Aug. 18, 1931. S. W. THOMPSON 1,819,137

INTERNAL COMBUSTION ENGINE

Filed Aug. 14, 1929 5 Sheets-Sheet 1

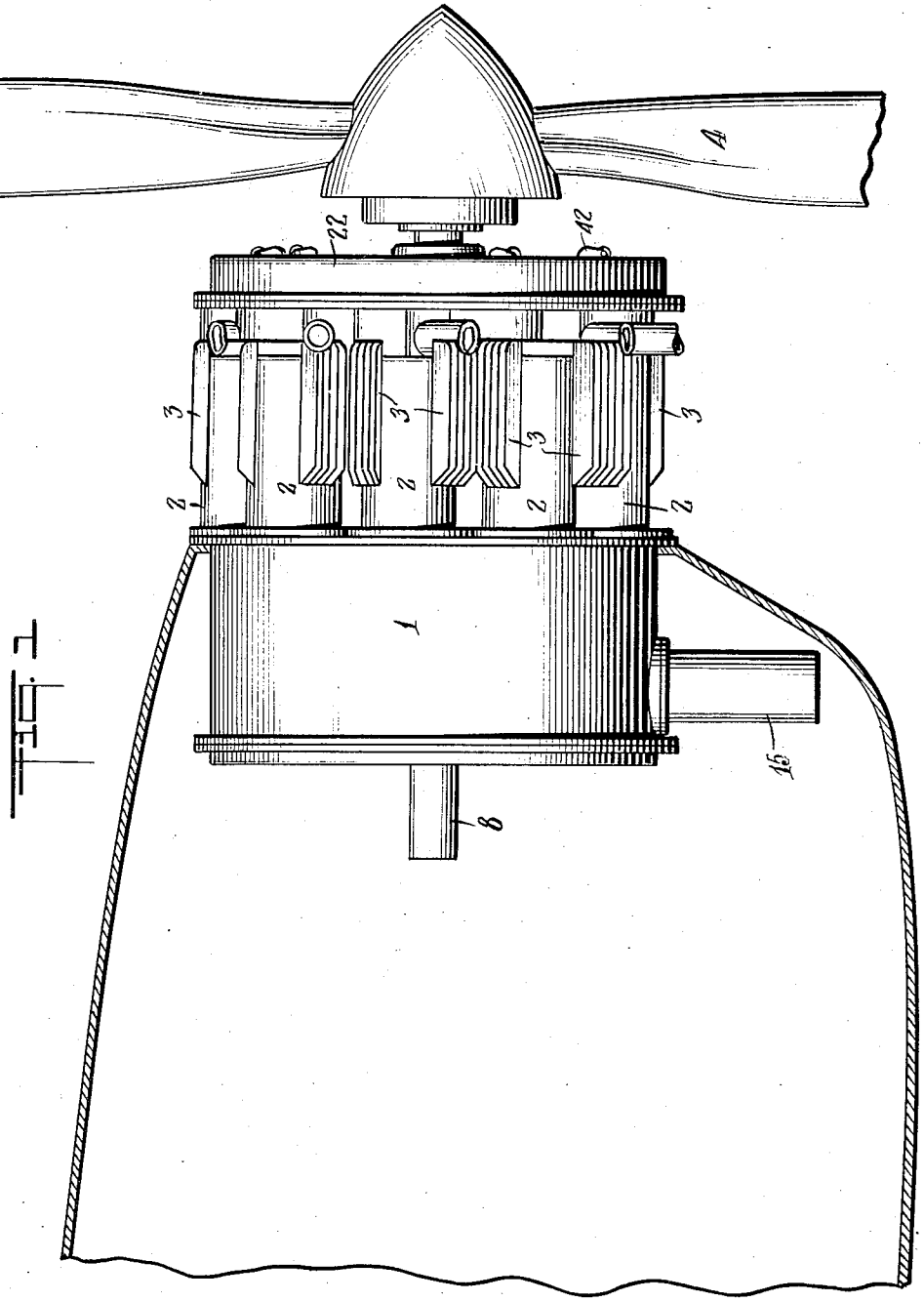

FIG. 1

INVENTOR
Seth W. Thompson
BY
