Oct. 19, 1943. A. H. NEULAND 2,332,105

BARREL ENGINE

Filed April 7, 1941

Fig. 1.

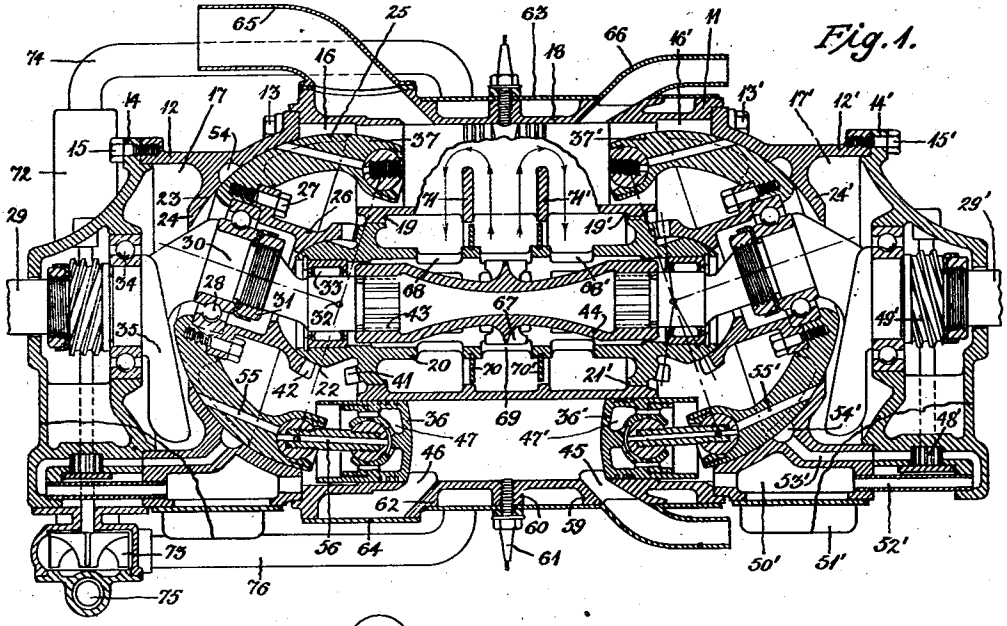


Fig. 2.

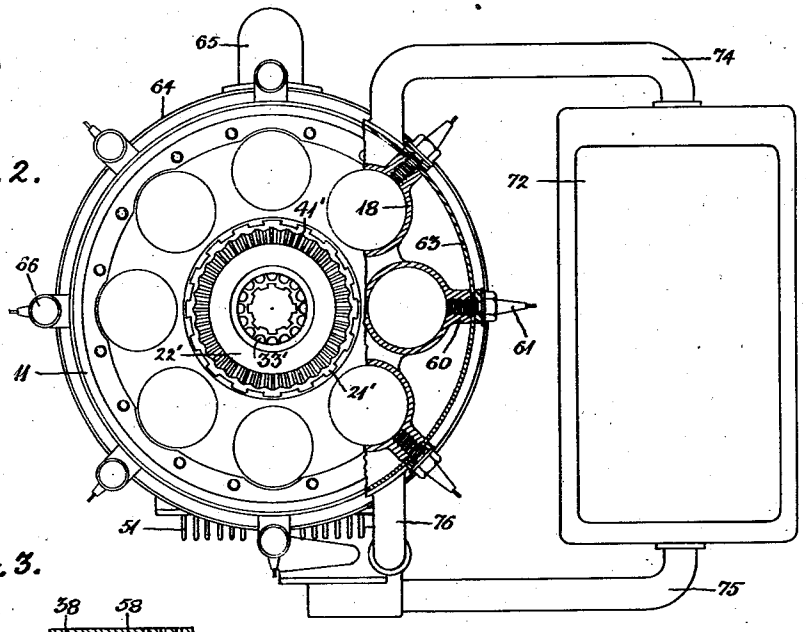
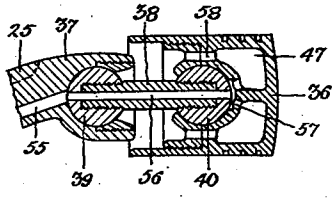


Fig. 3.



