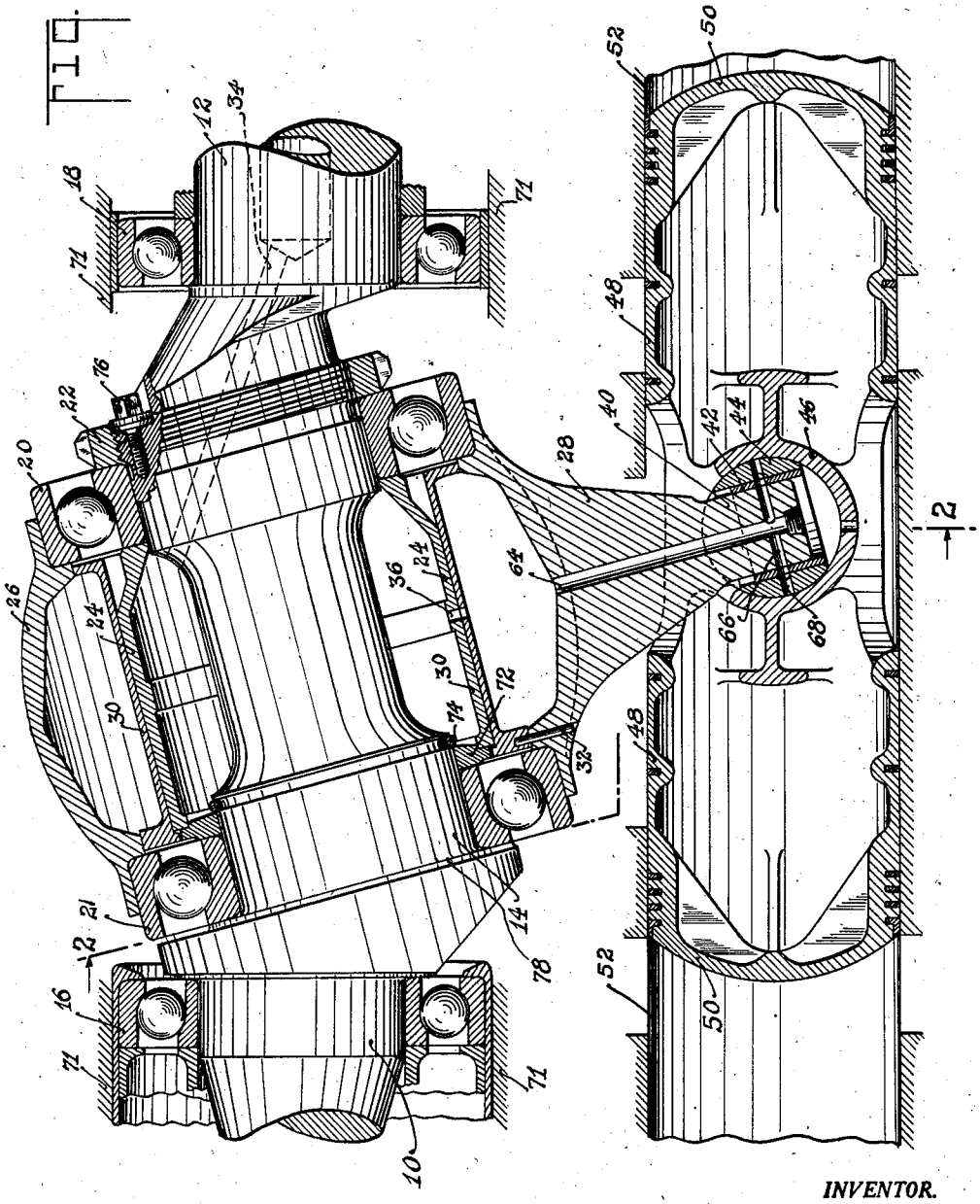
April 9, 1935. R. CHILTON 1,997,279

PISTON DRIVING MECHANISM

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FIG. 1.



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PISTON DRIVING MECHANISM

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FIG. 2.

