Oct. 4, 1932. H. E. WILSEY 1,880,224

ROTARY ENGINE

Filed March 3, 1930 4 Sheets-Sheet 1

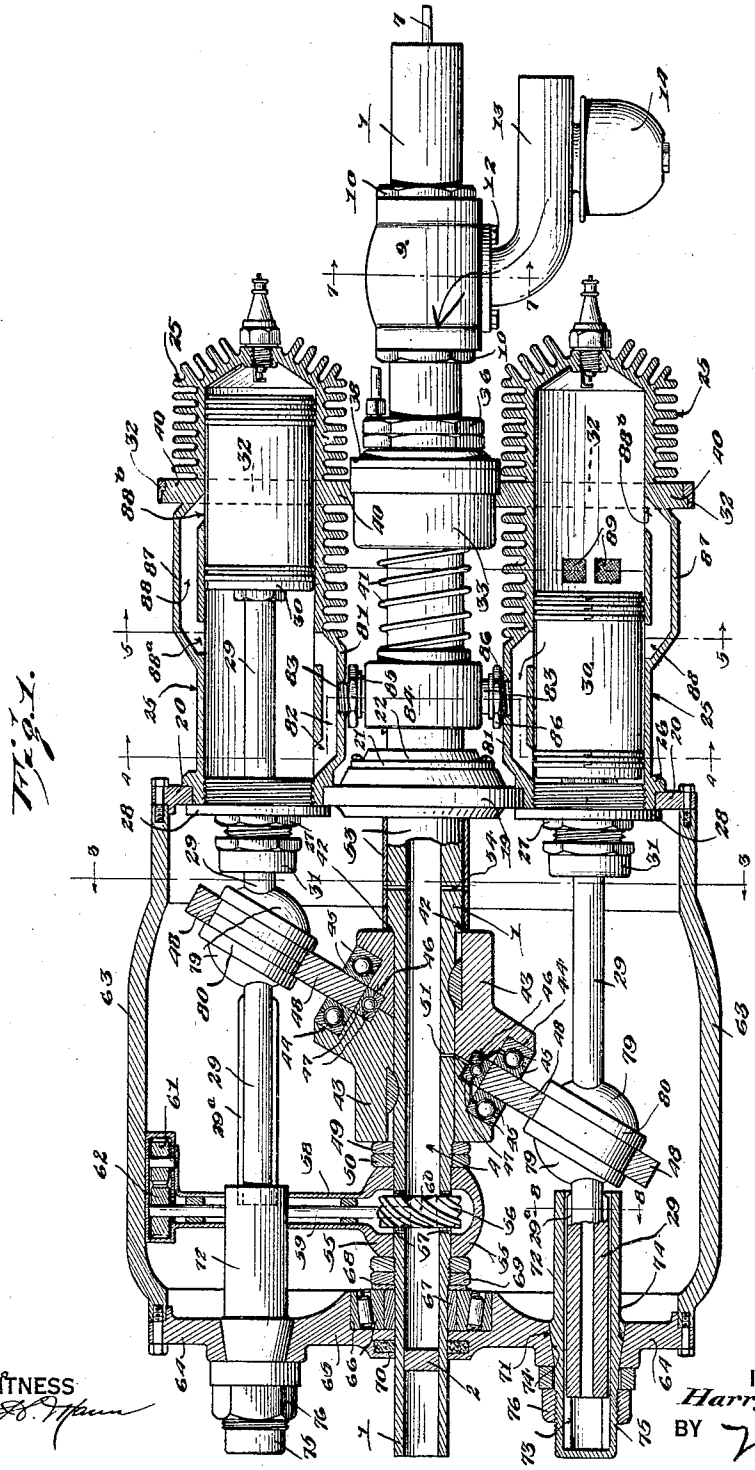


Fig. 1.

