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W. L. SHEPARD.

HYDROCARBON ENGINE.

APPLICATION FILED SEPT. 19, 1917.

1,347,762. **Patented July 27, 1920.**

3 SHEETS—SHEET 1.

Fig. 1.

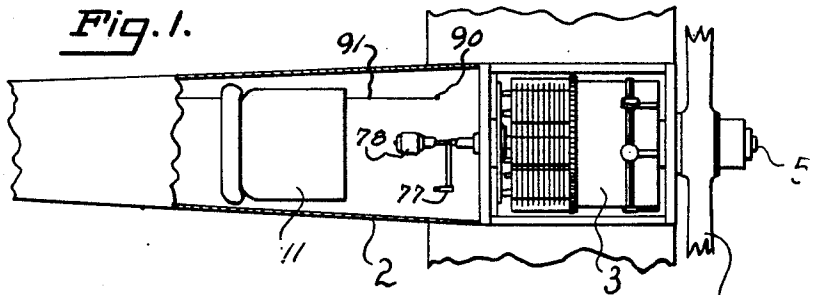


Fig. 2.

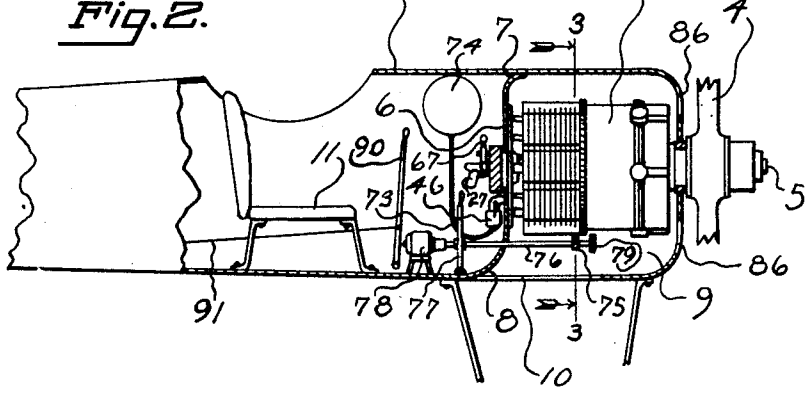


Fig. 8.

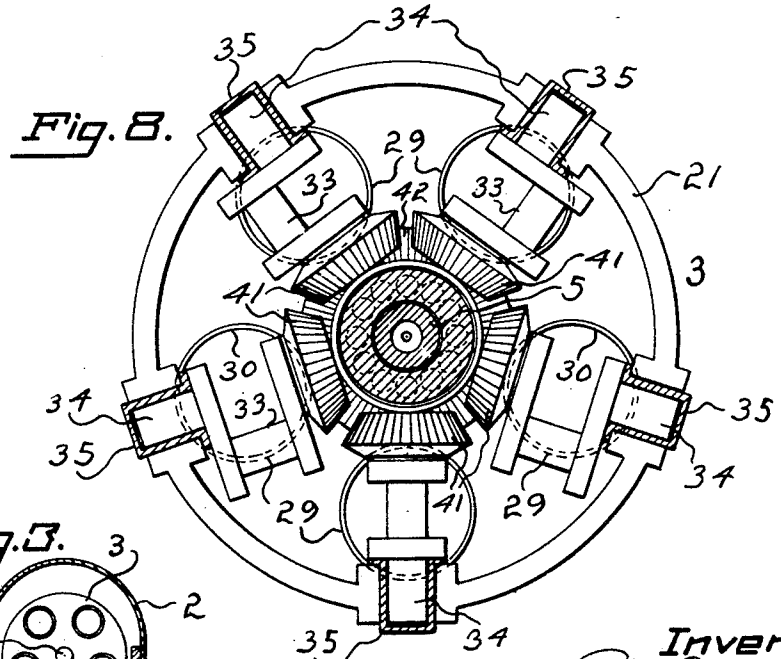
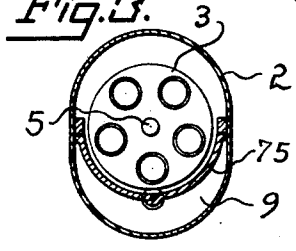


Fig. 3.



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3 SHEETS-SHEET 2.