Robert Gillgore
ATTORNEY

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INTERNAL COMBUSTION ENGINE

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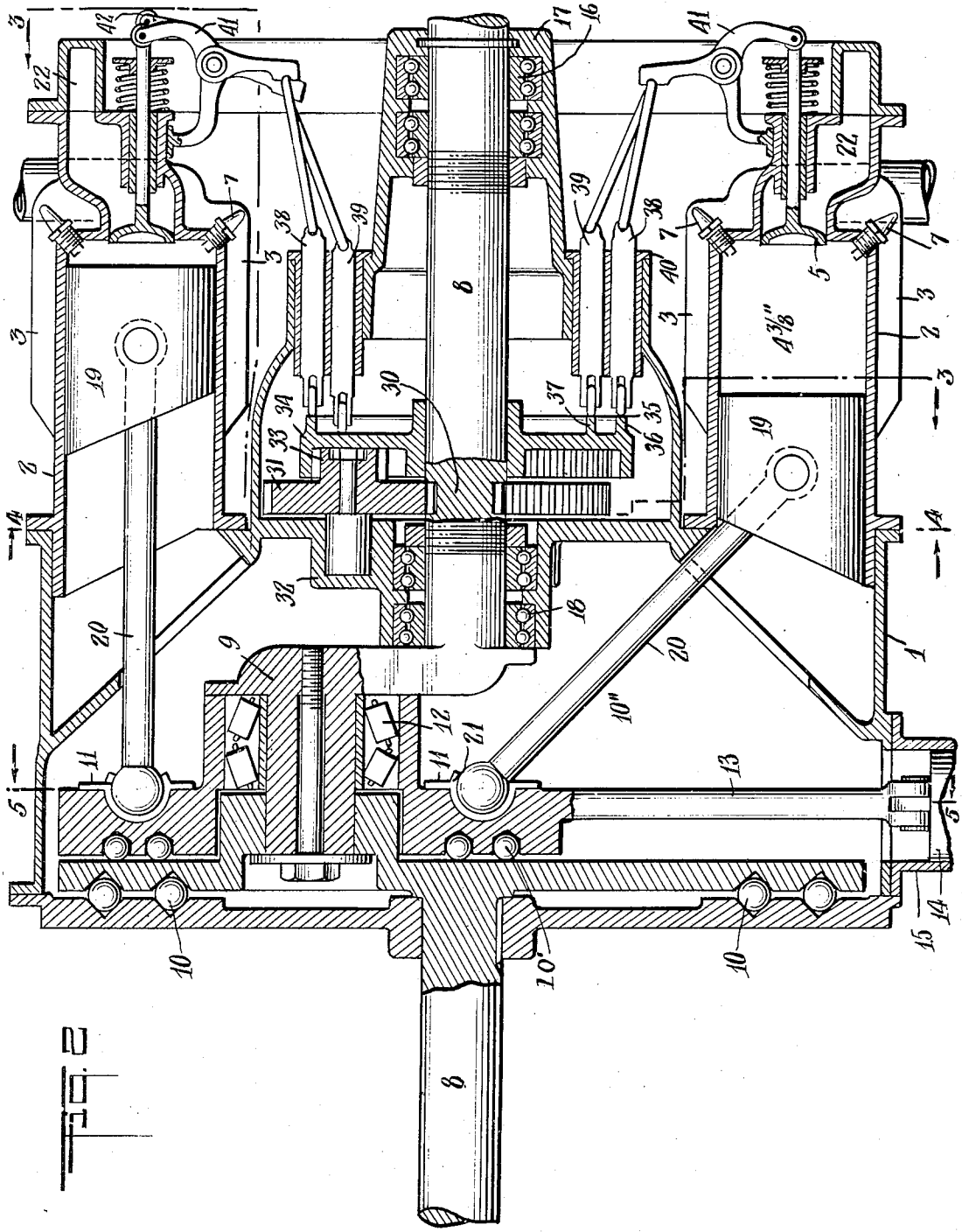