WITNESS

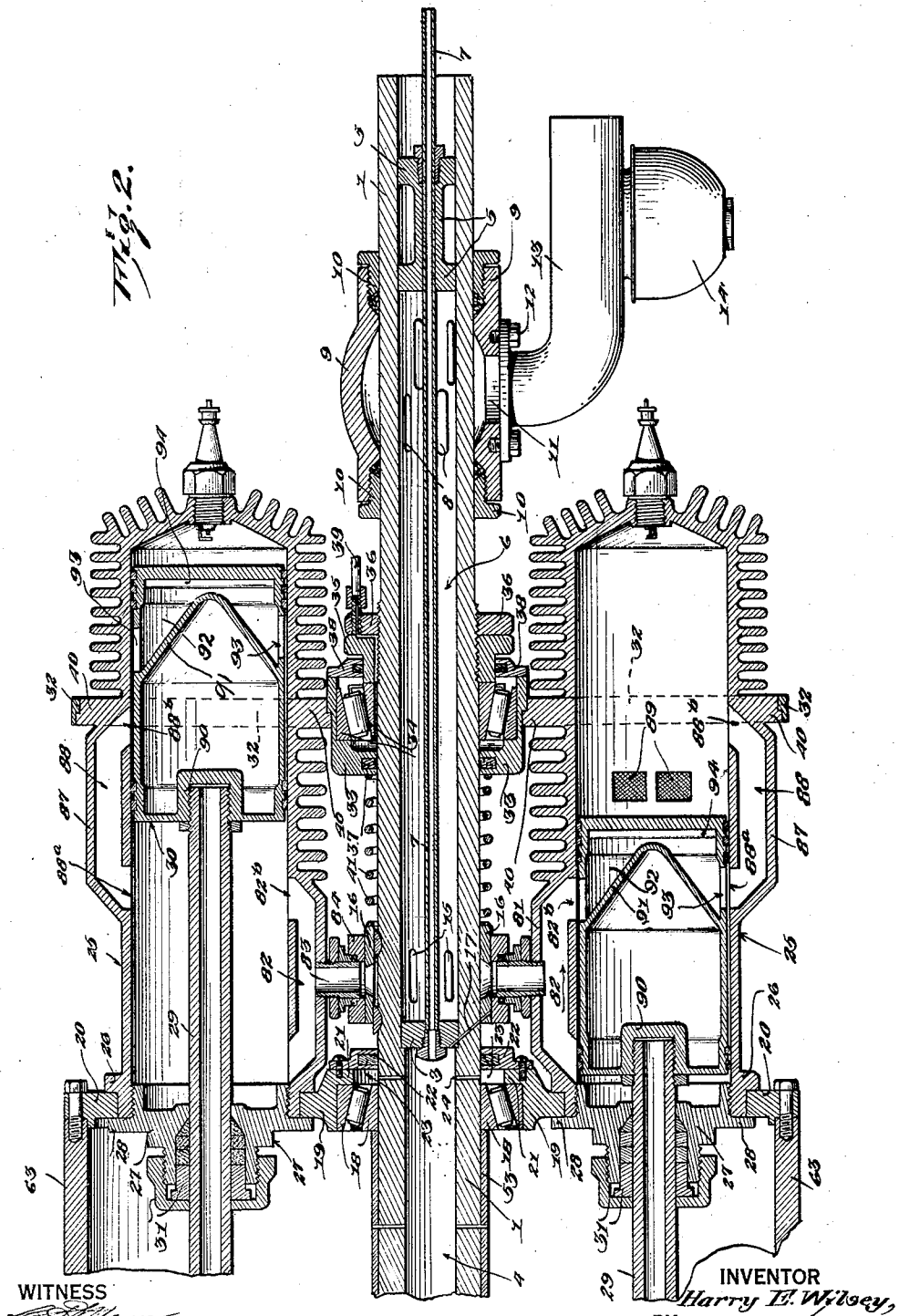
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Fig. 2.



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Fig. 4.

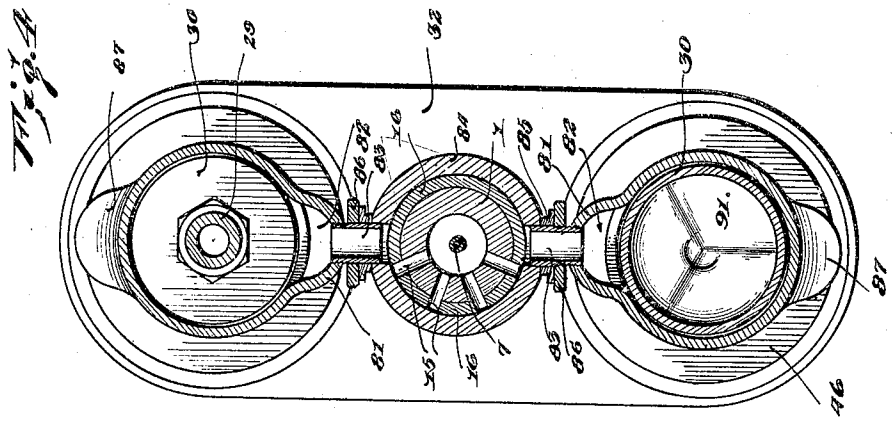
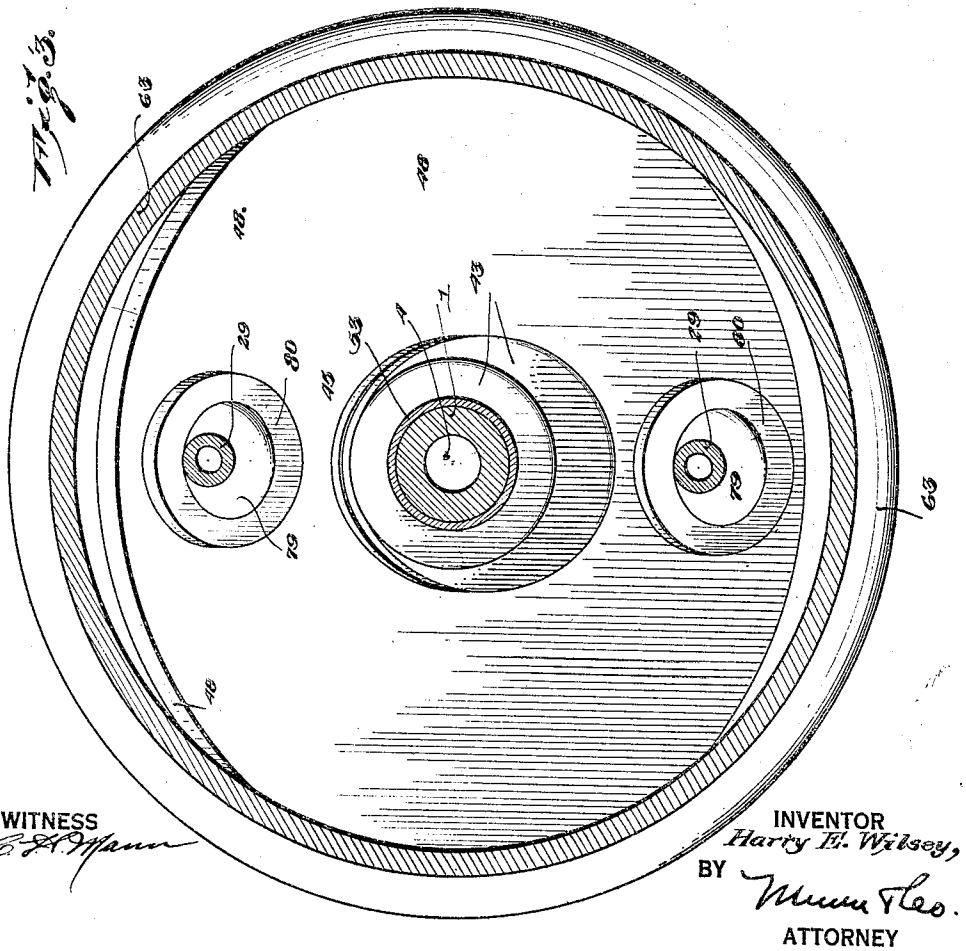