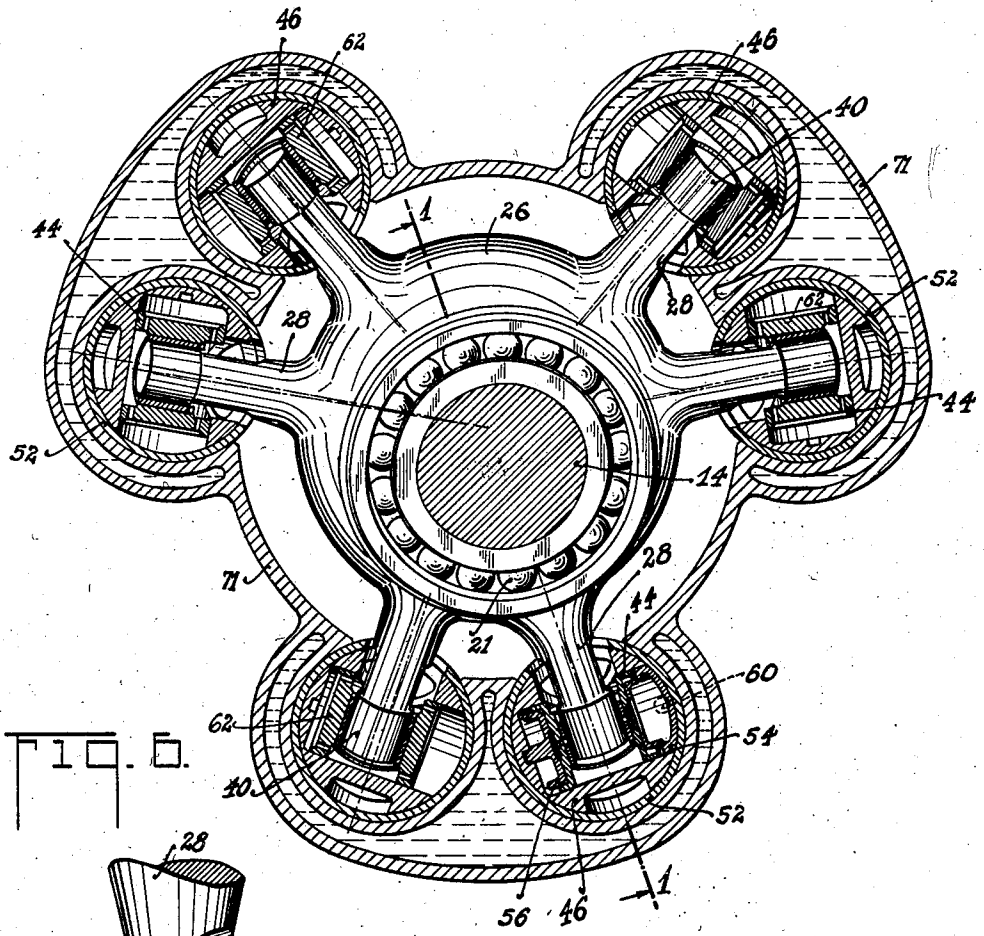
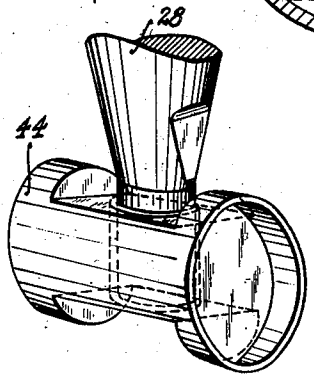


FIG. 6.



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PISTON DRIVING MECHANISM

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Fig. 3.