Fig. 2

Seth W. Thompson INVENTOR

BY Roberts & Kellogg

ATTORNEY

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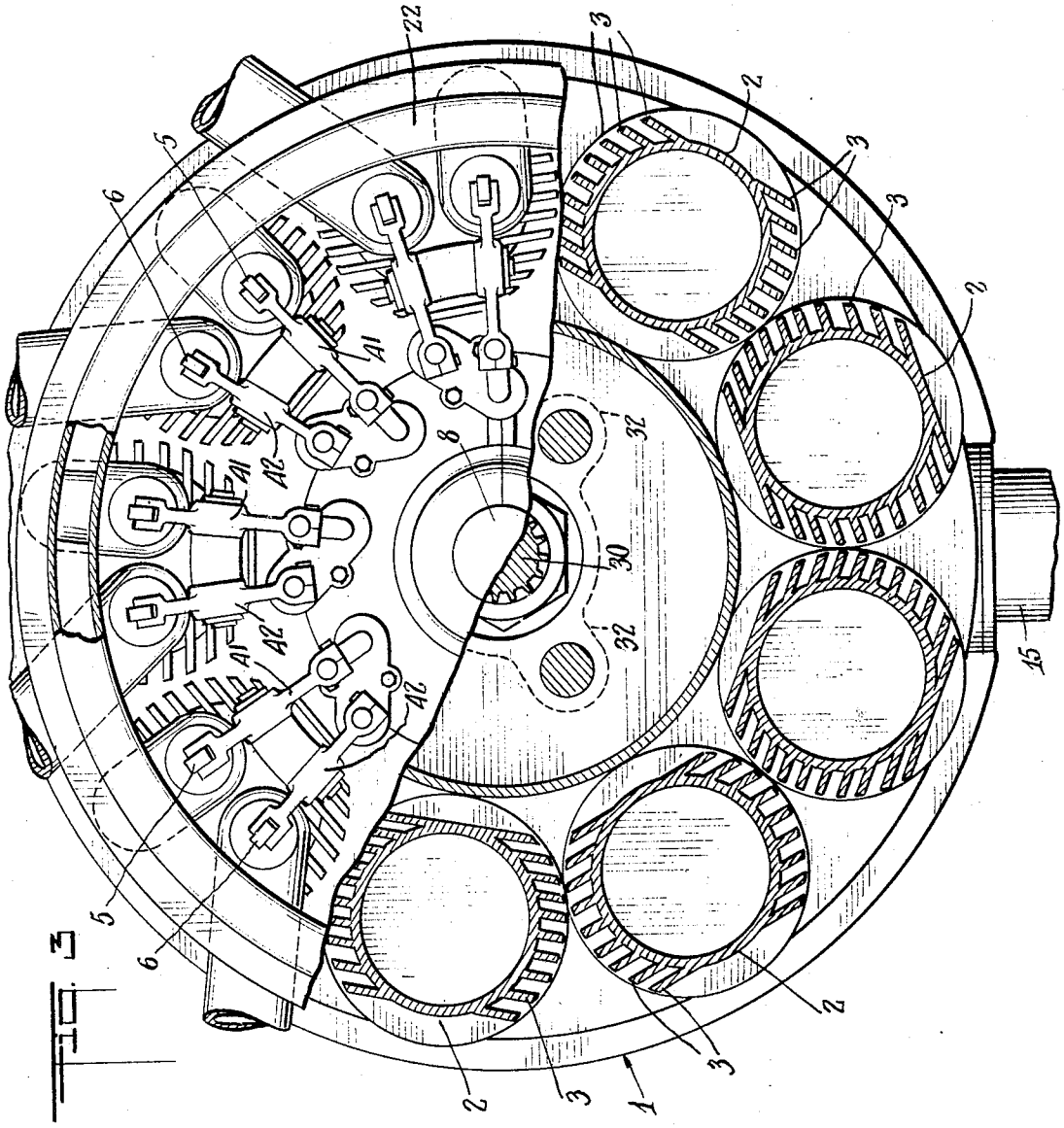