Fig. 5.



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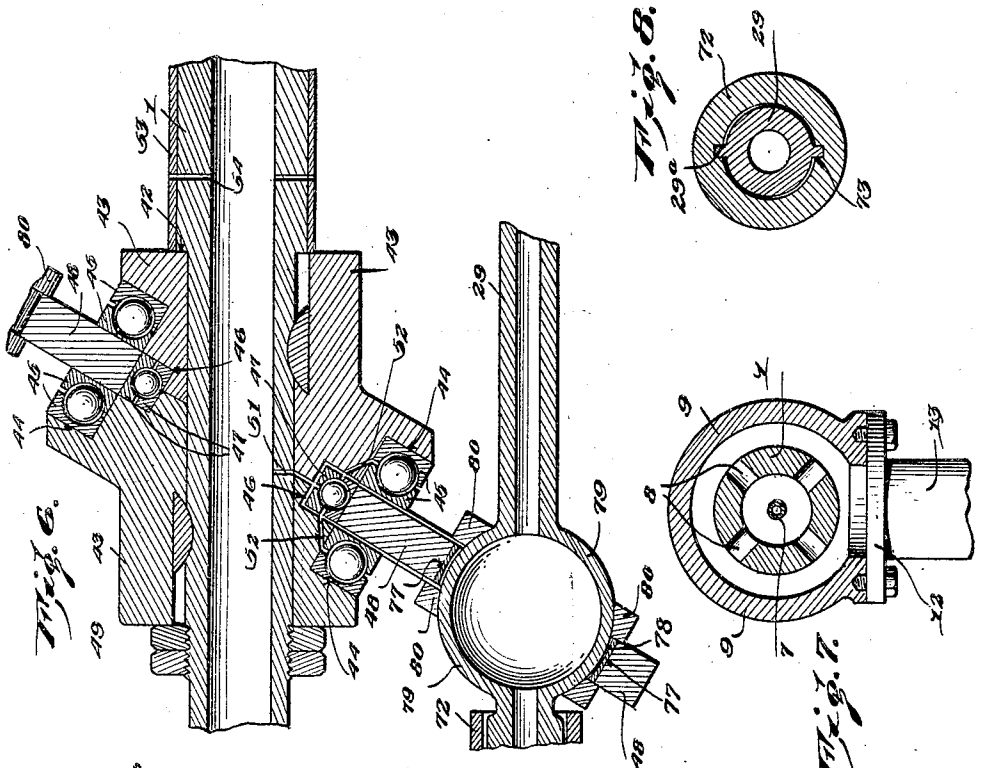


Fig. 6.

Fig. 8.

Fig. 7.

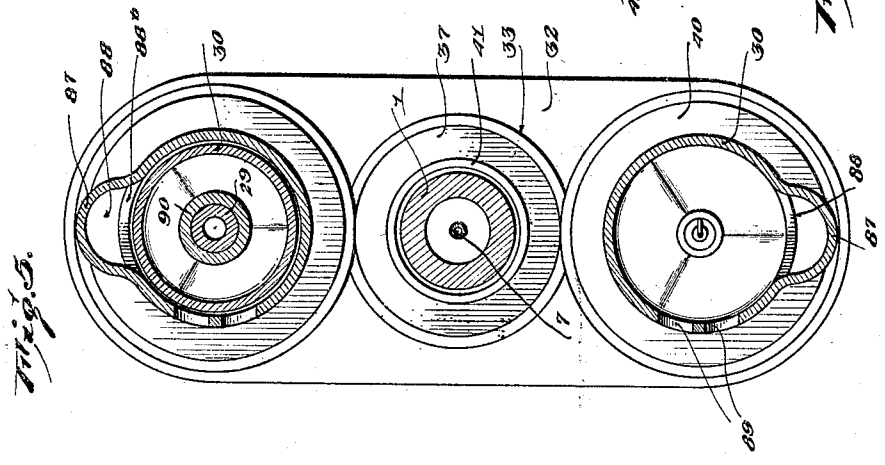


Fig. 5.