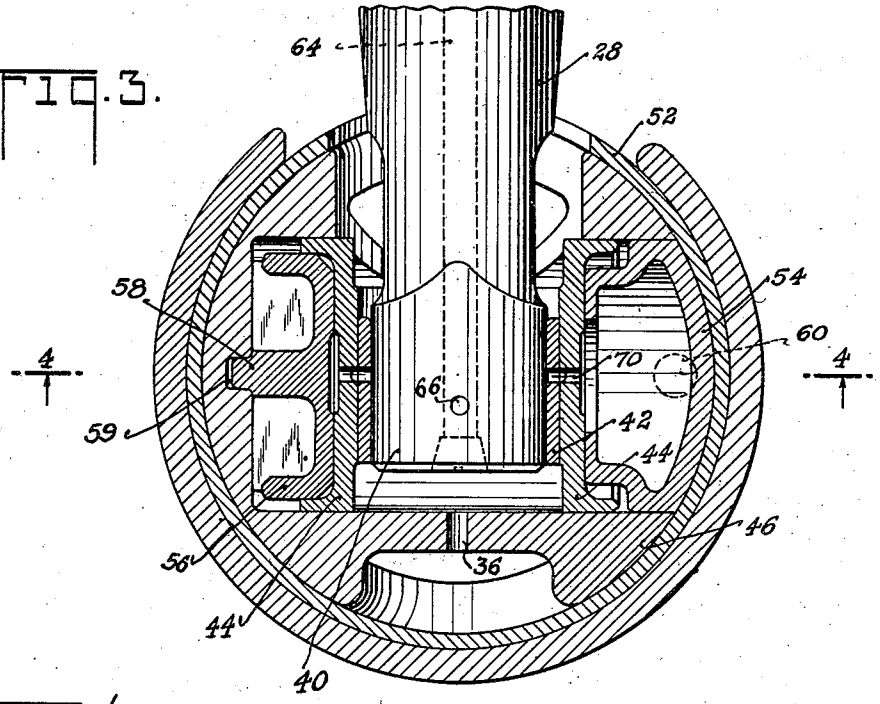


Fig. 4.

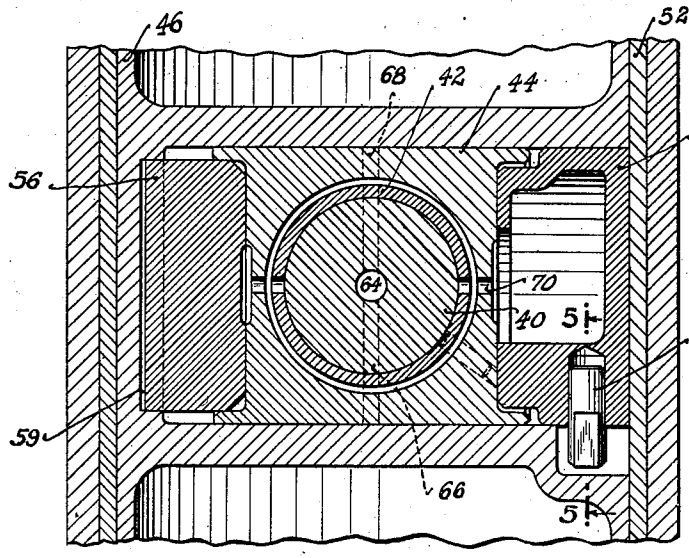
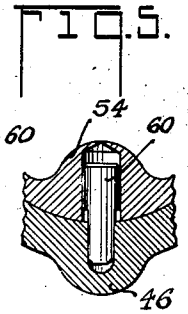


Fig. 5.