Fig. 3

INVENTOR
Seth W. Thompson
BY Roberts & Lillegard
ATTORNEY

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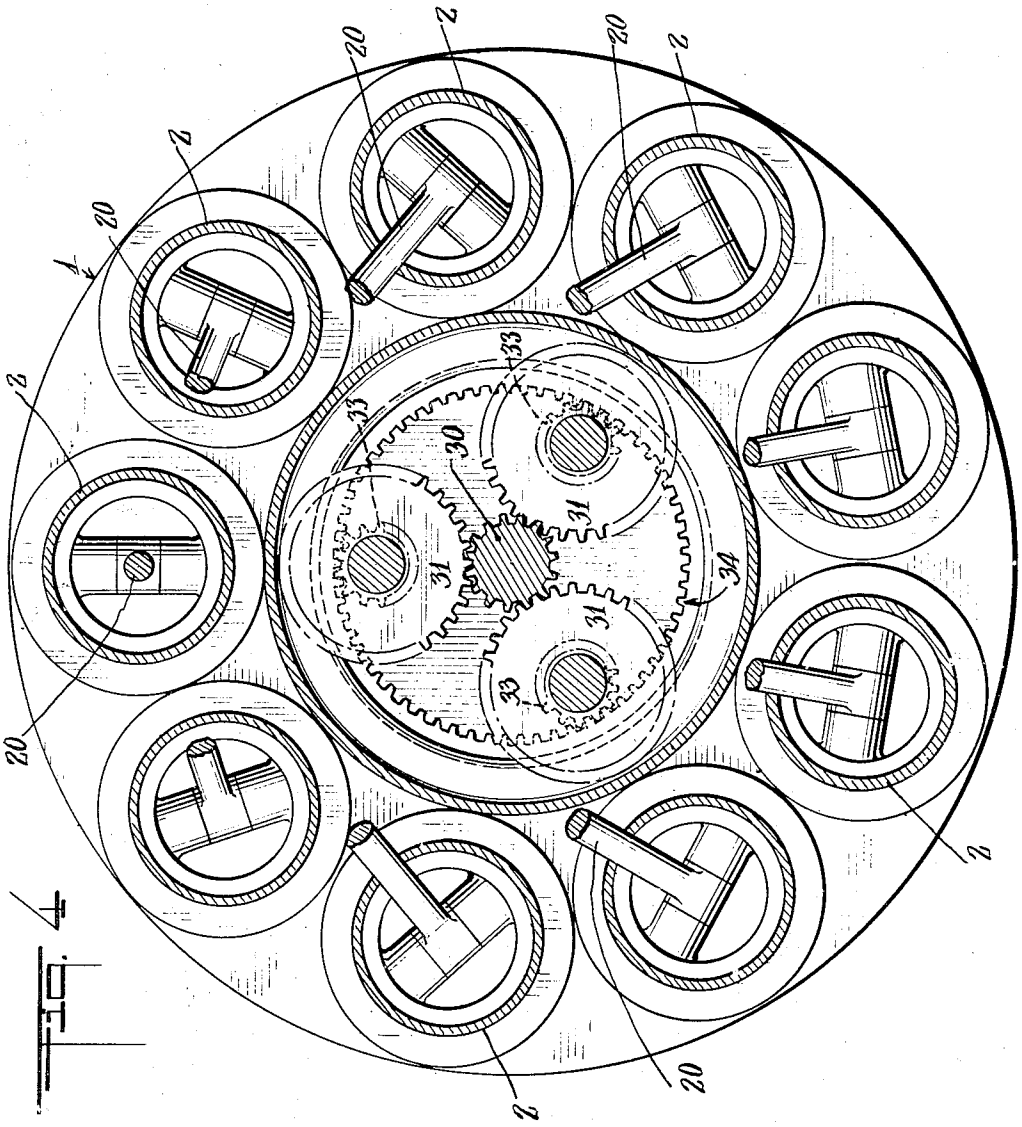

Fig. 4.

