said ends together.

12. In apparatus for generating electric energy, the combination of an electric generator having a casing and a rotatable shaft having inner and outer ends, the inner end terminating within the said casing and being provided with a socket extending axially thereof, and the said shaft also having a hole extending axially therethrough, a radial internal combustion engine structure located in contiguous relation to the said generator, said engine structure having a crank shaft having inner and outer ends, the inner end projecting into the said generator casing, a bearing provided in the said casing for supporting the inner end of the said crank shaft, the inner end of the said crank shaft projecting into the socket of the said rotatable shaft, means extending through the axial opening in the said rotatable shaft and engaging the inner end of the said crank shaft within the said socket for connecting the said shafts together, means for preventing relative rotation of the said shafts, and means for effecting rotation of the crank shaft whereby rotation of the rotatable shaft is effected.

13. In apparatus for generating electric energy, the combination of an electric generator structure having a rotatable shaft, a radial internal combustion engine comprising combustion cylinders, a hollow casing of annular shape in which the said cylinders are located and a crank shaft, means for securing said hollow casing upon the said generator structure whereby the said engine is supported by said structure, and means for connecting together the said shafts.

14. In apparatus for generating electric energy, the combination of an electric generator having a casing, which casing includes an inner end wall, an internal combustion engine comprising combustion cylinders and an annular casing in which the said cylinders are mounted, a plate secured to said annular casing, a crank shaft, means for securing the said annular casing to the said inner end wall of the said generator casing, and crank shaft bearings provided respectively in the said plate and in the said inner end wall of the said generator casing.

15. In apparatus for generating electric energy, the combination of an electric generator and a casing therefor, an internal combustion engine mounted in contiguous relation to said generator casing, said engine comprising combustion cylinders, an annular casing in which the said cylinders are mounted, a crank shaft, and bearings for said crank shaft, one of said bearings being formed in the said generator casing.

16. In apparatus for generating electric energy, the combination of an electric generator having a casing and a rotatable shaft, an internal combustion engine comprising combustion cylinders, an annular casing in which the combustion cylinders are mounted, a crank shaft, means for connecting said rotatable and crank shafts together within the casing of the generator, a plate secured to the said annular casing, and bearings for the said crank shaft formed respectively in said plate and in the said generator casing.

17. In apparatus for generating electric energy, the combination of an electric generator having a casing provided with an inner end wall and a rotatable shaft having inner and outer ends, the inner end terminating within the said casing in adjoining relation to the said inner end wall, an internal combustion engine comprising combustion cylinders, an annular casing in which the combustion cylinders of said engine are mounted, a two-part crank shaft for said engine having two crank arms and also having inner and outer ends, and a crank pin which connects the crank arms and which constitutes means for securing the said parts

together, the inner end of the said two-part crank shaft projecting through the said inner end wall of the said generator casing, means for securing said annular casing to the inner end wall of the said generator casing whereby said engine is supported by said generator casing, a plate secured to the said annular casing, means for securing together the inner ends of the said rotatable shaft and crank shaft, and bearings for said crank shaft formed in said plate and in the inner end wall of the said generator casing.

In testimony that I claim the foregoing as my invention, I have hereunto signed my name this 25th day of April, A. D. 1927.

OTIS D. TREIBER.