INVENTOR.

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UNITED STATES PATENT OFFICE

2,332,105

BARREL ENGINE

Alfons H. Neuland, Cleveland, Ohio

Application April 7, 1941, Serial No. 387,227

16 Claims. (Cl. 123—51)

This invention relates to engines in general having laterally arranged cylinders, sometimes referred to as barrel engines, and relates particularly to internal combustion engines of this type.

One object is to increase the power and improve the efficiency of engines and to provide an engine capable of operating with high cylinder pressures and at high speed. Another object is to provide a compact and simple construction that lends itself to rapid production and easy assembly; and still another object is to secure greater uniformity of temperature within the engine and particularly in operatively associated parts such as cylinders and pistons as well as in other important associated parts.

My invention resides in novel features of construction and in the arrangement and combination of certain of its component parts. The foregoing and other objects and advantages will appear in the following description and from the drawings showing one embodiment, and my invention will hereafter be more fully defined in the appended claims.

Fig. 1 is a vertical section of an engine embodying my invention having lower end portions cut away to show the pressure and circulating pumps.

Fig. 2 is an end elevation of the cylinder block with the bracket and crankshaft assembly at the right removed and with a portion cut away to show the central portion of cylinders in section.

Fig. 3 is an enlarged sectional view of the piston, showing its construction and relation with associated parts.

The illustrated embodiment of my engine, shown in the figures, consists of a stationary engine body comprising a cylinder block 11, brackets 12, 12' secured to the ends of the block by bolts 13, 13' and end brackets 14, 14' secured to brackets 13, 13' by bolts 15, 15'. The brackets 12, 12' form with the cylinder block, spaces or chambers 16, 16' which will hereafter be referred to as crank chambers and the end brackets 14, 14' form, with brackets 12, 12', adjacent chambers 17, 17', which will hereafter be referred to as counterweight chambers. The cylinder block is made up of a plurality of open ended cylinders 18, arranged with their axes about the rotational axis of the engine and extending laterally between crank chambers, tied together at their ends by webs 19, 19' preferably cast integral with the cylinders and extending beyond the cylinder ends to form outer closures for the crank chambers and seats, as shown, for centering the brackets 12, 12'. It should be noted that the internal parts in the left half of engine are identical with those in the right half and that in order to avoid congestion of numerals in the drawing, the prime mark has been applied to some of the numerals to indicate that such numeral will be found identifying a part on the right side which is identical with a corresponding part on the left side of the engine. The hollow core of the engine block is provided with a sleeve 20, supported by the webs 19, 19', and secured against rotation by a splined joint 21' formed in the sleeve and engine block. Each of the crank chambers is provided with an inner spherical bearing surface arranged concentric with respect to the cylinders, such as the convex spherical bearing 22, preferably formed in the end of sleeve 20, and with an outer, concave spherical bearing arranged also concentric with respect to the cylinders and inner bearing, such as the concave spherical thrust bearing 23, preferably formed directly in each bracket 12, 12' extending inwardly and forming a partial partition 24, 24', between crank and counterweight chambers. In instances where the thrust bearings are formed separately from the brackets 12, 12', or when the thrust bearing does not extend inwardly to form the partitions 24, 24', the end brackets 14, 14' need not be formed separately but may be formed as a part of brackets 12, 12'.

Arranged within the crank chambers I provide a pair of non-rotating but oscillatable annular elements, which will hereafter also be referred to as oscillators, each element comprising an outer bowl shaped portion 25, having a convexly spherical bearing journal operatively associated with the thrust bearing and an inner portion 26 secured to the outer portion 25 by bolts 27 and having an inner spherical bearing operatively associated with the sleeve bearing 22. The oscillator is thus laterally confined within the crank chamber but is free within limits, to tilt or weave in all directions. An anti-friction bearing, in the present instance a ball bearing 28, having an inner and an outer race is locked centrally between inner and outer portions of the oscillator and arranged axially concentric with respect to the spherical journal. I provide separate crankshafts 29, 29' and provide each crankshaft with an inclined crank element 30, to which the inner race of the ball bearing 28 is secured by locknut 31. The crank element may be of substantial diameter and take the form of an eccentric but is preferably of small diameter to form a crankpin as shown in the drawing. I arrange the