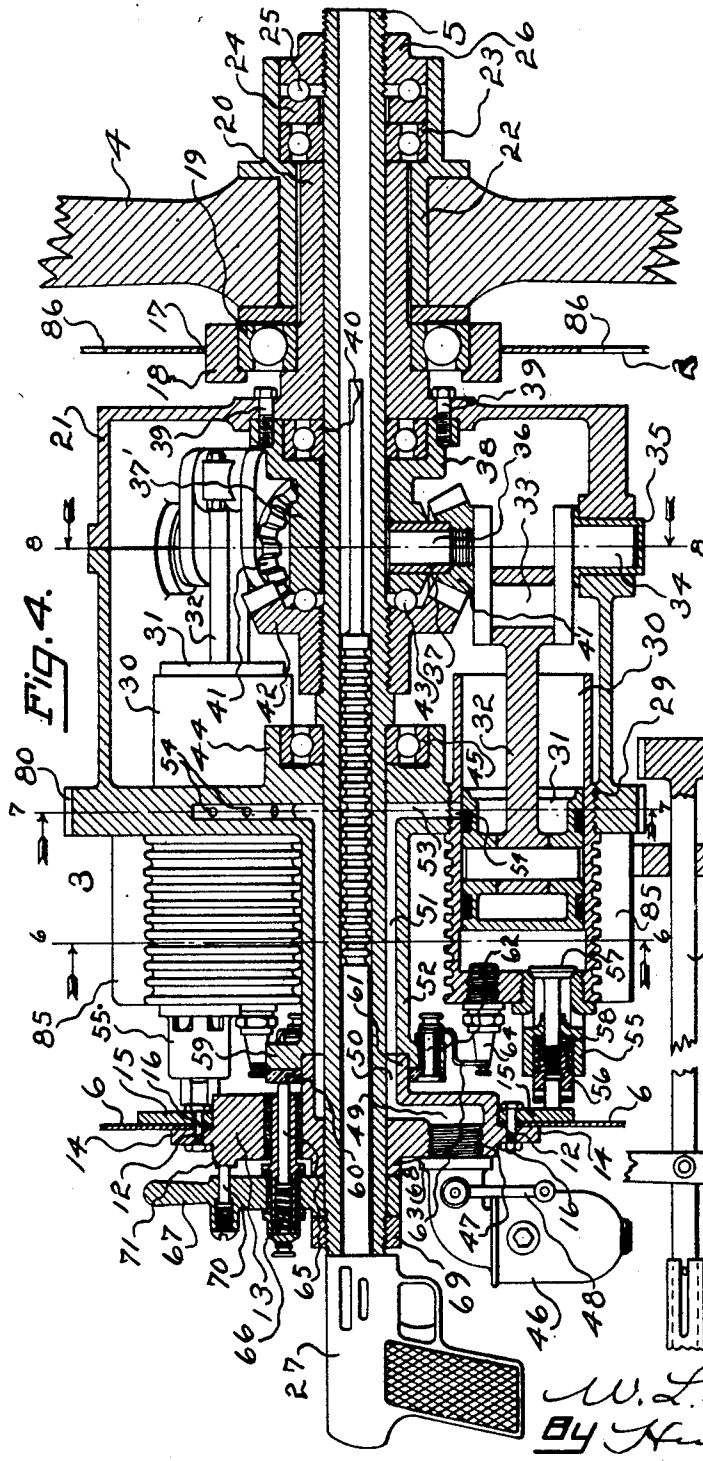


Fig. 4.

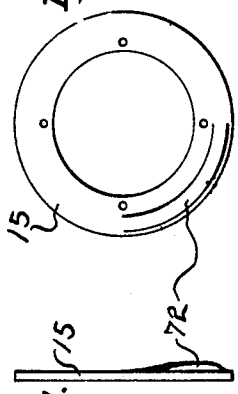


Fig. 10.

Fig. 9.

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3 SHEETS—SHEET 3.