INVENTOR
Seth W. Thompson
BY
Robert B. Gilgore
ATTORNEY

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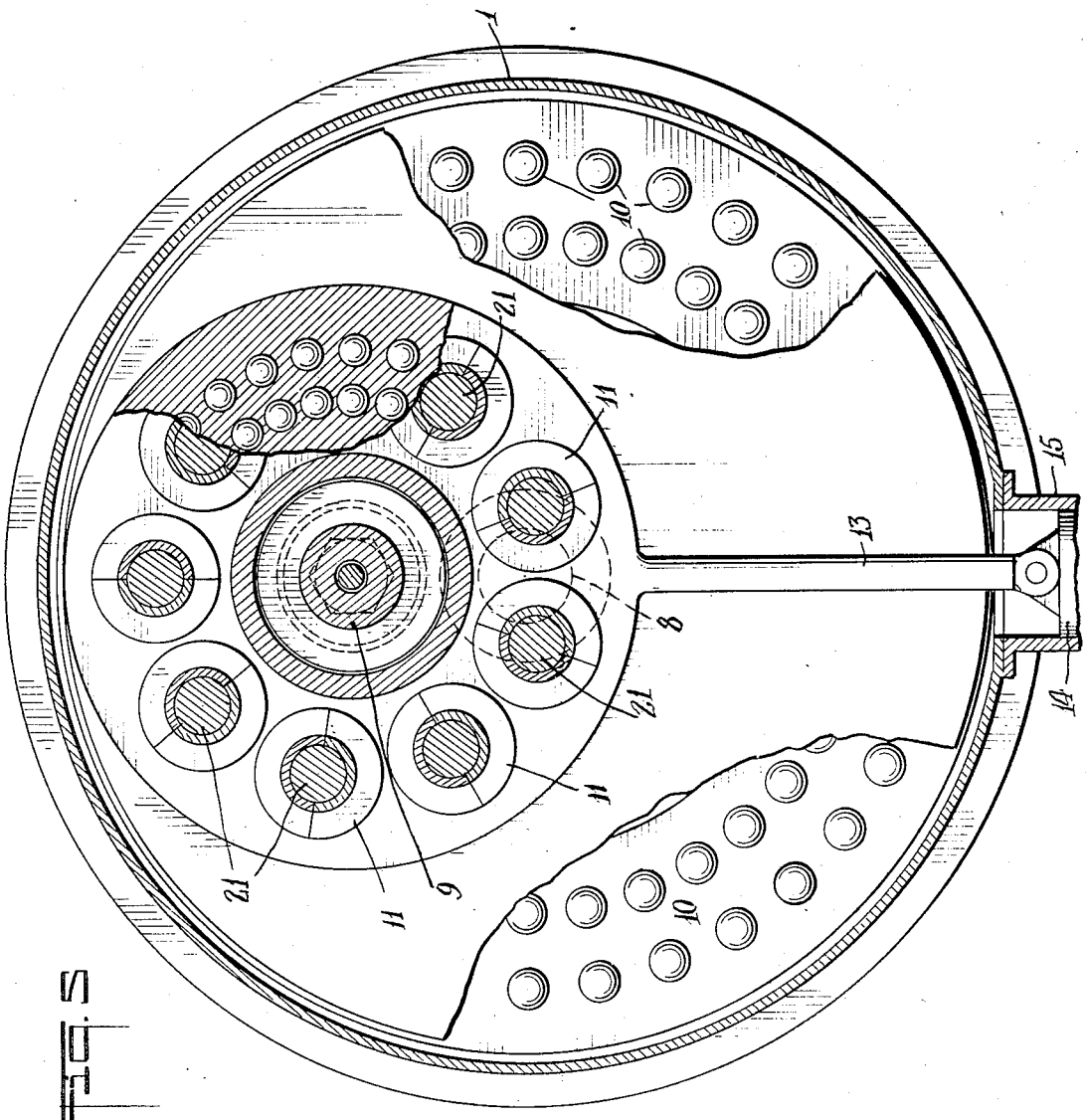