crank element so that its inclined axis substantially converges with the radial center 32 of the spherical journal and by this means secure complete freedom of movement of the oscillator between the spherical crank chamber bearings as the crankshaft rotates. Each crankshaft is rotatably supported on both sides of the crank element, by an anti-friction bearing 33 within sleeve 20, and by an anti-friction bearing 34 within end bracket 14, the bearings 33 and 34 being preferably slidably fitted within the sleeve and bracket, permitting the oscillator to float with respect to the spherical crank chamber bearings. Each crankshaft is further provided with a counterweight 35, arranged on the opposite side from the crank element and is proportioned to effectively counterbalance the crank element and oscillating parts.

The pistons 36, 36' in the cylinders are each provided with a spherical bearing while the outerly portions of the oscillators are also provided with spherical bearings formed in the bosses or arms 37, 37', extending from the inner side of the bowl, shown by the dotted lines in the drawing. The connecting rods 38 have spherical end portions 39, 40 which serve to connect the pistons with the oscillators. The centers of the spherical bearings in the oscillator arms are preferably positioned to extend from the point 32 outwardly at right angles to the axis of the inclined crank element. Such a positioning of the arm bearings causes only a slight deflexion of the connecting rods from the cylinder axis, permits the arms to reach into the cylinders and the use of short connecting rods.

I provide fulcrum means for transferring torque between each oscillator and the engine body and for holding the arm bearings substantially in circumferential alignment with the cylinder axes. This means comprises a bevel gear fixedly associated with the stationary engine body and a bevel gear fixedly associated with the oscillators meshing with the first mentioned gear. In the present embodiment the bevel gears are formed by gear teeth 41, cut directly in the face of sleeve 20, and by gear teeth 42 cut directly in the face of inner oscillator portion 26, the pitch lines of the gears converging at the point 32 in the center of the spherical bearings. With this construction and arrangement, rotation of the crankshaft causes the central portion of the spherical oscillator journal to weave with respect to the crankshaft axis; however the inclined axis of the crank element in combination with the gearing transforms rotations of the crankshaft into substantially straight line lateral reciprocations of the outerly portions of the oscillator. During the compression stroke, the inclined crank element forces the central portion of journal 25 radially outward against thrust bearing 23, which because of its spherical curvature, deflects the thrust and directs it laterally against the pistons; and when during the combustion stroke the pistons move outwardly, the thrust bearing, in cooperation with the other elements changes the direction of the piston thrust into a weaving movement of the oscillator and rotation of the crankshaft. It will be seen that the crankshafts are not called upon to carry thrust and that the thrust from the pistons is exerted against the brackets, which are firmly bolted to the ends of the engine block and form a rigid assembly, substantially free from distortion, and since the thrust bearings may have a relatively large bearing surface, my construction and arrangement are well suited for the production of high power. The surface of the spherical journal associated with outer portion 25 of the oscillator is preferably extended to include the arms 37, so that the piston thrust due to inertia, when the pistons are in an outer position during high speed operation, may be transferred to an outer portion of the thrust bearing as shown in the lower half of Fig. 1, to prevent distortion of the arms or journal surface.

The crankshafts are rotationally connected to operate as a unit in fixed circumferential relationship with one another. This is accomplished by an axially slidable joint 43 formed by splines cut in the ends of the crankshafts which may be made to mesh with each other or preferably by providing an intermediate shaft 44, having splines adapted to mesh with those on the crankshafts as shown. This feature of my invention is broadly claimed in my co-pending application for Engine, Serial No. 403,190, filed July 19, 1941. The crankshafts are preferably connected so that one crank element is in the lead and operates to uncover the exhaust ducts 45 before the inlet ducts 46 are uncovered. With my construction and arrangement, assembly and disassembly of the engine can be quickly and easily effected. For instance, removal of the bolts 13' permits the withdrawal of the bracket 12' together with the crankshaft, oscillator and pistons, and facilitates rapid inspection or replacement of these or associated parts. It is also seen that my construction of the crankshaft and associated parts makes the use of anti-friction bearings possible, not only for the main shaft bearings but also for the crank bearing, because of the inclined position of the crank element, which permits the bearing and locknut to be slipped into position over the small end, although it should be understood that plain bearings may be used in instances where a lower bearing efficiency is not objectionable.