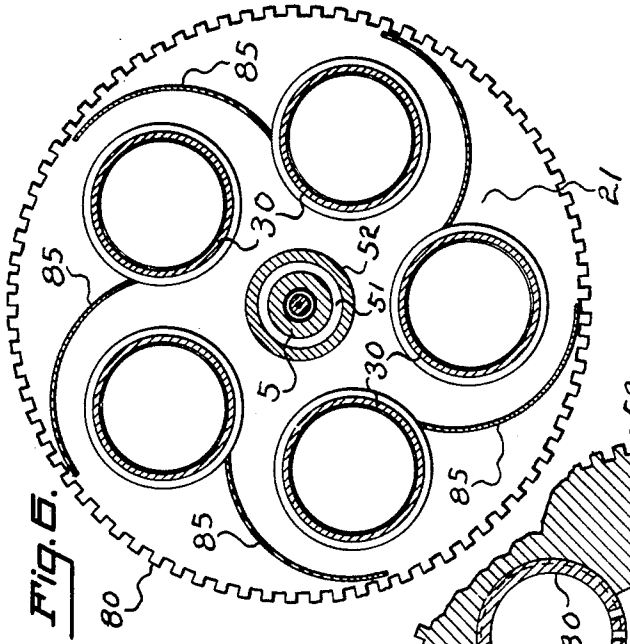


Fig. 6.

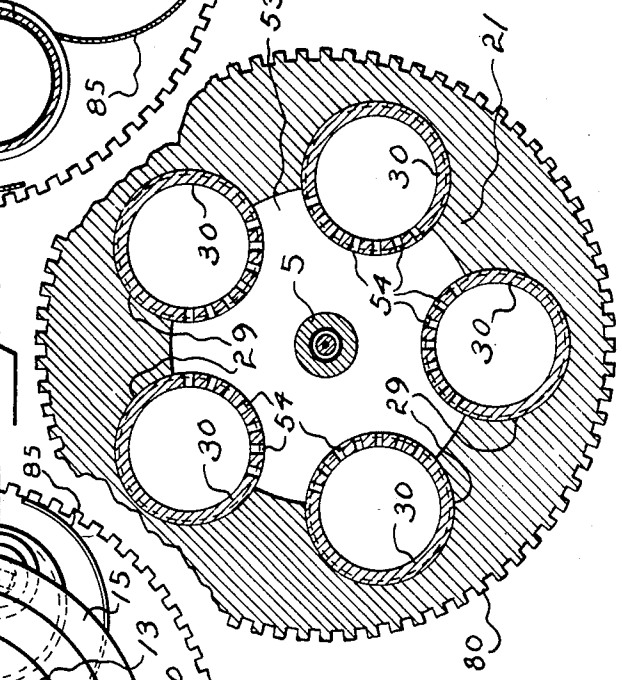


Fig. 7.

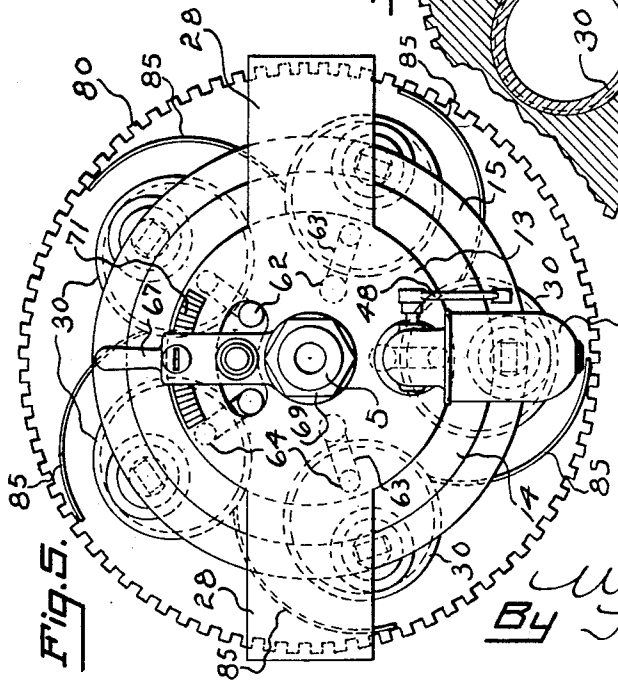


Fig. 5.

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UNITED STATES PATENT OFFICE.

WILBUR L. SHEPARD, OF ELMWOOD, CONNECTICUT, ASSIGNOR TO THE WORLD GAS ENGINE COMPANY, OF HARTFORD, CONNECTICUT, A CORPORATION OF MAINE.

HYDROCARBON-ENGINE.

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Application filed September 19, 1917. Serial No. 192,062.

