April 26, 1927. 1,625,790

C. P. BROCKWAY

TWO-CYCLE ROTARY PLANT

Filed July 27, 1921 3 Sheets-Sheet 1

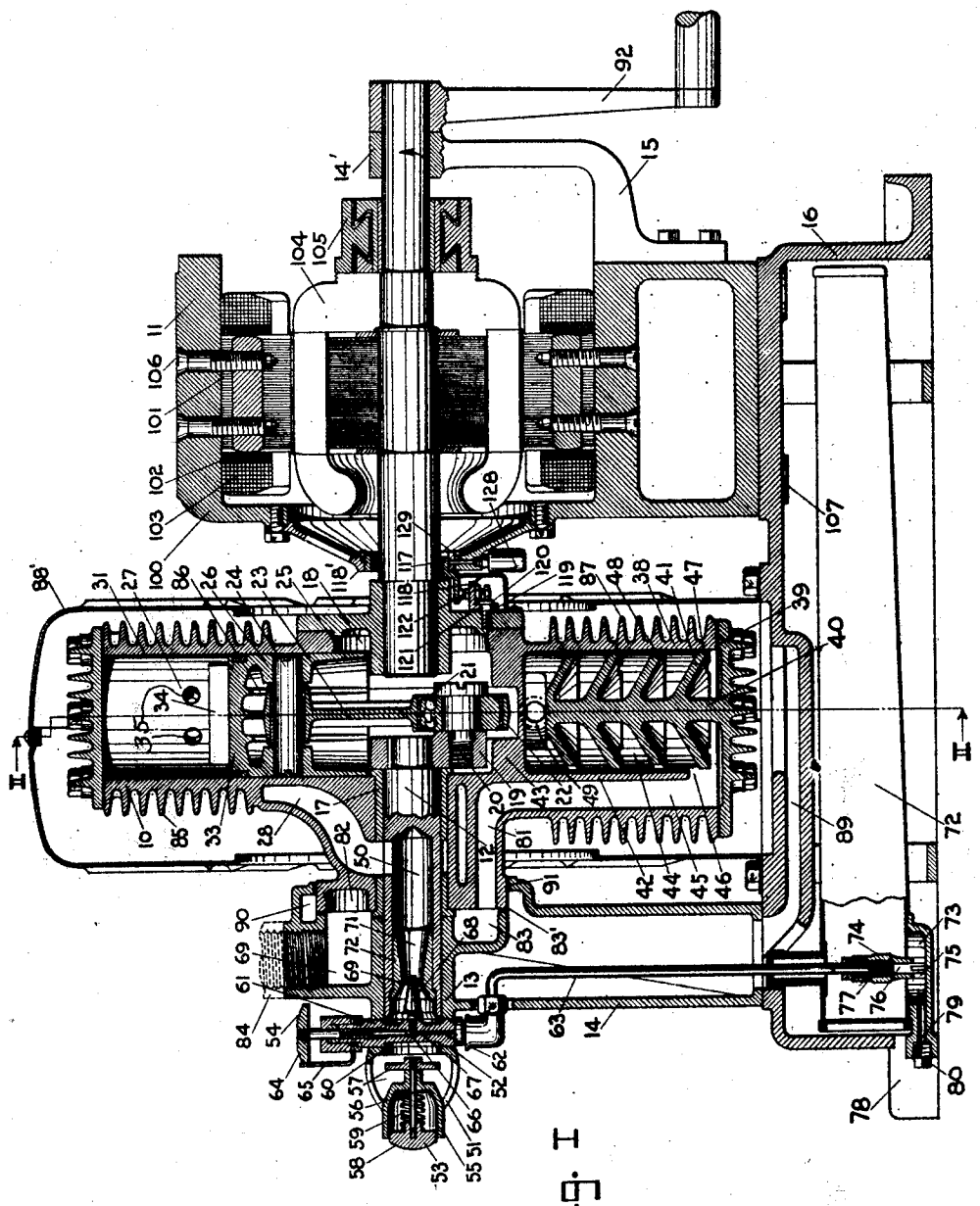


Fig. I

INVENTOR.
Carl P. Brockway