When the engine is operated with high cylinder pressure and at high speed, the spherical oscillator journal, the pistons connected to the oscillator, and the central portion of the cylinders tend to overheat and to expand unevenly or excessively. As heretofore mentioned one of the objects of the invention is to secure greater uniformity of temperature between operatively associated parts. For this purpose I provide a cooling chamber 47' in the head of each piston and a pump 48' preferably arranged within the bracket 14' and driven by the worm gear 49' and the crankshaft for circulating a coolant through the chamber. Oil from the lower portion of bracket 12' flows into the reservoir 50', past the radiator 51', is drawn into the pump through the pipe 52' and through the ducts 53' is forced into the annular chamber or groove 54' in the spherical bearing surface of bracket 12', and as the oscillator journal weaves with respect to the groove, various portions of the journal surface are successively exposed to the coolant which also serves as a lubricant. The outer portion of the oscillator 25 is provided with ducts 55, the connecting rods with ducts 56 and the piston chambers with inlet ducts 57, shown in Fig. 3, so that each time the pistons pass their intermediate position, duct 55 registers with groove 54 and conducts the coolant into cooling chamber 47 and through the outlet duct 58 back into the bracket, reservoir and pump. For the sake of compactness and in order to avoid external plumbing each end of the engine

is preferably provided with a separate circulating system, insuring effective temperature equalization in both end assemblies.

I also provide means for securing substantially uniform expansion of, and equalization of temperature in the cylinder block. In order to secure cylinder walls of uniform thickness and facilitate casting, the cylinder block is cast in one piece but without an outer jacket wall, and the cylinders are provided with outwardly extending open ended conduits **59**, forming the exhaust ducts **45** and with open ended conduits **60** extending outwardly from the combustion chamber, for the spark plugs **61**, or the like, and are further provided with an intermediate web or partition **62**, forming with outer web **19** an annular space adjacent the intake ports or ducts **46**. The webs **62** and **19'** and the ends of the conduits **59** and **60** are finished preferably to the same diameter and a separate jacket or sleeve **63** is tightly fitted over these portions of the block to form a cooling chamber or jacket for the cylinders and for the conduits **59**, **60**. This feature of my invention is claimed broadly in my co-pending application for Engine, Serial No. 393,308, filed May 14, 1941. A second sleeve or band **64** is fitted over the webs **19** and **62** to form an induction chamber and is provided with an opening and an intake conduit **65** to which induction means, such as a compressor or carburetor may be connected. The sleeve **63** is likewise provided with openings and exhaust nozzles **66** which may be connected with an exhaust pipe in any suitable manner, not shown. I provide means for circulating the liquid coolant vigorously within the cylinder block. It consists of an impeller **67** drawing the liquid through openings **68**, **68'** in sleeve **20** and expelling it through the openings **69** toward the cylinders. Guide plates **70**, **70'** and webs **71**, **71'** direct the coolant around all the cylinders and help to prevent the central cylinder portions from overheating. A radiator **72** and pump **73** connected with the engine jacket by pipes **74**, **75** and **76** serve to dispose of the excess engine heat. The feature for securing greater uniformity of temperature in the engine by an impeller arranged in substantially uniform proximity to all the cylinders within the engine jacket is broadly claimed in my co-pending application for Engine, Serial No. 393,308, filed May 14, 1941.

It should be noted that various changes may be made in the details of construction and combination of the various parts of my device and one or more of the features disclosed herein may be used in the illustrated or other embodiments without departing from the spirit of my invention, and I desire to cover by my claims such changes and other embodiments which may reasonably be included within the scope of my invention.