To all whom it may concern:

Be it known that I, WILBUR L. SHEPARD, a citizen of the United States, residing at Elmwood, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Hydrocarbon-Engines, of which the following is a specification.

This invention relates to what I shall for convenience term a "hydrocarbon engine." The title as observed is selected for convenience, because hydrocarbon is merely one fluid which can be utilized for the proper action of the appliance. It is conceivable in fact that the structure may be used otherwise as an engine. When the appliance is used as a motor, it is susceptible of advantageous use in various connections, although it is of particular utility and will be hereinafter described in fact, as a means for the propulsion of an aeroplane. I have a number of elemental motives in view, among them being the provision of a structure which is exceedingly compact and which is accurately balanced, which latter is a consideration of great importance when the device is installed upon an aeroplane.

In the drawings accompanying and forming part of the present specification I have shown in detail a form of embodiment of the invention which to enable those skilled in the art to practise the same will be set forth fully in the following description. I do not restrict myself to this particular disclosure; I may depart therefrom in several respects within the scope of the invention defined by the claims following said description.

Referring to said drawings:

Figure 1 is a top plan view partly in section of part of the car and certain adjunctive portions of an aeroplane furnished with an engine involving the invention.

Fig. 2 is a side elevation partially in longitudinal section of the same.

Fig. 3 is a cross section on the line 3—3 of Fig. 2, looking in the direction of the arrows.

Fig. 4 is a longitudinal section of the engine with certain of its adjuncts.

Fig. 5 is an elevation as seen from the left in Fig. 4 with the gun removed.

Figs. 6, 7 and 8 are transverse sections on the lines 6—6, 7—7 and 8—8 respectively of Fig. 4, looking in the direction of the arrows touching the several lines.

Fig. 9 is a side elevation, and

Fig. 10 is a front view of a cam ring.

Like characters refer to like parts throughout the several views, which it will be noted are on different scales.

I have already alluded to the fact that while the structure is eminently desirable when employed as a propelling medium, it is susceptible of use in widely different connections. I will assume that hydrocarbon, what is known as "gasolene," answering satisfactorily in this particular, is utilized as the agent to effect the action of the engine. I have already referred to the fact that the device when used as an engine can be employed in different ways. It has been found as I have already stated of particular usefulness to effect the movement of an aeroplane. In Figs. 1 and 2 I have shown partly and have denoted by 2 the car of such an appurtenance, the car supporting within it the hydrocarbon engine denoted in a general way by 3. At the front of the car is a propeller 4, and the engine 3 is provided in the showing made, to effect the rotation of this propeller. The propeller, although it rotates about a horizontal axis or one normally so, might easily be otherwise disposed; there might in fact be several of the propellers.

The engine includes as shown in its structure a shaft as 5, this shaft in the present case being both stationary and hollow, that is stationary or fixed with respect to the body 2. The body 2 has near its front end the division piece 6 which is usually made of comparatively thin sheet metal, the upper and lower ends of the division piece or plate 6 being forwardly and rearwardly directed as at 7 and 8 respectively, these portions 7 and 8 being united to the hull and roofed parts of the forward inclosed part of the car 2 to thus provide a chamber 9 (Fig. 2) in which the engine 3 is situated. The keel

portion of the car 2 has an outlet or opening 10 for the passage of the exhaust gases from the engine, so that these gases will not be conducted into the face of the aviator occupying the seat 11 back of the wall or plate 6. This wall or plate 6 has a substantially central opening 12 (Fig. 4) to receive the bearing 13 which snugly fits the opening and which has a circumferential annular flange 14 fitted flatwise against the rear face of the plate 6.