BY Chester H. Braselton
ATTORNEY

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Fig. III

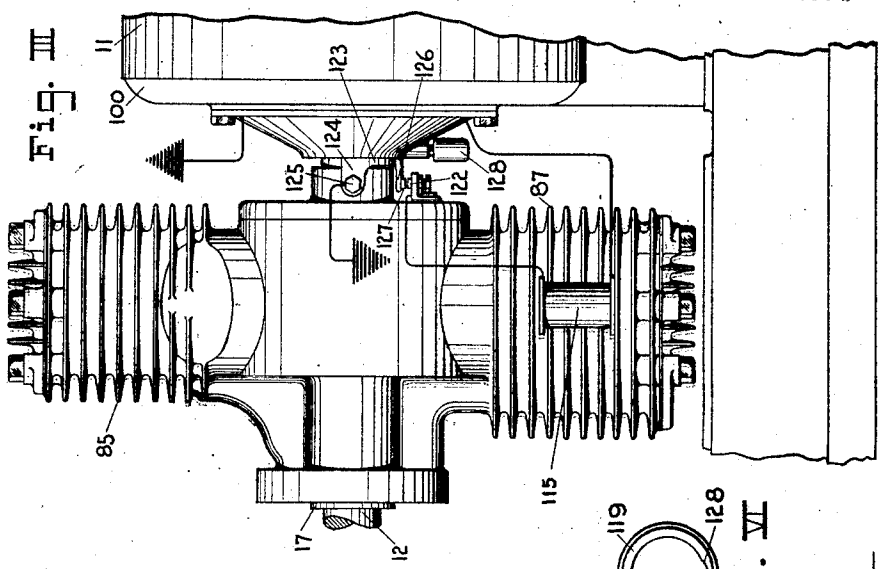
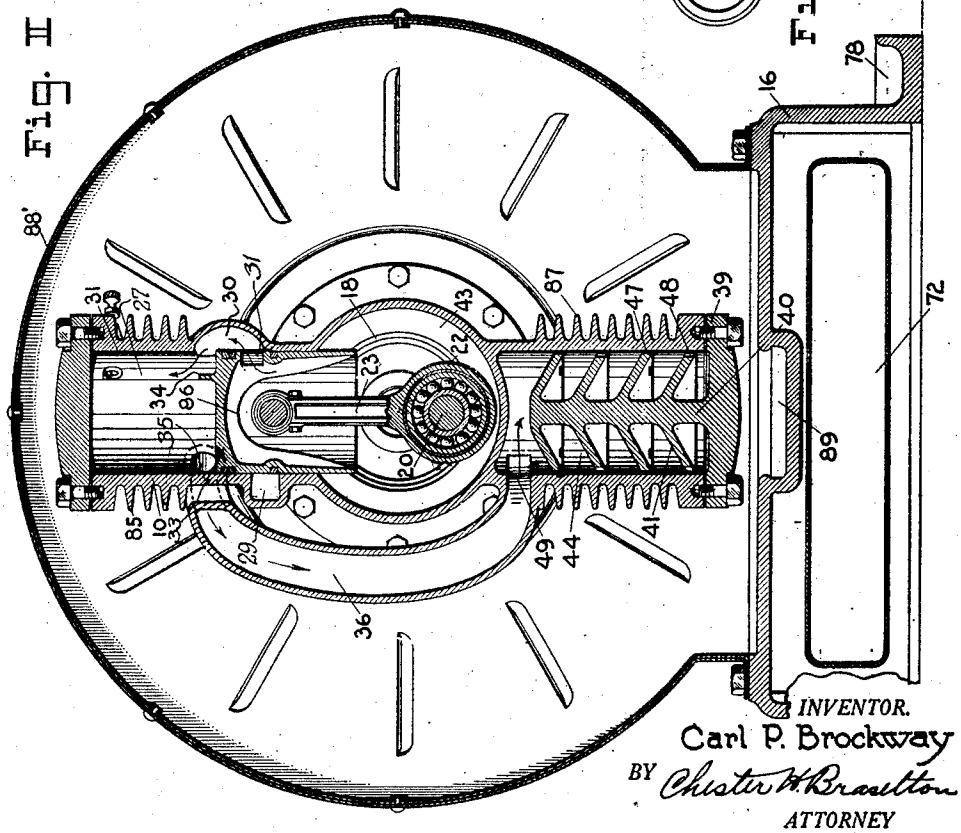