I claim as my invention:

1. In a barrel engine: the combination of a stationary engine body having a pair of crank chambers, a plurality of laterally extending cylinders connecting said crank chambers, an outer wall adapted to form a cooling jacket for said cylinders and a spherical thrust bearing associated with each crank chamber arranged concentric with respect to said cylinders; an annular oscillator in each crank chamber, each oscillator provided with a spherical bearing operatively associated with the thrust bearing in said crank chamber and provided with a central bearing arranged axially concentric with respect to said spherical bearing; a pair of opposed pistons in each cylinder, each piston provided with a cooling chamber; means including connecting rods for connecting the pistons with outer portions of said oscillators; a pair of rotatable crankshafts in said crank chambers, each crankshaft provided with an inclined crank element in operative association with a central oscillator bearing and adapted to hold said oscillator in an inclined position; bearing means for supporting the crankshafts by the stationary engine body; fulcrum means including gearing associated with the oscillators and stationary body for transferring torque therebetween; means including a slidable joint for rotatably connecting the crankshafts with each other; means for cooling the pistons and the spherical bearings including a coolant and ducts in said pistons, piston rods and oscillators for conducting the coolant through the cooling chambers in the pistons; and means for cooling the cylinders including a coolant in said jacket, an impeller connected to one of the crankshafts for agitating the coolant within the jacket, a radiator connected with the jacket to form a circuit, and a pump connected in said circuit for circulating the coolant between the jacket and radiator.

2. In a barrel engine: the combination of a stationary cylinder block having a hollow core and a plurality of cylinders arranged around the core extending laterally through the block; a sleeve disposed within said core in circumferentially fixed association with the cylinder block and provided at each end with a spherical bearing; a bracket secured to one end of the block provided with a concavely spherical thrust bearing arranged concentric with one of said sleeve bearings to form therewith a pair of concentric bearings; a bracket secured to the other end of the block also provided with a concavely spherical thrust bearing arranged concentric with the other sleeve bearing and forming therewith a second pair of concentric bearings; an annular oscillator having inner and outer spherical bearings operatively associated with one pair of concentric bearings and having a central anti-friction bearing arranged concentric with respect to the spherical bearings and a second annular oscillator having inner and outer spherical bearings operatively associated with said second pair of concentric bearings and also provided with a central anti-friction bearing arranged axially concentric with respect to the spherical bearings; a pair of opposed pistons in each cylinder and means for connecting the pistons with outer portions of the oscillators; a pair of rotatable crankshafts, each crankshaft provided with an inclined crank element in operative association with a central oscillator bearing and adapted to hold said oscillator in an inclined position; anti-friction bearing means for supporting one portion of the crankshafts by the brackets and another portion by said sleeve; means for rotatably connecting the crankshafts with one another including an axially slidable joint; and fulcrum means for transferring torque between the oscillators and cylinder block including a bevel sleeve gear associated with each end of said sleeve and a bevel oscillator gear associated with each oscillator and meshing with the sleeve gears, said gears having pitch lines converging with the radial center of adjacent spherical bearings.

3. In a barrel engine: the combination of a stationary body including a cylinder block hav-

ing a plurality of cylinders extending laterally through the block and a pair of brackets secured to the ends of the block and forming therewith a pair of crank chambers, each bracket being provided with a concavely spherical thrust bearing; an annular oscillator in each crank chamber, each oscillator provided with a spherical journal operatively associated with the thrust bearing in said crank chamber and provided with a central bearing arranged axially concentric with respect to said spherical journal; a pair of opposed pistons in each cylinder and means for connecting the pistons with outer portions of the oscillators; a pair of rotatable crankshafts in said crank chambers, each crankshaft provided with an inclined crank element in operative association with the central oscillator bearing and adapted to hold said oscillator in an inclined position; bearing means for supporting one portion of the crankshafts by the brackets and another portion by the cylinder block; means for rotatably connecting the crankshafts with one another including an axially slidable joint; and fulcrum means associated with the oscillators and stationary body for transmitting torque therebetween.