On the front or forward face of said plate 6 is situated a ring 15, the purpose of which will be hereinafter described, the ring and bearing being united together for instance by screws 16, of which there may be any desired number, this ring also closely fitting the forward portion of the bearing 13. Obviously the bearing is stationary, and it receives and thus supports the hollow or tubular shaft 5, to which I have already referred, the latter as also shown in said Fig. 4 extending rearwardly beyond the bearing. The shaft in question also extends entirely through the chamber or compartment 9 and projects through the front of the car. The front or bow portion of the car has an opening 17 in which the ring 18 is tightly fitted. In this ring is mounted an anti-friction bearing 19 which surrounds the tubular forwardly extending portion 20 of the casing 21, the latter and hence the forwardly extending portion or hub 20 being rotative. This forwardly extending portion or hub surrounds the stationary hollow shaft 5 and it also extends into the central opening of the propeller 4. In said central propeller opening is fitted the elongated sleeve 22 in the forward enlarged portion of which is the anti-friction bearing 23, the inner race member of which is fixed to the forward portion of the hollow shaft or tube 5. Abutting against the anti-friction bearing 23 and surrounding the tubular or hollow shaft 5 is the bearing member 24 which turns around said hollow shaft and which has a groove to receive the balls 25 fitting a complemental groove or race in the bearing member 26 which may for instance be threaded onto the forward end of said hollow shaft. I thus provide means for taking up radial and forward thrusts of said shaft. The shaft is, therefore, supported in a stable and substantial manner near its extremes. It is surrounded between its ends by the rotary casing or housing 21, to which I have already referred.

There is a motive in making the shaft 5 hollow. Said shaft 5 may present a receiver for the gun 27 which may be the so-called Lewis gun, the barrel of the gun being insertible into the hollow shaft by way of the rear end thereof. The stock or handle portion of the gun is at the rear end of the shaft and is thus within convenient reach of the aviator occupying the seat 11. For additional strength the bearing 13 to which I have already referred, may be provided with lateral arms or branches 28 connected at their outer ends to the sides of the car 2 inside the same just in front of the aviator. The engine structure is thus properly supported within the car 2.

The casing 21 is practically cylindrical, having in addition to its body a forward wall centrally from which the hub 20 already described extends. The rear wall of the casing 21 has several openings as 29 seen for instance in Fig. 4. The walls of these openings 29 as will be seen upon inspection best of Fig. 4, are threaded to be engaged by external threads upon the respective cylinders 30; as a consequence the cylinders are removably mounted. There may be any desirable number of said cylinders, for example, and as shown five. Each including its forward head or end can be very properly made from a single piece of stock. The front ends of the cylinders are open. The rear closed ends or walls of the cylinders carry plugs constituting part of sparking means hereinafter more particularly described and also means for the necessary entrance of the gaseous fluid. Each cylinder receives for sliding movement a piston as 31 to which is connected a pitman or connecting rod 32. The forward ends of these pitmen are connected to the wrist portions of cranks as 33. It will be clear that the several cylinders and their coöperating parts revolve around the central hollow shaft with the casing or housing 21. This is one of the features of the balanced structure to which I have alluded.

It will be obvious that the cranks 33 are equidistantly disposed from each other. Their outer gudgeons or journals 34 turn in bushings 35 set in properly spaced openings in the forward portion of the casing or housing 21 and closed in their outer ends. The inner gudgeons 36 fit bushings 37 disposed in properly spaced openings in the sleeve 37′ provided at its forward end with the enlarged or expanded portion 38 united as by one or more screws 39 to the front wall of the casing 21, the anti-friction bearing 40 being disposed between the portion 38 and the fixed hollow shaft 5, all as best shown in Fig. 4.

The cranks 36 have associated therewith means as the bevel pinions 41 connected as by threading with the inner gudgeons or journals 36 respectively thereof. Said bevel pinions 41 as will be understood revolve around the shaft 5 and their teeth mesh with the teeth of a fixed master bevel gear as 42, the hub of which is united as by threading with the shaft 5 which the gear

surrounds. Between the forward face of the master bevel gear 42 and the bearing sleeve 37 I may dispose a number of balls 43 revoluble in grooves or races formed in adjoining faces of the two parts. The front wall of the casing 21 as illustrated, has an annular flange 44 between which and the hollow shaft 5 an anti-friction bearing as 45 may be interposed.

The bearing 13 to which I have already referred presents a suitable support for a carbureter as 46, the threaded extension of the carbureter being fitted in a correspondingly threaded opening as 47 in said bearing and the valve of the carbureter being equipped with a handle or lever 48 within easy reach of the aviator. From this opening 47 or from the discharge end of the carbureter 46 the passage 49 leads, said passage 49 terminating in the annular part 50 in constant communication with the annular passage 51 within the tubular rearward extension 52 projecting centrally from the rear wall of the casing 21. This annular passage 51 is open on its inner side, and it has at its forward end the radial outwardly extending passages 53 which communicate at all times with ports as 54 formed in each of the bodies of the several cylinders 30 respectively to thereby supply at the proper times the hydrocarbon which is to be subsequently compressed, fired and then discharged as spent gas. Set into the forward closed ends of the respective cylinders 30 are cases 55 receiving in their outer open ends the plugs 56 connected with the stems of the exhaust valves 57 which when closed fit against seats at the front ends of the respective cases 55 and are held in said relation by springs 58. The stems of the valves 57 it will be perceived, extend rearward beyond the plugs 56, by reason of which they can be acted on at proper times by suitable means to effect the opening of the valves and the exhausting of the cylinders.