Fig. VI

Fig. II



INVENTOR.
Carl P. Brockway
BY Chester H. Braselton
ATTORNEY

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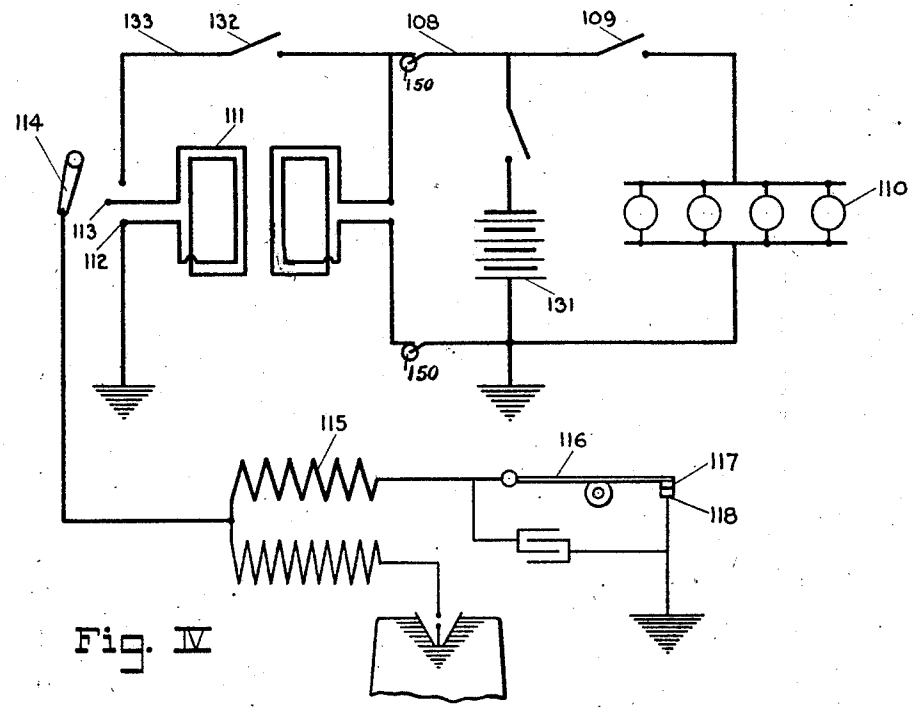


Fig. IV

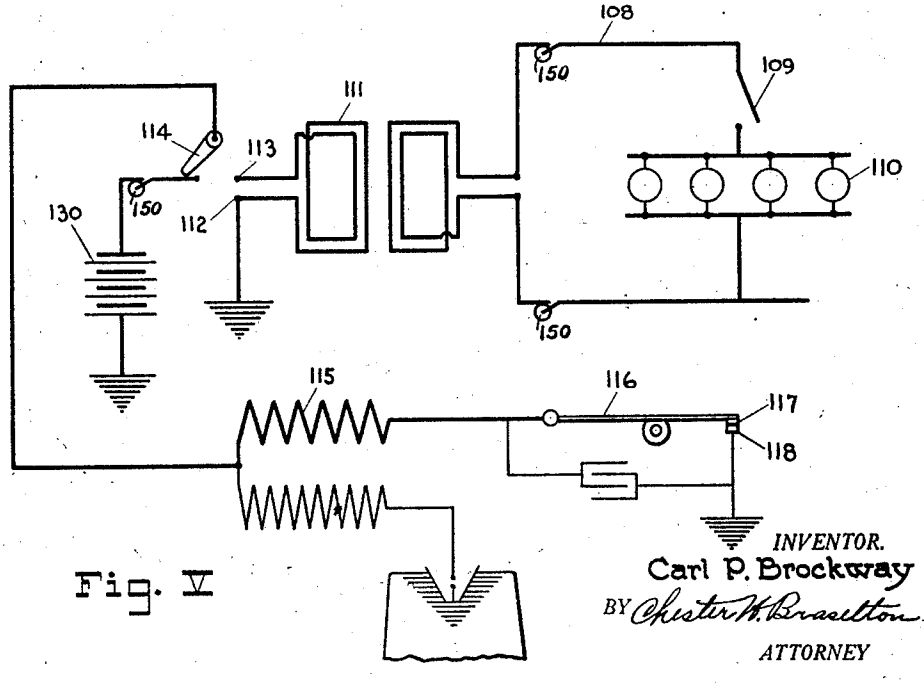


Fig. V

INVENTOR.
Carl P. Brockway
BY Chester K. Brasellton
ATTORNEY

Patented Apr. 26, 1927. 1,625,790

UNITED STATES PATENT OFFICE.