WITNESS

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UNITED STATES PATENT OFFICE

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ROTARY ENGINE

Application filed March 3, 1930. Serial No. 432,919.

This invention relates to improvements in rotary engines of the type shown for example in U. S. Letters Patent No. 1,042,018 to Macomber, granted October 22, 1912, wherein a plurality of parallel cylinders are arranged in concentric relation about a common axis and are mounted rigidly with respect to each other and arranged to be revolved bodily around their common axis through reciprocation of their pistons, with the plane of rotation transverse to the longitudinal axes of the cylinders, rotation being accomplished through a stroke plate to which the ends of piston connecting rods are ball jointed, which stroke plate is arranged in a plane at an angle to the plane of cylinder rotation and for rotation about the axis of cylinder rotation, the angularity of the plate, permitting relative reciprocatory movement of the pistons in their cylinders and presenting resistance causing the expansion of the fuel ignited behind the pistons to react against the cylinders and cause movement thereof in the line of less resistance constituted by rotation about said common axis. The invention is designed to improve prior two-cycle engines of this type.

One feature of the invention consists in a cylinder and piston construction designed to provide increased efficiency through permitting a longer piston stroke, a more efficient scavenging of exhaust gases, and the injection of a fuel charge into the combustion chamber of the cylinder without the use of stroke-limiting fuel diverting baffles on the heads of the pistons.

A second feature consists in the construction and mounting of the stroke plate and the connection of the piston rods thereto through provision of a continuous annular support for the stroke plate on a rigid axial support shaft, with the piston rods ball jointed to the stroke plate and guided for rectilinear movement parallel with the axis of cylinder rotation.

A further feature improves the construction of the pistons themselves by providing a fuel charge by-pass traversing the piston and having a baffle therein diverting the charge against heat fins on the interior of the piston head, serving the double purpose of cooling the pistons and preheating the fuel mixture to increase its efficiency.

As another feature, I have designed improved supporting means for the cylinder providing a common support for said cylinders mounted concentric to and revoluble with said cylinders about their axis of rotation, the cylinder supports involving annular supporting plates journaling on a fixed support shaft concentric with said axis. Additionally, I have mounted the cylinders, connecting rods and stroke plate on supports for axial rotatory movement as a unit with the pistons and connecting rods maintained for rectilinear movement in the longitudinal axis of the cylinders. With the connecting rods ball jointed to the angular stroke plate, their maintained rectilinear movement through the resistance offered by said plate thereto, provides increased torques to the reactance force of the ignited charges.

These various features and other features of construction and design will be more clearly apparent from the following detailed specification which is to be read in conjunction with the accompanying drawings forming part thereof and in which:—

Figure 1 is a longitudinal vertical section through a rotary engine of the type described embodying the improvements of the present invention.

Figure 2 is a similar section on an enlarged scale through the cylinder end of the assembly, with opposed cylinders and their pistons showing at the beginning and end of their power strokes, respectively.

Figure 3 is a transverse vertical section taken on line 3—3 of Figure 1 through the oil reservoir and stroke plate housing.

Figure 4 is a transverse vertical section taken on the line 4—4 of Figure 1 through the rear ends of opposed cylinders and through the rotary fuel valve.

Figure 5 is a similar section on line 5—5 of Figure 1 through the fuel jet passages and exhaust ports of opposed cylinders.

Figure 6 is an enlarged detail in section showing the mounting of and bearings for the stroke plate on the fixed axial supporting

shaft and the ball jointed connection of a piston rod with the stroke plate.

Figure 7 is a transverse vertical section through the intake manifold taken on line 7—7 of Figure 1.

Figure 8 is a similar section, taken on line 8—8 of Figure 1 through the connecting rod guide.

Referring to the drawings by numerals, it will be seen, by reference to Fig. 1, that the hub of the motor is constituted by a fixed tubular rectilinear shaft 1 which is to be appropriately supported and which adjacent its outer or front end is provided with an internal closure plug 2 and at an intermediate point with a second plug 3 (Fig. 2) partitioning off the intervening portion of the hollow shaft and forming a lubricant holding and distributing chamber 4.

Adjacent the rear or inner end, a third and cylindrical closure plug 5 (Fig. 2) is inserted, the space enclosed between plugs 3 and 5 constituting a fuel chamber 6. These last named plugs may be axially bored and an oil pressure gauge tube 7 may extend therethrough and outwardly from the rear end of shaft 1 for connection to an appropriate pressure gauge. The tube at the front and rear ends of the plugs 3 and 4 is provided with suitable packing glands to prevent the entrance of lubricant into the fuel chamber 6 and the escape of fuel from said chamber.

Adjacent and forwardly of the plug 5, the tubular shaft 1 is provided with a series of fuel intake ports 8. A domed sleeve 9 overlies these ports and is held in position on the shaft by end collared packing glands 10. The bottom of the domed sleeve 9 is provided with a fuel intake port 11 and the end flange 12 of a fuel intake pipe 13 is bolted to the bottom of sleeve 9 with its pipe communicating with said port. A suitable carburetor 14 is attached to said pipe.

Adjacent and rearwardly of the closure or partitioning plug 3, the fuel chamber section of the shaft is provided with groups of outlet slots 15 externally overlaid by a distributing ring 16 ported in alinement with the slots 15 and keyed to the shaft. A duct 17 traversing the plug 3, shaft 1 and ring 16 conducts lubricant from chamber 4 to the outer face of ring 16 which serves as a bearing for a cooperating rotary sleeve valve hereinafter described.