4. In a barrel engine: the combination of a stationary engine body having a crank chamber, a plurality of laterally extending cylinders extending into said crank chamber, an outer wall adapted to form a cooling jacket for said cylinders and a spherical thrust bearing associated with the crank chamber arranged concentric with respect to said cylinders; an annular oscillator in said crank chamber having a spherical bearing operatively associated with the thrust bearing in said crank chamber and having a central bearing arranged axially concentric with respect to said spherical oscillator bearing; a piston in each cylinder provided with a cooling chamber; means including connecting rods for connecting the pistons with outer portions of said oscillator; a rotatable crankshaft in said crank chamber having an inclined crank element in operative association with said central bearing adapted to hold the oscillator in an inclined position; bearing means for supporting the crankshaft by the stationary engine body; fulcrum means including gearing associated with the oscillator and stationary body for transferring torque therebetween; means for cooling the pistons and the spherical bearings including a coolant and ducts in said pistons, piston rods in said oscillator for conducting the coolant through the cooling chambers in the pistons; and means for cooling the cylinders including a coolant in said jacket, an impeller connected to the crankshaft for agitating the coolant within the jacket, and external means associated with the jacket for cooling said jacket coolant.

5. In a barrel engine: the combination of a stationary cylinder block having a plurality of laterally extending cylinders and provided with an inner spherical bearing surface arranged concentric with respect to said cylinders; a bracket secured to the cylinder block adapted to form therewith a crank chamber and provided with a concavely spherical thrust bearing arranged concentric with respect to said inner spherical bearing; a non-rotating oscillator arranged within the crank chamber having an inner portion provided with a spherical bearing surface operatively associated with said inner bearing, an outer portion provided with a convexly spherical journal operatively associated with said thrust bearing, an anti-friction bearing having an outer race and an inner race and means associated with said oscillator portions for locking the oscillator portions firmly together and for securing said outer bearing race centrally within the oscillator; a rotatable crankshaft having an inclined crank element and means for locking said inner bearing race firmly to the crank element whereby the oscillator is held in an inclined position; anti-friction bearing means for supporting the crankshaft by the cylinder block and by the bracket; pistons in said cylinders; means for connecting the pistons with said oscillator; and fulcrum means for transferring torque between the oscillator and cylinder block including bevel gear teeth in said inner oscillator portion and bevel gear teeth fixedly associated with the cylinder block meshing with the oscillator gear teeth, said gear teeth having pitch lines converging with the center of said spherical bearings.

6. In a barrel engine: the combination of a stationary cylinder block having a plurality of laterally extending cylinders and provided with an inner spherical bearing surface arranged concentric with respect to said cylinders; a bracket secured to the cylinder block adapted to form therewith a crank chamber and provided with a concavely spherical thrust bearing arranged concentric with respect to said inner spherical bearing; a non-rotating oscillator arranged within the crank chamber having an inner portion provided with a spherical bearing surface operatively associated with said inner bearing, an outer portion provided with a convex spherical journal operatively associated with said thrust bearing, an anti-friction bearing having an outer race and an inner race and means associated with said oscillator portions for locking the oscillator portions firmly together and for securing said outer bearing race centrally within the oscillator; a crankshaft having an inclined crank element and means for locking said inner bearing race firmly to the crank element whereby the oscillator is held in an inclined position; bearing means for supporting the crankshaft by the cylinder block and the bracket; pistons in said cylinders; means for connecting the pistons with said oscillator; and fulcrum means for transferring torque between the oscillator and cylinder block.

7. In a barrel engine: the combination of a stationary cylinder block having a plurality of laterally extending cylinders; a bracket secured to the block forming therewith a crank chamber having an outer concavely spherical thrust bearing arranged to face the cylinders and an inner spherical bearing arranged concentric with respect to said thrust bearing; a non-rotating annular oscillator having a pair of concentric spherical bearings operatively associated with the crank chamber bearings and provided with a central bearing arranged axially concentric with respect to the spherical oscillator bearings; a crankshaft having an inclined crank element rotatably associated with said central bearing and adapted to hold the oscillator in an inclined position; bearing means associated with the cylinder block and bracket for rotatably supporting the crankshaft near both ends of said crank element; pistons in said cylinders and connecting means for reciprocably connecting the pis-

tons with outer portions of the oscillator; and fulcrum means for transferring torque between the oscillator and cylinder block including a pair of meshing bevel gears, one gear being fixedly associated with the oscillator and the other gear being fixedly associated with the engine block.