CARL P. BROCKWAY, OF TOLEDO, OHIO, ASSIGNOR TO INDUSTRIAL RESEARCH CORPORATION, OF TOLEDO, OHIO, A CORPORATION OF DELAWARE.

TWO-CYCLE ROTARY PLANT.

Application filed July 27, 1921. Serial No. 487,974.

This invention relates to rotary engines of the internal combustion type, and contemplates the utilization of improvements in both the electrical and mechanical elements of this type of power mechanism.

An object of the invention is the provision of a muffler as a counterbalancing unit for a single cylinder gas engine thereby facilitating the employment of air cooling.

Another object is to provide means which will permit of a free nonfrictional joint between the rotatable muffler member and the non-rotatable member.

Still another object is the utilization of exhaust gases in a rotary engine for heating the intake gases.

An object also of the invention is the provision of electrical contact members in the ignition system which are operable by centrifugal means thus having particular utility in connection with rotary engines.

The invention also has for an object the utilization of a current source connected with the dynamo-electric machine which may have a voltage different from that of the dynamo and at the same time be normally independent of battery units.

An object also is the utilization of the so-called dead-coil space in a dynamo for ignition purposes.

A further object is to provide means for cooling the engine bearing by means of the intake gases.

An object also is the provision of an engine piston having internal heat radiating ribs.

Further objects and objects relating to economies of manufacture and details of construction will become apparent as the description of the invention proceeds.

A preferred embodiment of the invention is illustrated in the accompanying drawings wherein—

Figure I is a vertical section of the combined engine and dynamo unit taken through the shafting;

Figure II is a section through the engine along lines II—II of Figure I;

Figure III is a view showing the timing device in position on the engine;

Figure IV is a wiring diagram of the electrical connections including a floating battery unit;

Figure V is a wiring diagram of the electrical connections as ordinarily employed; and

Figure VI is a detail view of the ignition camming unit.

Referring to Figure I the combined power unit is shown as including a rotary engine 10 and a dynamo-electric machine 11 both of which are interconnected and in axial alignment; the engine having support through the stationary crank shaft 12, bearing 13, standard 14, and the dynamo having support through the bearing 14′, and standard 15 upon the common base 16.

The engine is rotatably mounted through the bushing 17 upon the stationary crank shaft 12 which extends into the crank case 18 of the engine. The crank shaft carries on the crank case end the crank arm 19 to which, by means of the screw 20, the roller bearing 21 of the connecting rod head 22 is attached.

The connecting rod 23 is rotatably mounted on the wrist pin 24 which pin has a pivoted bearing in the skirt 25 of the piston 26 so that rotation of the engine about the fixed crank shaft bearing will, by reason of the offset crank arm pivot 21, cause recurring reciprocation of the piston in the explosion chamber 27.

The engine is of the two cycle type and has an intake passage 28 which communicates with an inlet port 29 in the crank case so positioned that when the piston is in its upper position the port is exposed to the crank case interior permitting inflow of fuel gases. A conduit 30 is formed in the cylinder wall 31 having a lower and upper outlet so positioned that when the piston is in its lowermost position the lower outlet registers with the port 32 cut in the piston skirt 25 and the upper outlet opens into the explosion chamber 27 above the piston head 33. It is apparent therefore, that when the piston is in the lowermost position unburned gas is entering the explosion chamber from the crank case through conduit 30. A deflector 34 of conventional design is utilized to give the incoming gas an upward movement.

The outlet or exhaust port 35 is so placed in the engine wall that when the piston is at its lowermost position the port is completely

uncovered. A pipe 36 conducts the expelled gases to the muffler 37 which will now be described.