Forwardly of the plug 3 and overlying the adjacent lubricant chamber 4 of the shaft, the inner race plate of a roller bearing 18 is fixed on the shaft. The hub 19 of an annular support plate 20 seats over the outer race plate of the bearing and is revolubly mounted thereon for rotation about the shaft as an axis. The hub is provided with a rearwardly offset flange 21 from which depending an annular packing ring 22 embracing the shaft and providing an annular lubricant channel 23 between it and the roller bearing 18 into which lubricant is led from chamber 4 by a duct 24 in shaft 1.

A plurality of cylinders 25, of which only two are shown, have their outer or non-compression ends open, internally threaded and provided with peripheral abutment flanges 26. These ends of the cylinders are inserted in bores of corresponding diameter in the support plate 20 adjacent its outer edge and are clamped thereto with their longitudinal axes in parallel with each other and with the shaft 1 by externally threaded end closure plates 27 having peripheral flanges 28 engaging the opposed face of the support plate 20. These plates 27 are centrally bored to guide in the longitudinal axes of their cylinders the tubular connecting rods 29 threading into the bases of their pistons 30 and extending outwardly through the bores in the closure plates which are packed by glands 31 as shown.

The cylinders 25 which, as shown, are of the externally finned air cooled type, are also rotatably supported adjacent their opposite or compression ends by a second annular support plate 32 having an axial hub 33 housing and resting on the outer race of a roller bearing assembly 34 retained within the hub by an end bushing 35 threading on the external periphery of shaft 1 and locked in position by a backing lock nut 36 likewise threaded on the shaft, the forward side of the hub has a depending annular packing flange 37 engaging the shaft and the rear open side of the hub is closed by an annular packing plate 38. The inner faces of the roller bearing and bushing are grooved; the rear face of the bushing is channeled and a lubricant tube 39 extending through the lock nut 36 provides means for feeding lubricant to the bearing as through the usual pressure "gun". Between the hub flange 37 and the distributing ring 16, a coiled spring 41 encircles shaft 1 and maintains the ring against its seat on the shaft.

The second support plate 32 is provided in alinement with the cylinders 25 with bores having rabbetted inner faces in which are fitted rabbetted peripheral flanges 40 formed on the cylinders 25, the cylinders being thus supported by and rotating with plates 20 and 32 with their longitudinal axes in parallel with each other and with shaft 1.

Forwardly or outwardly from the roller bearing 18 of the first cylinder support plate 20, the shaft 1 is reduced in external diameter providing a shoulder 42. Seating against this shoulder at its rear or inner end and keyed to the shaft is a hub 43 (Fig. 1) having its peripheral face formed with a channel 44 therein extending in a plane inclined to the right angular transverse plane of rotation of the support plates 20 and 32 and their cylinders. The opposite sides of this channel are

faced with side thrust bearings 45 and at the base of the channel a central groove 46 extending in a similarly inclined plane seats a circular ball bearing 47.

The inner circular edge of an annular stroke plate 48 engages and journals on the central roller bearing 47 with its adjacent side faces engaging the side thrust bearings 45, the stroke plate extending outwardly from hub 43 in an inclined plane alined with that of the channel 44 and its central base groove and confronting and lying in outwardly spaced relation to the outer ends of cylinders 25 and their support plate 20. The inner end of hub 43 is held firmly against shoulder 42 by a clamping nut 49 threading on the shaft and backed by a lock nut 50, these two members serving to space the outer end of the hub from a lubricant pump casing hereinafter described. A lubricant duct 51 passing through shaft 1 and hub 43 conveys lubricant from shaft chamber 4 to the ball bearing 47, and other ducts 52 (Fig. 6) convey lubricant from groove 46 to the side thrust ball bearings 45. A spacing sleeve 53 extends between the rear or inner end of hub 43 to the axial roller bearing 18 of support plate 20 and is provided with a lubricant ejecting opening therein alining with a lubricant duct 54 in the shaft to spray lubricant upon the connecting rods 29.

Outwardly of the hub 43 and spaced therefrom by the nuts 49, 50, the hollow hub 55 of a lubricant pump casing encircles and is journaled on the reduced periphery of shaft 1 and encloses therewithin a spiral gear ring 56 fixed on the shaft, and lubricant entrance ducts 57 in the enclosed portion of the shaft. A tubular housing 58 integral with the hub 55 extends radially outward therefrom and has appropriately journaled therein a rotatable pump shaft 59 mounting a spiral gear 60 on its inner end meshing with the spiral gear ring 56. The tubular casing 58 at its outer end is laterally enlarged to house a toothed pump gear 61 meshing with a second toothed gear 62 fixed on the outer end of the shaft. The laterally enlarged portion of the casing is provided with a lubricant intake opening, the gears 61—62 functioning as the usual gear type pump to draw in and force lubricant through the tubular housing 58 to the hub 55.

The outer end of the tubular casing 58 is rigidly secured to the inner face of an annular housing plate or drum 63 whose inner or rear edge is bolted to the peripheral edge of the cylinder support plate 20 and whose outer or or front edge is similarly bolted to the peripheral edge of an annular drive plate 64 having an axial hub portion 65 journalling on a roller bearing assembly 66 carried on a shaft sleeve 67 and retained within the hub by a washer plate which in turn is held thereagainst and spaced from the pump housing by spacing washers or nuts 69 threaded externally on the shaft 1 and engaging the pump casing hub 55 at the side opposite to the spacing nuts 49, 50. The hub 65 has its outer face formed with a packing flange 70 engaging the shaft.