The tubular extension 52 is furnished at its rear end with an annular flange 59 against which fits the ring 60 of suitable insulating material, the ring turning upon the hub 61 of the relatively fixed bearing 13. Through this ring 60 and also through the annular flange 59 extend contacts in the form of pins 62, the rear ends of these pins being flush with the rear face of the insulating ring 60 and their front ends being electrically joined as by connectors 63 with the spark plugs 64 of the several cylinders 30, it being understood that in the construction shown there are five of such contacts 62 and hence a corresponding number of plugs 64. These revoluble pins 62 which turn with the cylinders 30 and also with the casing 21, coöperate with the fixed contact 65 which is yieldingly constantly urged forward by a spring 66 and which is sustained by a carrier as the lever 67, the body of which surrounds and is capable of turning on the rear end of the hollow shaft 5. The purpose of this particular movement of the contact carrier or lever 67 is to effect proper timing and hence accurate spark production in the several cylinders. The front end of the contact or pin 65 is at all times against the insulating ring 60 and is obviously in the path of rotation of the several contacts or pins 62, so that when a pin 62 engages the coöperating pin or contact 65 a spark will be created in the cylinder 30 coöperative with the pin 62 to fire the compressed gas in said cylinder and thus effect the propulsion of the piston 31 therein. The body of the lever 67 is held against the rearwardly extending hub 68 by the nut 69 threaded onto the rear end of the hollow shaft 65, the engagement, however, not being sufficient to prevent comparatively easy manipulation of the lever 67 when desired. The lever is held in its adjusted position by a detent such as the pin 70 which engages in a space between two adjacent teeth of the segment or arcuate rack 71 on the rear side of the bearing 13. Although this rack appears in Fig. 4, it is best shown in Fig. 5.

The cam ring 15 to which I have referred has on its front face at the proper place the cam portion or bulge 72 up, along and down which the rear ends of the stems of the several exhaust valves travel on the rotation of the casing 21 so as to effect the opening of the exhaust valves and the consequent exhausting of the cylinders with which they are respectively associated. The carbureter 46 is connected by a duct or pipe as 73 with the tank 74 containing the necessary gasolene which is fed by gravity or otherwise to the carbureter and directed by the latter under proper control in the five cylinders 30.

I have provided means for positively starting the engine, and the means shown for this purpose may like other elements, vary decidedly as to character, although that shown and now to be described meets the conditions. The car 2 in the chamber or compartment 9 sustains the bearing or yoke 75. This bearing constitutes a suitable support for the telescopic shaft 76 to the front section of which is jointed the lever 77 carried upon the floor or keel portion of the car 2 within reach of the driver occupying the seat 11. The rear member of this telescopic sectional shaft 76 is connected with the starting motor 78 (Figs. 1 and 2) while the forward section has rigid with it the pinion 79 coöperative with the teeth 80 constituting a spur-gear, on and integral with the rear portion of the body of the casing 21 as shown best in Fig. 4. It will be understood that normally the pinion 76 is out of

mesh with the teeth of the gear 80. Mesh of the two sets of teeth can be accomplished by swinging the lever 77 rearwardly. When the two sets of teeth are meshed, the motor 78 will be started by throwing a switch to thus turn the shaft 76. Consequently the pinion 79 and hence the casing 21 will be caused to rotate to start the engine. After the engine is thus started the pinion 79 will be disengaged from the gear 80 by the action of the lever 77 and the motor 78 will be also stopped. These two actions can be accomplished in desired order. Subsequent to the starting of the engine it becomes self-operative. It will be assumed that the casing 31 is being rotated for instance through the agency of the starter in the manner already set forth.