The muffler 37 is designed to form a counter weight for the engine cylinder 31 and inclosed piston 26. For this purpose the muffler cylinder 38 is formed as an extension of the engine crank case 18 and is positioned on the side of the engine axis opposite the engine member. The muffler has a mass approaching in value that of the engine member and includes in addition to the cylindrical wall 38, a head 39 to which is integrally secured an inwardly projecting central post 40 having outwardly and laterally extending partition plates 41 fixed thereto at approximately regular intervals. An outwardly projecting plate 42 extends from the closed inner end 43 of the muffler to a point adjacent the muffler cylinder head 39 thus dividing the muffler cylinder radially into a larger chamber 44 and smaller chamber 45 connected by a passageway 46. The chamber 44 is preferably cylindrical in transverse section and the plates 41 conform in outline to the interior of the chamber, their edges approaching the chamber wall but terminating at a distance therefrom so that an annular passageway 47 around each plate is formed. In addition passages 48 are cut in the various plates at points which do not register radially in successive plates. The exhaust pipe 36 connects with a port 49 opening into the inner end of the muffler chamber 44.

The gas mixing and intake chambers and valves are positioned in and adjacent the crank shaft member. For a portion of its length exterior to the engine crank case and within the bearing 13, the crank shaft 12 is hollowed, the inner end of the hollowed portion 50 connecting with the intake conduit 28 and the outer end opening into exterior ports 51 cut into a cap 52.

An air valve 53 and a fuel valve 54 are connected to the intake chamber 50. The cap 52 carries a cup member 55 opening axially and outwardly in which is slidably mounted a valve stem 56 carrying a valve member 57 and a push button 58 and a coil spring 59 so mounted as to urge normally the valve member in an outer direction. The valve member 57 is designed to engage in a valve seat 60.

Adjacent the air valve seat 60 and inwards thereof is a transverse post 61 having a conduit 62 therein which connects at its lower end with the fuel pipe 63. The upper portion of the post 61 retains the fuel valve 54 which is shown as a screw valve having a thumb head 64 and a setting plate 65 contacting with the periphery of the thumb head. The pointed end 66 of the fuel valve contacts in a seat 67 about midway the post 61 and an outlet conduit 68 is here attached which extends axially within the intake chamber to a point beyond the most contricted section 69 of a Venturi tube 70. The portion 71 of the Venturi tube and the hollow inner portion 50 of the crank shaft form the mixing chamber for the engine.

The fuel pipe 63 extends into a tank 72 placed in the base 16. Directly beneath the fuel pipe terminal in the tank 12 the base of the tank is lowered as at 73 and a sleeve 74 fixed to the fuel pipe terminal and having its lower end slotted as at 75 rests upon the lowered base 73 of the tank. The sleeve 74 is also provided with an inlet valve 76 which is held in a normally closed position by means of a spring 77. The lower portion 73 communicates with an external oil drain 78 by means of a drain conduit 79 which latter is ordinarily closed by means of a plug 80.

The chamber 45 extends radially toward the engine shaft and is then offset axially as at 81 terminating in an annular U-shaped channel 82 opening outwardly and axially from the engine. The channel 82 registers with a similar U-shaped channel 83 fixed to the bearing 13, the edges of the channels being adjacent, the inner edges contacting and the outer edges 83′ being sufficiently separated to form a non-frictional joint thereby permitting passage of gases therethrough. In the channel 83 the stationary exhaust port is formed to which the exhaust pipe 84 is secured.

The cooling features include means for directly cooling the engine explosion chamber and piston and means for cooling the exhaust gases prior to the passage thereof past the engine bearing.

The explosion chamber cooling is provided for in transverse fins 85 formed integral with the cylinder casing exterior. Rotation of this cylinder cools it through well known laws of conduction and radiation.

Piston cooling is provided for in ribs 86 formed integral with the inner surface of the piston head 33 and extending radially on the inner surface of the piston skirt. In this arrangement the cool crank case gases moving up along the heated piston walls and head to the port 32 absorb heat therefrom.

The exhaust gases are cooled by conduction and radiation from transverse fins 87 formed integrally with the walls of the muffler cylinder. In addition the heated gases expand into the muffler chambers 44 contacting with the partition surfaces 47 releasing heat thereto which in turn is conducted to the muffler head and radiated.