FIG. 5

INVENTOR
Seth W. Thompson
BY
Robert H. Killgore
ATTORNEY

Patented Aug. 18, 1931 1,819,137

UNITED STATES PATENT OFFICE

SETH W. THOMPSON, OF MONTCLAIR, NEW JERSEY

INTERNAL COMBUSTION ENGINE

Application filed August 14, 1929. Serial No. 385,743.

My invention relates primarily to a method and mechanism for the conversion of reciprocating motion in one plane to rotary motion in another plane not parallel to the plane of the reciprocating motion and the reverse thereof and the present application discloses such method and mechanism embodied in an internal combustion engine especially designed for aviation purposes, and it is my object to produce a multi-cylinder engine in which the cross-sectional area will be small thereby reducing the head resistance in flight and increasing the visibility of the pilot at all times and practically eliminating the so-called "blind spot", in which the heads of the cylinders and valves may be presented to the line of travel in flight thereby increasing the cooling efficiency, in which the cooling will be uniform entirely around each cylinder and in which the leverage exerted on the eccentric or crank shaft by the pistons and connecting rods will be increased over the standard practice.

In developing my engine I have discovered a new method of applying the power of a piston to an eccentric or crank shaft in which a relatively small movement of the piston produces a large movement of the big end of the connecting rod thereby increasing the leverage exerted by the piston on the eccentric or crank shaft and increasing the torque of the latter.

For the purpose of disclosing my invention I have illustrated an air cooled engine with the propeller ahead of the cylinder heads but the engine may be liquid cooled and the engine may be in reversed position with the propeller ahead of the crank case without departing from my invention.

In the drawings Fig. 1 is a side, perspective view of my engine; Fig. 2 a sectional view of the engine; Fig. 3 a head view, partly broken away, of the structure of Fig. 2 on the line 3—3 thereof; Fig. 4 a sectional view of the valve driving mechanism of the structure of Fig. 2 on the line 4—4 thereof; and Fig. 5 a view of the thrust bearing and master rod of the structure of Fig. 2 on the line 5—5 thereof.

As is well known radial air cooled engine cylinders are not uniformly cooled, the backs of the cylinders operating in a partial vacuum and running hotter than the fronts which are presented to the propeller wash, thereby causing the cylinders to expand unequally. As the size of the cylinders in radial engines is increased to obtain greater horse power the "blind spot" becomes bigger due to the increase in cross-sectional area of the engine as a whole and the hazards of taking off and landing are increased as well as the resistance to flight.

I have eliminated these defects in my engine and, due to its design, have secured certain additional advantages over the orthodox construction.

As shown in the drawings my engine comprises a case 1 having a plurality of cylinders 2 mounted thereon, each of which is preferably provided with longitudinal cooling fins 3. These cylinders are mounted with their bores approximately parallel, but in some cases the bores may be inclined with respect to one another and the eccentric or crank shaft to reduce side thrust on the pistons. The heads of the cylinders face forwards toward the propeller 4 and the inlet valves 5 and exhaust valves 6 are mounted in the heads, as are the spark plugs 7.

The shaft 8 may be provided with either a throw or an eccentric and is mounted in the case 1 in a line with the center of the cylinder group and, in the form shown, has a single throw 9 with a thrust bearing 10 at its rear end to take the piston thrust.

A connecting rod bearing ring 11 is mounted on the crank throw 9, preferably on roller bearings 12, and carries a master rod 13 which is jointed to a guide piston 14 in an open ended cylinder 15 secured to the crank case 1. A thrust bearing 10′ is preferably provided for this ring.

The shaft 8 is carried on a bearing 16 mounted in a box 17 between the cylinders and carries a propeller 4 at its forward end and outside the cylinder heads. An intermediate bearing 18 is also provided next to the crank throw 9.