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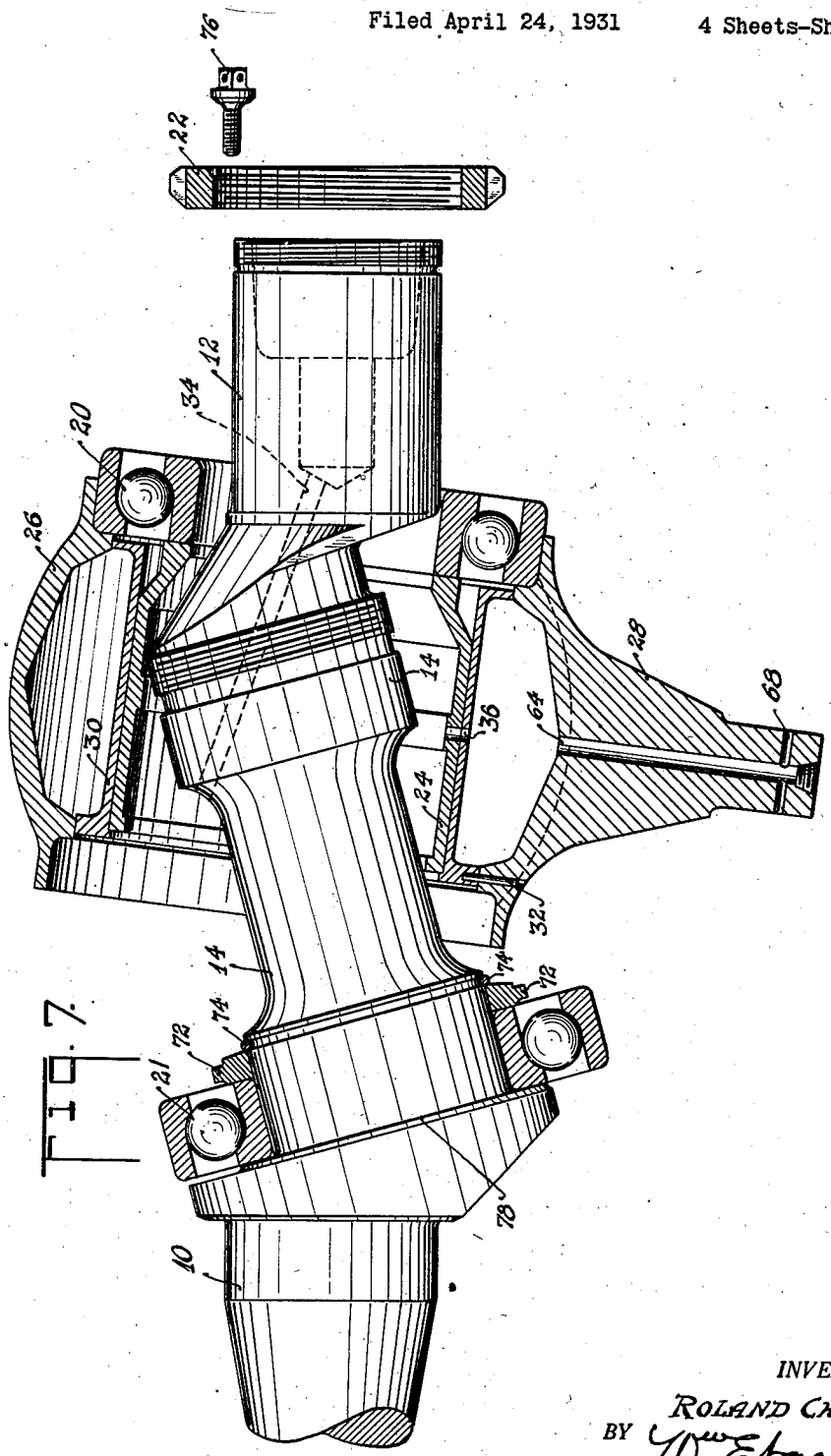


FIG. 7.

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Patented Apr. 9, 1935 1,997,279

UNITED STATES PATENT OFFICE

1,997,279

PISTON DRIVING MECHANISM

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Application April 24, 1931, Serial No. 532,552

1 Claim. (Cl. 74—60)

This invention relates to a new and improved piston driving mechanism for engines wherein the cylinders are disposed in a circle around, and parallel to, an angularly cranked driving shaft on which is journaled a wabble member.

In the preferred embodiment of the invention the nutator or wabble member comprises a spider having a plurality of piston-engaging arms which transmit the power and control the reciprocation of the pistons. When one of such arms is restrained to straight line motion by means adapted to prevent rotation of the spider, there is then relative sidewise or tangential motion at the other arms unless one of these should be disposed at 180° to the first, in which case that arm also will have a straight line motion. In the specific showings of the drawings no arm falls at 180° to another.