8. In a barrel engine: the combination of a stationary body having a cylinder block provided with a plurality of laterally extending cylinders, an intermediate bracket secured to the engine block, an outer bracket secured to the intermediate bracket and a partition shaped to form a concave spherical thrust bearing and a crank chamber on one side of the partition and a counterweight chamber on the other side; a non-rotating oscillator disposed within said crank chamber having a spherical journal operatively associated with said thrust bearing and having a central bearing arranged axially concentric with respect to the spherical journal; a crankshaft having an inclined crank element rotatably associated with said central bearing adapted to hold the oscillator in an inclined position and provided with a counterweight disposed within said counterweight chamber; bearing means for supporting one portion of the crankshaft by the cylinder block and another portion by the outer bracket; pistons in said cylinders and means for connecting the pistons with outer portions of the oscillator.

9. In a barrel engine adapted to be cooled by a liquid: the combination of a stationary engine body having a crank chamber, a plurality of laterally extending cylinders opening into said crank chamber and a spherical concave thrust bearing associated with said crank chamber arranged to face one end of the cylinders; a non-rotating oscillator arranged within said crank chamber having a spherical journal operatively associated with said thrust bearing and having a central bearing arranged axially concentric with respect to said spherical journal; a crankshaft having an inclined crank element rotatably associated with said central bearing adapted to hold the oscillator in an inclined position; bearing means for supporting the crankshaft by said engine body; pistons in said cylinders and means including connecting rods for connecting the pistons with outer portions of said oscillator; and means for cooling the pistons and oscillator bearing and journal including a cooling chamber in each piston head, an inlet duct and an outlet duct associated with each piston cooling chamber, a duct in each connecting rod communicating with an inlet duct, a plurality of ducts in said oscillator communicating with the connecting rod ducts, a liquid coolant and means for conducting the coolant to the oscillator ducts.

10. In an engine of the class wherein a double ended cylinder block provides laterally extending cylinders having axes arranged about the rotational axis of the engine, each cylinder being provided with a pair of oppositely arranged reciprocable pistons and a pair of separately formed but interconnected power shafts having inclined crank elements providing reciprocation of the pistons with respect to the cylinders: the combination with said cylinder block of a pair of thrust brackets secured thereto forming therewith an engine body and a crank chamber at each end thereof, each bracket providing a concentric surface, with respect to a shaft, concavely spherical thrust surfaces arranged to face the ends and to be intersected by the axes of said cylinders; and a pair of oscillators operatively associated with said engine body and with said inclined crank elements having outer portions connected with said pistons, each oscillator being provided with a convex spherical bearing surface operatively engaging a corresponding thrust surface for the transmission of power between the pistons and a shaft.

11. In an engine of the class wherein a double ended cylinder block provides laterally extending cylinders having axes arranged about the rotational axis of the engine, each cylinder provided with a pair of oppositely arranged reciprocable pistons and the ends of the engine provided with a pair of power shafts, each having an inclined crank element adapted to provide reciprocation of the pistons with respect to the cylinders: the combination with said cylinder block of a pair of thrust brackets secured thereto forming therewith an engine body and a crank chamber at each end thereof, each bracket providing a concentric surface, with respect to a shaft, concavely spherical thrust surfaces arranged to face the ends and to be intersected by the axes of said cylinders; a pair of oscillators operatively asociated with said engine body and with said inclined cranks having outer portions connected with said pistons, each oscillator being provided with a convex spherical bearing surface operatively engaging a corresponding thrust surface for the transmission of power between the pistons and a shaft; and means for connecting said shafts in circumferentially fixed relation with one another including an axially slidable joint.

12. In an internal combustion engine of the class wherein a stationary cylinder block provides laterally extending cylinders arranged about the rotational axis of the engine, reciprocable pistons in said cylinders provided with cooling chambers and a power shaft having an inclined crank element providing reciprocation of the pistons with respect to the cylinders: the combination with said cylinder block of a thrust bracket secured thereto forming therewith an engine body and a crank chamber at one end thereof, said bracket providing a concentric, with respect to said shaft, concavely spherical thrust bearing surface facing the ends of said cylinders; an oscillator operatively associated with said engine body and with said inclined crank element having an outer portion connected with said pistons, said oscillator being provided with a convex spherical bearing surface operatively engaging said thrust surface for the transmission of power between the pistons and said shaft; and means for cooling and lubricating said pistons and said spherical thrust bearing, said means including a liquid and ducts in said pistons, oscillator and bracket for conducting said liquid through the cooling chambers in said pistons.