Each cylinder has a piston 19 therein, the skirt of which is preferably longer on one side than on the other to reduce wear due to

side thrust on the cylinder wall and to clear the connecting rod at the bottom of the stroke. Each piston has a connecting rod 20 which is secured at its big end to the connecting rod bearing ring 11 by a joint 21 capable of universal movement.

The inlet manifold 22 is secured to the cylinder heads with passages leading to the inlet valves 5, and the carbureters (not shown) are mounted thereon.

The valve drive comprises a gear 30 secured on the shaft 8 which gear meshes with gears 31 mounted on the web 32 of the case 1. Each of these gears 31 also carries a pinion 33 which meshes with an internal gear 34 on the cam track disk 35. As the shaft 8 revolves the gears cause the cam track disk to revolve in the opposite direction. This cam track disk 35 has two cam tracks 36 and 37 on its outer face, one for the inlet valves and one for the outlet valves.

For each cylinder, push rods 38 and 39 are slidably mounted in the guides 40 mounted on the hub 17 and operate rocker arms 41 and 42 which open the valves 5 and 6, the return being by spring in the usual manner.

The operation of the engine is as follows:—As the shaft 8 revolves the master rod 13 causes the connecting rod bearing ring 11 to travel in a circle with the throw 9 but does not permit it to revolve on it. As the connecting rod bearing ring 11 travels on its circular path the connecting rods 20 rise and fall moving the pistons with them. While this is taking place the valve operating cam tracks are being revolved and the valves opened and closed at the proper time.

It is apparent from this construction that as the explosions occur in the cylinders the pistons will be driven outwardly and the connecting rods will push the connecting rod bearing ring sideways with an angular movement of the connecting rod thus causing the ring to turn the shaft 8 through the medium of the throw 9 since the master rod resists its rotation on the throw.

It should be noted that the effective throw is not the length of the throw proper on the shaft 8 but the distance from the axis of the shaft 8 to the axis of a universal joint 21 on the connecting rod bearing ring thereby applying a greater torque than if the connecting rods were directly connected to the throw proper. Due to this peculiar resultant of outward and side movement of the connecting rod big end a 4⅜ inch piston stroke becomes a 10 inch movement of the big end of the connecting rod.

When the piston, connecting rod and crank throw are in the same plane or parallel planes, the crank throw movement and the distance travelled by the piston is the same. Any variation from parallel changes the equality of distance moved. This is true with one exception, viz:—if the connecting rod is exactly the same length as the throw. The length of the connecting rod varies the proportion of distance travelled by the piston as compared with the distance travelled by the crank throw. With a given length connecting rod and a given crank throw the distance the piston moves decreases as the cylinder and piston are moved from parallelism to right angles.

In the construction shown in the drawings the propeller wash is first thrown on the cylinder heads and valves, the hottest part of the engine, and then uniformly down the entire surface of the cylinder walls, effectually cooling the engine.

In the drawings I have shown one embodiment of my invention but I do not limit myself to the construction shown and described herein as the details may be varied without departing from my invention.

It is obvious that my invention may be embodied in a two cycle or in a Diesel engine without departing therefrom as the underlying principle is the translation of reciprocating power impulses generated by a cylinder and piston to a rotating crank shaft approximately parallel therewith. The same principle may be applied to pumps by applying power to the crank shaft to move the pistons in the cylinders. The engine may also be duplicated on a two throw crank shaft.

By the words "approximately parallel" in the claims I mean to include any variation from a strictly mathematical parallelism so long as the connecting rods exert their thrust to the ring on the eccentric shaft in the direction of its face rather than its edge.

By the words "eccentric shaft" in the claims I mean a shaft provided with either a crank throw or an eccentric on which the connecting rod bearing ring is mounted.

I claim:—

1. The conversion of reciprocating motion in one plane to rotary motion in another plane which is not parallel to the plane of reciprocating motion by the use of an eccentric shaft, a non-rotating member on said shaft at substantially right angles to the shaft and means for imparting the reciprocating motion to said non-rotating member.