One object of the invention is to provide an improved form of angular crank piston operating mechanism wherein the parts shall have great strength and rigidity and which shall afford high load capacity in all the bearings and joints. Another object is to provide simple means for restraining the torque reactions developed in a mechanism of this type, while permitting proper freedom for the various necessary motions of the piston connections. An associated object is to provide a mechanism wherein the torque reactions may be taken by one or more of the pistons themselves without recourse to added mechanism.

Another object of the invention is to provide a construction which will permit the use of simple one-piece pistons which may be of double-ended form, as shown in the drawings. Another object is to provide a construction whereby both the crank and the associated wabble member may be assembled without resorting to a split or built-up construction for either. Yet another object is to achieve these results in a symmetrical mechanism wherein each of the reciprocating units has the same weight, as is necessary for correct balance.

An analysis of the motion of the piston connections shows that each must be free for plunge and rotational oscillation about the axis of the associated radial arm and must also be free for rotation and plunge about an axis normal to the radial, herein called the tangential axis, except in the case of the master piston wherein the tangential plunge is suppressed.

In the drawings:

Fig. 1 is a fragmentary longitudinal section on the line 1—1 of Fig. 2, containing the axes of the power shaft and of one piston;

Fig. 2 is a transverse section on the line 2—2 of Fig. 1, looking into the direction of the arrows. This section passes through the axes of the piston connections;

Fig. 3 is an enlarged transverse section through a master rod piston;

Fig. 4 is a fragmentary longitudinal section through the master piston connection on the line 4—4 of Fig. 3;

Fig. 5 is a fragmentary sectional detail on the line 5—5 of Fig. 4;

Fig. 6 is a perspective view illustrating the cross pin of the piston connection; and

Fig. 7 is a view, in part, similar to Fig. 1, showing the wabble member and its associated parts partly assembled on the crankshaft.

Referring first to Fig. 1, 10 and 12 designate axial journal portions of a shaft having an angular crankpin (14) and mounted on bearings (16 and 18). Anti-friction bearings (20 and 21) are axially clamped at the ends of the angular crankpin (14) by a nut (22) and distance piece or spacer (24). Journaled on these bearings is the spider or wabble member (26) provided in this case with six radial arms (28). The sleeve (30) is a running fit over the distance piece (24) and is driven into the spider body (26) and secured by a pin (32); the function of this sleeve being to conduct oil from the duct (34) to the spider by way of the holes (36).

Each of the arms (28) has at its outer end a cylindrical journal (40) engaging a bushing (42) in a cross pin or trunnion (44) journaled in a bore in the boss (46) which is preferably formed integral with the piston (48). In this case each piston is double-ended (having heads at 50) and slides in the cylinder sleeves (52).

Referring now to the enlarged views of Figs. 3 and 4 which show the master rod piston, it will be seen that in this case thrust blocks (54 and 56) are inserted in the piston to prevent end motion of the cross pin (44) and to thus oppose the torque reaction developed by the spider (26), and prevent rotation of this member. The transverse bore of the boss (46) is preferably closed at one end and the main thrust block (56) has a key (58) engaging in a groove (59) in this closed end; the counter-thrust block (54) having an arcuate face engaging the bore of the cylinder (52) and thus holding the parts in assembled relation. The thrust block (54) is restrained from rotation by a pin (60). The parts are so disposed that the block (56) in the blind end of the piston cross bore is disposed on the side on which the torque reactions from the arm (28) normally fall, where-

by an uninterrupted piston surface is available to sustain the loads.

Referring now to Fig. 2, it will be seen that the thrust blocks (54 and 56) are provided in the master rod piston only, leaving spaces at the ends of the cross pins (44) in the other pistons to permit the tangential motion developed by the associated arms. In order to compensate for the weight of the thrust blocks (54 and 56), the master piston cross pin may be made lighter than the others, as indicated by comparison with the extra thickness at 62 (Fig. 2). In this figure the relative side motions at the unrestrained cross pins are indicated.