In order to prevent largely the escape of gases from the muffler into the atmosphere immediately about the engine through the open joint between the rotary and stationary parts of the engine, utilization is made of the air pressure developed through the rotation of the engine unit in a drum shaped

casing 88 which communicates, by means of a conduit 89 in the base, with the hollow standard 14. From the standard 14 an annular channel 90 leads around the exhaust channel 83 and the loose joint 83′ between the registering channels 82 and 83, the inner edge 91 of the channel 90 having a close but small frictional bearing on the channel member 82.

It is apparent that the air pressure developed in the engine casing is transmitted to the annular joint 83′ thus tending to prevent egress of exhaust gases at this point and thus making possible a non-contacting joint between the heated rotating member and non-rotating channel members 82 and 83. Further, the air pressure developed forces some air through the joint 83′ which air being relatively cool and mixing with the exhaust gases, tends to diminish the temperature of the same thereby preventing excess heat at the rotating bearing 17. It should be also noted that the passage of the heated exhaust gases about the intake chamber heats the same thereby permitting ready combustion of the intake gases.

The electrical features of the unit include a dynamo-electric machine for power purposes and an ignition system for the engine.

The dynamo-electric machine 11 is generally of conventional design and includes a frame 100, laminated field poles 101, shunt field winding 102, series field winding 103, armature 104 and commutator 105. The field poles are retained by screws 106 and the dynamo frame secured to the base 16 by screws 107. From the commutator connection is made through the power circuits 108, and switch 109 to the load 110 as indicated diagrammatically in Figure V.

The ignition is not taken from the dynamo mains since for reasons of efficiency the dynamo voltage is at a higher value than is ordinarily usable with the ignition coils and contacts employed. Utilization is therefore made in the igniton system of an extra coil 111, Figure V fixed in the armature in the usual way and subject to the dynamo field, but entirely disconnected from the main dynamo-circuit. One terminal 112 of the coil 111 is grounded and the other terminal 113 leads through the switch 114, ignition coil 115, and interrupter 116 to ground. A condenser 117′ is shunted around the interrupter.

The interrupter 116 combines two contact members 117 and 118 fixed to the rotatable engine and a cam member 119 fixed to the dynamo frame 100. The non-movable contact member 118 includes a bracket 118′ fastened to the engine by screw 120 and separated from the engine by insulation 121. A contact element 122 is affixed to the plate. The movable contact member 117 includes a stirrup form member 123 having a pivot arm 124 pivotally mounted on the engine at 125 and a contact arm 126 to which a contact element 127 adapted to contact with the contact element 122 is secured.

The cam member 119 shown in Figures I, III and VI is in the form of a collar preferably of fibre wherein a portion is cut away on its inner surface as at 128. The contact member 123 rides on the inner surface of the collar and it is apparent that when it passes over the cut out portion 128 of the cam the contact member moves outwardly, impelled by centrifugal force, thereby permitting the contact elements 122 and 127 to make contact. It is of course evident that auxilary means such as spring devices may be utilized to normally impel the cam member outwardly but these devices are not essential. An oil cup 150 having an oil conduit 129 is employed to oil the cam surfaces.

During starting, while for some designs of units the speed of the dynamo develops a sufficient voltage for ignition in others it is desirable that additional means be provided and in Figure V, I have shown diagrammatically as connected to the ignition system a small ignition battery 130 which is connectible to the ignition circuit by means of the switch 114 above mentioned. With this arrangement in case the dynamo fails to develop the proper voltage the switch 114 is connected to the battery thereby securing proper ignition current for starting.

Figure IV shows a modified electrical arrangement wherein a storage battery 131 is floated from the dynamo mains 108 and a connection made between the switch 114 and dynamo main 108 through a switch 132 and circuit 133. In this arrangement at starting the storage battery is utilized for ignition through switches 114 and 132 and connection 133. Subsequently in case the battery or main dynamo circuits are broken, ignition may still be obtained through the auxiliary coil circuit 111 as described with reference to Figure V.

The operation of the gas engine as described is as follows. Starting is secured by energizing the dynamo as a motor if a storage battery is floating on the mains or by means of the hand crank 92. Rotation of the engine causes a flow of air through the intake Venturi tube thus increasing the suction therein caused initially by the piston movement.