2. The conversion of rotating motion in one plane to reciprocating motion in other planes not parallel to the plane of rotating motion by means of an eccentric shaft at substantially right angles to the shaft, a non-rotating member on said shaft, and means for imparting the rotating motion to the reciprocating member.

3. In a mechanical structure, a cylinder, a piston in said cylinder, a connecting rod on said piston, an eccentric shaft approximately parallel with the cylinder bore, a connecting rod bearing ring on the eccentric shaft at substantially right angles to the shaft, means for

connecting the connecting rod and connecting rod bearing ring, and means for preventing the rotation of said ring.

4. A mechanical movement comprising an eccentric shaft, a ring on said shaft at substantially right angles to the shaft, means for preventing the rotation of said ring, a cylinder, a piston in said cylinder, means for connecting the piston and ring whereby piston pressure is exerted in the direction of the face of the ring.

5. An internal combustion engine comprising a case, a plurality of cylinders concentrically mounted thereon, a piston and connecting rod in each cylinder, an eccentric shaft in said case centrally located with respect to the cylinders and approximately parallel with their bores, a connecting rod bearing ring on said eccentric shaft, means for connecting the connecting rods and connecting rod bearing ring, and a master rod on said ring to prevent rotation thereof.

6. An internal combustion engine comprising a case, a plurality of cylinders concentrically mounted thereon, inlet and exhaust valves in each of said cylinders, means for actuating said valves, a piston and connecting rod in each cylinder, an eccentric shaft in said case centrally located with respect to the cylinders and approximately parallel with their bores, a connecting rod bearing ring on said eccentric shaft, means for connecting the connecting rods and connecting rod bearing ring, and a master rod on said ring to prevent rotation thereof.

7. An internal combustion engine comprising a case, a plurality of concentrically arranged cylinders thereon, a piston and connecting rod in each cylinder, an eccentric shaft in said case centrally located with respect to the cylinders and approximately parallel with their bores, a connecting rod bearing ring on said eccentric shaft, means for connecting the connecting rods and connecting rod bearing ring, a master rod on said ring to prevent rotation thereof, inlet and exhaust valves in each cylinder, a cam track ring concentric with the eccentric shaft, means for rotating said cam track ring, and push rods and rocker arms connecting said valves and cam track ring whereby the valves are operated.

8. An internal combustion engine comprising a case, a plurality of cylinders concentrically mounted thereon, a piston and connecting rod in each cylinder, an eccentric shaft mounted in said case aproximately parallel with and concentric with the cylinder bores, a connecting rod bearing ring on said eccentric shaft, means for connecting the connecting rods and connecting rod bearing ring, a master rod on said ring to prevent rotation thereof and a thrust bearing on the eccentric shaft to resist the thrust of the connecting rods.

9. An internal combustion engine comprising a case, a plurality of cylinders concentrically mounted thereon, inlet and exhaust valves in each cylinder, a piston and connecting rod in each cylinder, an inlet manifold mounted on the cylinders and connecting with the inlet valves, an eccentric shaft in said case centrally located with respect to the cylinder bores and approximately parallel therewith, a connecting rod bearing ring on said eccentric shaft, means for connecting the connecting rods and connecting rod bearing ring, a master rod on said ring to prevent rotation thereof, a cam track ring concentric with the eccentric shaft, means for rotating said cam track ring, push rods and rocker arms connecting said cam track ring and valves whereby the valves are operated.

10. An internal combustion engine comprising a case, a plurality of cylinders concentrically mounted thereon, a piston and connecting rod in each cylinder, an eccentric shaft mounted in said case approximately parallel with and centrally located with respect to the cylinder bores, a connecting rod bearing ring on said eccentric shaft, a master rod on said ring to prevent rotation thereof, means for connecting the connecting rods and bearing ring on one face of the ring and a thrust bearing between the opposite face of the ring and the eccentric shaft.

In testimony whereof I have hereunto subscribed my name.

SETH W. THOMPSON.