The cylinder structure has been shown as comprising a water-jacketed casting (70) in which the sleeves (52) are inserted. Oil holes (64 and 66) are drilled in each of the arms and further holes (68) are formed in the cross pins (44) so that all of the joint surfaces are under pressure lubrication. In addition, the cross pin for the master rod piston is drilled as at 70 to provide pressure lubrication for the thrust faces of the blocks (54 and 56).

In the prior art, disassembly in wabble plate mechanisms has been secured by using very large bearings for mounting the wabble member so that the drive shaft becomes virtually an angular eccentric, or alternatively, built-up shafts have been used in conjunction with normal diameter bearings resulting in a cranked shaft having a demountable joint for disassembly. In the present invention, on the contrary, a one-piece crankshaft with normal diameter bearings and a one-piece wabble member are used to admit of an organization permitting disassembly as illustrated in Fig. 7, in which the reason for the enlargement of the sleeve (24) towards its left-hand end will be apparent. At this end the sleeve engages a loose collar (72) abutting the bearing (21) held in position during assembly by the spring ring (74). It will be clear that when the nut (22) is tightened with the parts in assembled relation, the inner race of the bearing (20), the distance piece (24), the collar (72) and the inner race of the bearing (21) are all firmly clamped upon the crankpin by abutment of the last said inner race against the shoulder (78) of the crankpin. Upon withdrawal of the nut (22) it will be seen that the proportions of the parts are such that the integral wabble member (26) with the bearing (20), the distance sleeve (24), and the oil sleeve (30), may be removed as a unit by threading them over the end of the shaft, leaving behind the bearing (21) and the loose collar (72), which may in turn be disassembled after the lock wire (74) has been removed. In this way the advantages of normal sized bearings, having continuous rings and of an integral crankshaft and a one-piece spider, are realized.

This invention is applicable to any number and spacing of cylinders; the specific paired cylinder disposition shown (which is the subject of a copending application) being appropriate to the use of only one master piston since there are no diametrically opposite cylinders.

The operation of the device is as follows:

Due to the inclination of the journal axis on which the spider (26) is mounted, rotation of the crankshaft produces a wabble action of the arms (28). One of these arms engages the master piston provided with the thrust blocks (54 and 56) whereby rotation of the spider is prevented. This arm accordingly reciprocates in the radial axial plane of the master cylinder. The other arms combine with their reciprocation a slight sideways motion, the actual trace of the end of each arm being a much elongated figure 8. The amount of side motion is a maximum in a cylinder located at 90° to the master cylinder, wherein the 8 is symmetrical. In the other cylinders the axis of the 8 becomes arcuate and its width is reduced.

In all the connections there is oscillation about two axes at right angles, i. e., the radial and the tangential axes and relative plunge along these axes in all but the master cylinder wherein the plunge along the tangential axis is prevented by the thrust blocks (54 and 56). In using the blocks the torque reactions on the spider are restrained.

In spite of the slight tangential or sideways motion of certain of the cross pins, it is a feature of this construction that all the pistons have the same stroke length and reach the ends and the mid-points of their strokes at equal intervals whereby their motion is harmonic. This is not the case in the conventional crank and connecting rod mechanisms wherein secondary out-of-balance forces are introduced because the pistons do not attain their mid-stroke positions at equal intervals from the end stroke points.

It will be seen that in this invention simple connections of high load capacity and capable of performing these various functions have been provided.

It is to be understood that the above described embodiment of the invention is for the purpose of illustration only, and various changes may be made therein without departing from the spirit and scope of the invention.

I claim as my invention:

In an engine, a shaft including an integral angular crankpin provided at its opposite ends with bearing surfaces, a wabble member including a one-piece hub mounted on said crankpin, axially spaced bearing units interposed between said bearing surfaces and said hub, said bearing units being held in spaced apart relation by their engagement with said hub, and said crankpin, intermediate of said bearing surfaces, being reduced in diameter to admit of said shaft and hence said crankpin being threaded endwise through said bearing units and said hub, and adjustable clamping means for holding said bearing units against said hub.

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