Suction in the intake draws up fuel through the inlet pipe 63 into the mixing chamber and the mixed air and fuel is then drawn into the engine crank case in the usual way.

Compression of the crank case gases occurs when the piston descends and when the port 32 registers with the conduit 30

gas flows along the piston wall and head cooling the same.

Subsequent to explosion the exhaust gases pass into the muffler wherein after successive expansions the gas is expelled through the annular channel 83 about the intake and into the exhaust pipe 84.

The rotation of the coil 111 in the dynamo field produces an alternating flux in the ignition circuit, which latter is successively opened by the interrupter at the point of compression when the current value approaches a maximum value thus giving proper ignition to the engine.

It should be noted that the electrical coil apparatus is designed to rotate with the engine unit except in the cases where an auxiliary battery are provided. In these arrangements connection between the rotating and stationary circuits may be made by rotary contacts 150 as diagrammatically indicated in Figures IV and V and the ignition coil positioned at any suitable stationary point in the circuit intermediate the battery and engine.

Having thus described the invention I desire to claim for Letters Patent:

1. In a rotary gas engine a muffler therefor, said muffler comprising a primary and secondary chamber radially extending from the engine axis, the primary chamber being adapted to conduct exhaust gases away from the engine axis and the secondary chamber being adapted to conduct exhaust gases toward the engine axis.

2. In combination, a rotatable muffler and stationary means for conducting gases from said muffler.

3. In a rotary engine, the combination of a rotary muffler; a stationary outlet for the muffler; and means for accelerating movement of gases through said outlet and from said muffler.

4. In a rotary engine, the combination of a rotary muffler; a stationary outlet for the muffler; and means dependent for operation on the rotation of the engine for accelerating movement of gases through said outlet and from said muffler.

5. In a rotary engine, the combination of an exhaust muffler and a plurality of outlets from said muffler, one of said outlets being normally maintained in an inoperative condition while the engine is running.

6. In a rotary engine of the internal combustion type, an intake conduit connected thereto, and an exhaust conduit surrounding said intake conduit.

7. In a rotary engine of the internal combustion type, the combination of a stationary crank shaft; an intake conduit in the crank shaft and an exhaust conduit surrounding the crank shaft.

8. In a rotary engine, the combination of a crank shaft, a power cylinder mounted rotatably on said shaft, a muffler cylinder also rotatably mounted on said shaft in opposition to the power cylinder, a piston movable in said power cylinder and connected to the crank shaft, a fuel supply, means for feeding fuel to said power cylinder, an exhaust conduit intermediate the power cylinder and muffler, and stationary means for removing the exhaust gases from said muffler.

9. In a rotary engine, the combination of a crank shaft, a power cylinder mounted rotatably on said shaft, a muffler cylinder also rotatably mounted on said shaft in opposition to the power cylinder, a piston movable in said power cylinder and connected to the crank shaft, a fuel supply, means for feeding fuel to said power cylinder, an exhaust conduit intermediate the power cylinder and muffler, stationary means for removing the exhaust gases from said muffler, and means for preventing leakage of exhaust gases between the muffler and said stationary removing means.

10. In a rotary engine, the combination of a crank shaft, a power cylinder mounted rotatably on said shaft, a muffler cylinder also rotatably mounted on said shaft in opposition to the power cylinder, a piston movable in said power cylinder and connected to the crank shaft, a fuel supply, means for feeding fuel to said power cylinder, an exhaust conduit intermediate the power cylinder and muffler, a stationary exhaust conduit, an open connection between said conduit and muffler, and means for preventing leakage of exhaust gases through said connection.

11. In a rotary engine, the combination of a crank shaft, a power cylinder mounted rotatably on said shaft, a muffler cylinder also rotatably mounted on said shaft in opposition to the power cylinder, a piston movable in said power cylinder and connected to the crank shaft, a fuel supply, means for feeding fuel to said power cylinder, an exhaust conduit intermediate the power cylinder and muffler, a stationary exhaust conduit, an open connection between said conduit and muffler, and means for preventing leakage of exhaust gases through said connection, said means including an air compressor and a conduit for leading compressed air to said connection.

In testimony whereof, I affix my signature.

CARL P. BROCKWAY.