In line with the cylinders 25 the drive plate is provided with tapered bores 71 in which are seated tubular guides 72 having longitudinally grooved inner faces 73, intermediate externally tapered peripheral portions 74 and closed externally threaded outer ends 75. Nuts 76 threading on the outer threaded ends 75 draw the tapered portions 74 of the guides into frictional tightly clamped seating engagement in the drive plate. The tubular guides extend in alinement with the longitudinal axes of the cylinders 25 and are open at their inner or rear ends to receive the outer ends of the tubular connecting rods 29 which are provided with external peripheral ribs 29a (Fig. 8) seating in the grooves 73 of the guides.

The tubular connecting rods pass through circular openings or sockets 77 in the stroke plate 48 faced by bushing rings 78 and are enlarged to provide spherical enlargements 79 of a diameter to seat in these openings and provide universal ball joint connections with the stroke plate in the line of their cylinder axes. The ball joints or spherical enlargements 79 are retained in the stroke plate sockets by annular cross head plates 80 embracing opposite sides of the stroke plate and having concaved inner faces conforming to and engaging the spherical faces of the ball joint spheres 79.

The housing 63 encloses therewithin between the drive plate 64 and support plate 20, the lubricant chamber portion of the shaft, the stroke plate and its hub, the gear pump housing, the tubular guides and the connecting rods. It constitutes also a rigid connection between the drive plate and the cylinder supporting plate 20 and forms a lubricant reservoir. The outer end of the pump casing is fixed to the housing drum 63 and rotates therewith, the gear 60 on the inner end of the pump shaft riding over the fixed spiral gear 56 on shaft 1 and rotating the pump shaft to cause its gears 61—62 to draw oil or other lubricant down into the tubular case 58 and to the hub 55 from whence it passes through the shaft ducts into the lubricant chamber 4 and is distributed as described. It will be noted that the inner or rear face of the drive plate roller bearing assembly 66 is exposed on the interior of the housing 63 and is directly lubricated. Since the lubricant is thrown to the outer side of the housing by centrifugal action in the rotation of the housing about the shaft, the pump gears 61—62 will always feed lubricant while the engine is in operation.

The cylinders 25 and pistons 30 are of par-

ticularly advantageous construction and have peculiar combinative interrelation. While I have shown only two cylinders in diametrically opposed relation, it will be obvious that this number may be increased as desired and as consistent with the size of the motor and that the stroke plate and connecting rod connections and guiding means will be duplicatively increased accordingly, as well as cylinder and piston arrangement and mounting.

The engine herein involved is of the two cycle type and the cylinder and piston constructed of the present invention is designed to provide increased efficiency through provisions for longer stroke, more complete scavenging, cooling of the piston head and preheating of the fuel passing to the combustion chamber of the cylinders.

Accordingly, the outer or noncompression ends of the cylinders 25 at their sides adjacent shaft 1 and outwardly of the distributing sleeve 16 are formed with longitudinally extending peripheral enlargements 81 providing for internal longitudinally extending fuel receiving passages 82 having their opposite ends ported into communication with the interior of the cylinder. Fuel tubes 83 threaded into the enlargements 81 intermediate of their ends extend inwardly therefrom and seat in bores in a valve sleeve 84 closely fitting over and revolving on the fuel distributing ring 16 on shaft 1 and are held in the sleeve bores by packing glands 85 backed by nuts 86 threaded on the tubes 83. As shown (Fig. 2) the valve sleeve 84 is provided with opposed fuel intake openings with which the tubes 83 communicate. As this sleeve rotates with the cylinders, support and drive plates, etc., about shaft 1 as an axis the group (as for example where two cylinders only are used), or groups of ports 15 will register successively with successive tubes 83 in the cycle of rotation, the registration period being, obviously, timed to the rearward movement of the pistons on their compression stroke to draw a charge of fuel into the outer noncompression end of the cylinder, this charge being forced by the piston on its succeeding firing stroke through by-passes to the compression end of the cylinder for compression and firing on the next succeeding compression stroke.

This is accomplished by providing the cylinder walls at the sides opposed to the receiving passages 82 with similar longitudinally extending peripheral enlargements 87 providing for longitudinal internal fuel jet passages 88 ported at their opposite ends into communication with the interior of the cylinder. The passage 88 constitutes, at the sides of the cylinder opposite thereto, a prolongation of the receiving passage 82 in the direction of the compression end of the cylinder, with the intake or outermost end port 88*a* opposed to the innermost or discharge port 82*b* of the fuel receiving passage. The walls of the innermost or discharge port 88*b* of the fuel jet passage are inclined toward the rear or compression end of the cylinder to direct the jet of fuel diagonally rearward toward the compression end thereof.

The walls of the cylinders at points outwardly and forwardly of the jet discharge ports 88*b* and quartered in location, or intermediate the opposed passages 82 and 88 are provided with exhaust ports 89 therein. With the exhaust ports so located with reference to the fuel jet ports and the latter inclined toward the compression end of the cylinder, I am enabled to dispense with the usual jet diverting baffle plate on the exterior of the cylinder head and thus permit further inward or compression movement of the piston and a longer stroke thereof. Furthermore the location of the exhaust ports with reference to the fuel jet ports, enables, in a two cycle engine, a more complete scavenging of the exhaust and maximum power from the explosion since these exhaust ports will not be opened until close to the end of the power stroke when the gases have reached their fullest possible expansion.