13. In an engine of the class wherein a cylinder block provides laterally extending cylinders having axes arranged about the rotational axis of the engine, the cylinders provided with reciprocable pistons and a power shaft having an inclined crank element on one side and a counterweight on the opposite side providing reciprocation of the pistons with respect to the cylinder: the combination with said cylinder block of a thrust bracket secured thereto providing on its inner side a crank chamber and a concentric surface, with respect to said shaft, forming a concavely spherical thrust bearing surfaces arranged to face the ends and to be intersected by the axes of said cylinders and providing on its outer side a chamber for housing said counter-

weight; and an oscillator operatively associated with said engine body and with said inclined crank element having an outer portion connected with said pistons, said oscillator being provided with a convex spherical bearing surface operatively engaging said thrust bearing surface for the transmission of power between the pistons and said shaft.

14. In an engine of the class wherein a cylinder block provides laterally extending open ended cylinders having axes arranged about the rotational axis of the engine, the cylinders provided with pistons and a shaft having an inclined crank element adapted to provide the rotational axis for the engine and relative reciprocation between pistons and cylinders: the combination with said cylinder block of a bracket secured thereto forming therewith an engine body and a crank chamber at one end thereof, said bracket providing a concentric with respect to the shaft concavely spherical thrust bearing surface arranged to face the open ends and to be intersected by the axes of said cylinders; and a relatively movable oscillator associated with said inclined crank element having joints arranged within the radius of said spherical thrust bearing and providing beyond the radius of said joints a convex spherical bearing surface operatively engaging said thrust bearing surface whereby linear thrust between engine body and pistons is made to exert a torsional thrust upon said shaft.

15. In an engine of the class wherein an engine body provides a crankcase and open ended cylinders, having axes arranged about the rotational axis of the engine, extend laterally into the crankcase, the cylinders provided with pistons, a shaft providing the rotational axis for the engine and an inclined crank element associated with said shaft arranged on an axis intersecting the rotational axis of the engine substantially at the vertex and adapted to provide relative reciprocation between the pistons and cylinders: the combination with said engine body of an inner spherical bearing surface arranged concentric with said vertex and an outer concavely spherical thrust bearing surface arranged concentric with the inner bearing surface to face the open ends and to be intersected by the axes of said cylinders; and a relatively movable oscillator associated with said inclined crank element providing spherically concentric inner and outer bearing surfaces operatively engaging the inner and outer spherical bearing surfaces of the engine body and further providing joints arranged radially intermediate the inner and outer spherical bearing surfaces connecting the oscillator with the pistons whereby linear thrust between engine body and pistons is made to exert a torsional thrust upon the shaft.

16. In an engine of the class wherein a cylinder block provides laterally extending open ended cylinders having axes arranged about the rotational axis of the engine, the cylinders provided with pistons, a shaft providing the rotational axis for the engine and an inclined crank element associated with said shaft provides reciprocation between the pistons and cylinders: the combination with said cylinder block of a bracket secured thereto forming therewith an engine body and a crank chamber at one end thereof, said bracket providing a concentric with respect to the shaft concave spherical thrust bearing surface arranged to face the open ends and to be intersected by the axes of said cylinders; a bevel fulcrum gear arranged concentric with an radially between the cylinders and said shaft; and a relatively movable oscillator associated with said inclined crank element comprising an inner portion having a bevel gear in mesh with said fulcrum gear, an outer portion providing a convex spherical bearing surface operatively engaging said thrust bearing surface radially beyond the outer circle of said cylinder axes and further comprising joints connecting the pistons with the oscillator intermediate the bevel gear and the outer periphery of said convexly spherical bearing surface whereby linear thrust between engine body and pistons is made to exert a torsional thrust upon the shaft.

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