As the casing rotates the bevel pinions 41 will be revolved about the relatively fixed bevel gear 42, the result being that the pinions 41 will be rotated on their axes to thereby reciprocate through the cranks 33 and rods 32 the several pistons 31 in their coöperating cylinders 30. When a piston 31 has been advanced forward sufficiently to uncover the several inlet ports 54 in its cylinder, there will be supplied into the cylinder by way of the carbureter 48 and passages 49, 51 and 53 a supply of hydrocarbon gas. After the supply of gas is received in the cylinder in question the piston is moved backward, thus closing the inlet ports 54 and necessarily compressing the charge of gaseous vapor in the cylinder. The latter continues its revolution until the movable contact 62 associated with the cylinder being described, strikes the relatively fixed contact 65 to produce a spark at the inner end of the plug 64, which fires the compressed charge and thus causes the advance of the piston. This same action is repeated with the several pistons and revolving cylinders, so that after one or more of the cylinders have been charged and fired, the action becomes automatic and the pinion 79 can then be disengaged from the gear 80 by the rearward movement of the rear portion of the telescopic shaft 76 through the operation of the hand lever 77. After the charge is compressed and exploded in the cylinder 30, the latter continues its revolution until the rear end of the stem of the exhaust valve 57 engages and rides along the cam bulge 72 which results in the momentary opening of the valve 57 to exhaust the cylinder and the latter continuing its revolution the exhaust valve will be closed, and when the cylinder is exhausted, the supply ports 54 thereof will be uncovered by the forward motion of the piston 31 to receive a fresh charge of gaseous vapor which is afterward compressed and fired in the manner already described. As the piston 31 moves forward, it carries the rod 32 therewith to revolve the coöperating crank and thus the bevel pinion 41 so as to effect thereby the rotation of the casing 21, the action being after this automatic, the motion continuing as long as the circuit involving the firing pin 70 is closed.

In connection with the respective cylinders 30 I provide means for maintaining the same and hence the coacting engine parts in a properly cool condition. This means may vary decidedly as to character, although it comprises a plurality of vanes which are concavo-convex in cross section and which abut at their forward ends practically against the rear head of the casing 30, the rear ends of the vanes being virtually coincident with the rear ends of the cylinders. Each vane as will be seen best upon inspection of Fig. 6 engages against a cylinder at its inner edge, its outer edge being approximately coincident with the circumference of the casing 21. In the front of the car 2 are one or more inlets as 86 for atmospheric air. The air entering the chamber 9 as the car 2 travels through the air is taken up and passes through the chamber 9 where it is scooped up by the concaved seats of the fans or blades 85 and directed against the respective cylinders to maintain the same in a cool condition. The car 2 may have within it, forward of the seat 11, the lever 90 connected as by the wire 91 with the ailerons or other movable parts.

What I claim is:

1. The combination of a hollow carrier, cylinders individually removably fitted in an end wall of the carrier, projecting from said end wall and extending into the carrier, the longitudinal axes of the cylinders being in parallelism with each other and with the longitudinal axis of the carrier, the cylinders being disposed approximately equal distances apart, pistons slidable in said cylinders, rods jointed to the respective pistons within said carrier, cranks to which the rods are respectively connected, the cranks being disposed in said carrier and the rods also extending thereinto, means in the carrier for receiving the effect of the respective cranks, means for causing the reciprocation of the pistons in their respective cylinders and arcuate fan blades fitted against the carrier, engaging each outer end portion of the cylinders and spaced respectively from each other.

2. The combination of a cylindrical, hollow carrier, cylinders individually removably fitted by screw threading in an end wall of the carrier and extending oppositely from said end wall approximately equal distances whereby a part of each cylinder will be inclosed in the carrier and the remaining part thereof will be outside of

the carrier, pistons reciprocatory in the respective cylinders, rods jointed to the respective pistons, cranks to which the respective rods are connected, means for receiving the effect of the respective cranks, means whereby the reciprocation of the pistons in their cylinders is caused, the longitudinal axes of the cylinders being in parallelism with each other and also in parallelism with the longitudinal axis of the carrier and arcuate fan blades fitted against the carrier, engaging each outer end portion of the cylinders and spaced respectively from each other.

In testimony whereof I affix my signature in the presence of two witnesses.

WILBUR L. SHEPARD.

Witnesses:

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HEATH SUTHERLAND.