The fuel received in the passage 82 on the compression stroke of the piston is forced by the piston on its power stroke through the passage to its discharge port 82*b* and is permitted by the piston, at the time of maximum pressure on the fuel to by-pass through the interior of the piston under substantial pressure to enter the intake port 88*a* of the fuel jet passage for discharge therefrom as a jet directed to the compression end of the cylinder.

This result, accompanied by cooling of the piston head and preheating of the by-passing fuel, is accomplished advantageously by the piston construction as shown in Fig. 2 in which the pistons 30 are of hollow construction with internally threaded sockets 90 in their outer ends to receive the threaded ends of the connecting rods 29. Adjacent the head of the piston a conical partition 91 forms with the adjacent interior surface of the piston head a transverse passage or fuel by-pass 92 across through the interior of the piston. The side walls of the piston at the opposite ends of the passage 92 are formed with ports 93 which, at the end of the power stroke of a piston (as shown in Figs. 1 and 2) alines with and cross connects the discharge port 82*b* of the fuel receiving passage and the intake port 88*a* of the fuel jet passage. The conical partition 91 acts as a baffle or deflector and directs the by-passing fuel against the inner face of the piston head or end, which may have one or more heat radiating fins 94 formed thereon. The head of the piston is thus continuously cooled by the by-passing fuel which, by absorption of the fin radiated heat, is preheated before entering the com-

bustion chamber, with obvious resultant advantage. With the exhaust ports positioned to be opened by the piston at and slightly prior to the completion of its power stroke (as seen in Fig. 2), they are located at the natural head of expansion of burning gases and not only is maximum permissible expansion thereof secured prior to exhausting but the exhaust occurs at that point to which the expanding gases normally flow and increased scavenging is therefore secured as compared to previous location of the exhaust and intake ports in substantial opposition with an intervening piston baffle deflecting the incoming fuel.

Since the operation of the type of internal combustion engine involved herein is well known, the preceding detailed description of the structure and function of the specific mechanism of the present invention renders recapitulation of its operation unnecessary.

The specific form of the invention described herein while representing a preferable embodiment of the inventive idea, is intended as illustrative rather than restrictive and is subject to modification in form and arrangement to suit different conditions of manufacture and use in consonance with the spirit of the invention and the scope of the appended claims.

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

1. In an internal combustion engine, the combination of a fixed tubular bearing shaft having a fuel chamber therewithin, a plurality of cylinders arranged about said shaft with their longitudinal axes in parallel with each other and with said shaft, and revolubly mounted to rotate about said shaft in unison, longitudinal fuel intake passages formed within each cylinder wall adjacent its outer non-compression end at the side adjacent said shaft in transverse alinement with each other and with said fuel chamber and communicating at opposite ends with the interiors of their cylinders, a valve sleeve surrounding said shaft and rotatable with said cylinders said shaft and sleeve having spaced ports adapted to register at certain times to place said fuel chamber in communication with said fuel intake passages intermediate of their ends, discharge ports in said fuel chamber portion of the shaft alined with and enclosed by said rotatable cylinder valve sleeve, pistons in said cylinders of greater longitudinal extent than the length of said intake passages having transverse fuel passages therethrough adjacent their heads alining at one end with the inner ends of said cylinder intake passages at the end of the outward strokes of their pistons, longitudinal fuel jet passages formed in the cylinder walls at the inner end of the cylinders at the sides opposite to the intake passages and having their outer ends communicating with the interiors of their cylinders at points alining with the other end of said transverse piston fuel passage at the end of the outward piston stroke, and having their inner ends communicating with the interior of the cylinders adjacent their inner combustion ends and inclined to direct a fuel jet charge to said end.

2. In an internal combustion engine, the combination of a fixed rectilinear bearing shaft, a plurality of cylinders arranged with their longitudinal axes in parallel with said shaft and with each other, a common support for said cylinders mounted for rotation therewith as a unit about said shaft as an axis, an annular strokeplate spaced from said cylinders and their support lying in a plane inclined to the path of revolution of said cylinders and their support, a continuous circular bearing for said plate fixed on said shaft, pistons mounted in said cylinders for reciprocation, a drive plate journaled on said shaft in spaced relation to said cylinders and stroke plate and rigidly connected with said cylinder support for conjoint rotation therewith, guides on said plate alined with said cylinders, connecting rods extending from said pistons through said stroke plate and into cooperative relation to said plate guides for restriction thereby to reciprocation in the plane of their cylinder axes, said connecting rods having universal joint connections with the stroke plate.

3. In an internal combustion engine, the combination of a fixed rectilinear bearing shaft, a pair of spaced annular support plates journaled on said shaft for rotation thereabout as an axis, a plurality of cylinders carried by and conjointly rotatable with support plates with their longitudinal axes in parallel with said shaft and with each other, a stroke plate rotatably journaled on said shaft in spaced relation to said cylinders and support plate and extending and rotatable in a plane inclined to the plane of rotation thereof, pistons mounted in said cylinders for reciprocation, connecting rods extending from said pistons and having universal joint connection with said stroke plate, and a drive plate rotatably mounted on said shaft connected with said cylinder support plates for conjoint rotation therewith, and having guiding means thereon in alinement with the cylinders cooperating with their connecting rods to guide and maintain said rods in the plane of the longitudinal axis of their cylinders.

4. In an internal combustion engine, the combination of a fixed rectilinear bearing shaft, a pair of spaced annular support plates journaled on said shaft for rotation thereabout as an axis in planes at right angles to the shaft axis, a plurality of cylinders carried by and conjointly rotatable with said support plates with their longitudinal axes in parallel with each other and with said

shaft, a bearing hub fixed to said shaft in outwardly spaced relation from said support plates and cylinders having a circular guide channel in a plane inclined to the right angular plane of rotation of said support plates and cylinders, an annular stroke plate having a continuous circular bearing in said guide channel and extending in a similarly inclined plane, a drive plate revolubly mounted on said shaft outwardly of and spaced from said stroke plate and rigidly connected with said cylinder support plates for conjoint rotation therewith, tubular guides offset inwardly from said drive plate in axial alinement with the longitudinal axes of said cylinders, pistons mounted in said cylinder for reciprocation, connecting rods extending from said pistons in the line of the longitudinal axes of their cylinders through said stroke plate with their outer ends extending into said tubular guides and maintained by said guides in the longitudinal axes of their cylinders, said connecting rods having universal bearings in said stroke plate in said longitudinal axes.

5. In an internal combustion engine, the combination of a fixed rectilinear bearing shaft, a pair of spaced annular support plates journaled on said shaft for rotation thereabout as an axis in planes at right angles to the shaft axis, a plurality of cylinders carried by and conjointly rotatable with said support plates with their longitudinal axes in parallel with each other and with said shaft, a bearing hub fixed to said shaft in outwardly spaced relation from said support plates and cylinders having a circular guide channel in a plane inclined to the right angular plane of rotation of said support plates and cylinders, an annular stroke plate having a continuous circular bearing in said guide channel and extending in a similarly inclined plane, a drive plate revolubly mounted on said shaft outwardly of and spaced from said stroke plate, tubular guides offset inwardly from said drive plate in axial alinement with the longitudinal axes of said cylinders, an annular housing rigidly connecting the outer edges of said drive plate and the adjacent cylinder support plate for conjoint rotation thereof and enclosing therewithin said shaft, stroke plate, connecting rods and tubular guides, and constituting a lubricant-holding reservoir, a lubricant chamber formed within said shaft and ported into communication with hub and plate bearings thereon, means within said reservoir for forcing lubricant therefrom into said chamber, pistons mounted in said cylinders for reciprocation, connecting rods extending from said pistons in the line of the longitudinal axes of their cylinders through said stroke plate with their outer ends extending in said tubular guides and maintained by said guides in the longitudinal axes of their cylinders, said connecting rods having universal bearings in said stroke plate in said longitudinal axes.

6. In an internal combustion engine, the combination of a fixed rectilinear tubular bearing shaft internally partitioned to provide fuel and lubricant holding chambers, an annular support plate rotatably journaled on said shaft, a plurality of cylinders supported thereon for conjoint rotation about the fuel chamber portion of said shaft as an axis and having their longitudinal axes in parallel with each other and with said shaft, a valve sleeve carried by and rotating with said cylinders about said shaft and periodically ported into communication with the fuel chamber thereof, and with the interior of said cylinders, a bearing hub fixed on the lubricant chamber portion of the shaft in outwardly spaced relation to said cylinders having a circular guide channel inclined to the plane of rotation of said cylinders and ported into communication with said lubricant chamber, an annular stroke plate opposed to said cylinders having a continuous circular bearing on said guide and extending in a similarly inclined plane, a drive plate spaced outwardly from the stroke plate having an axial bearing surface journaled on said lubricant chamber portion of the shaft and ported into communication therewith and having inwardly offset tubular guides alining with the longitudinal axes of said cylinders, pistons mounted in said cylinders for reciprocation, connecting rods extending from said pistons in the line of the longitudinal axes of their cylinders through said stroke plate with their outer ends extending in said tubular guides and maintained thereby in the longitudinal axial line of their cylinders, with said rods provided with universal bearings on said stroke plate, in the line of said longitudinal axes, an annular housing rigidly connecting the outer edges of said drive and support plates for conjoint rotation thereof and enclosing the lubricant chamber of the shaft, said hub, stroke plate, tubular guides and connecting rods therewithin and providing a lubricant reservoir, means for feeding lubricant therefrom to said shaft lubricant chamber and means for feeding fuel to said shaft fuel chamber.

7. In an internal combustion engine, the combination of a fixed bearing shaft having a fuel chamber therein, a plurality of cylinders journalled for rotation about said shaft as an axis and having their longitudinal axes in parallel with each other and with said shaft, a valve sleeve rotatable with said cylinders about said shaft and periodically ported into communication with said fuel chamber and with the interior of said cylinders, a stroke plate journalled on said shaft in spaced relation to said cylinders for rotation about an axis inclined to the axis of said shaft, pis-

tons mounted in said cylinders for reciprocation therein, connecting rods extending from said cylinders and having a universal connection with said stroke plate, and a drive plate rotatable with said cylinders and having guide means thereon in alinement with said cylinders and for cooperation with said connecting rods.

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