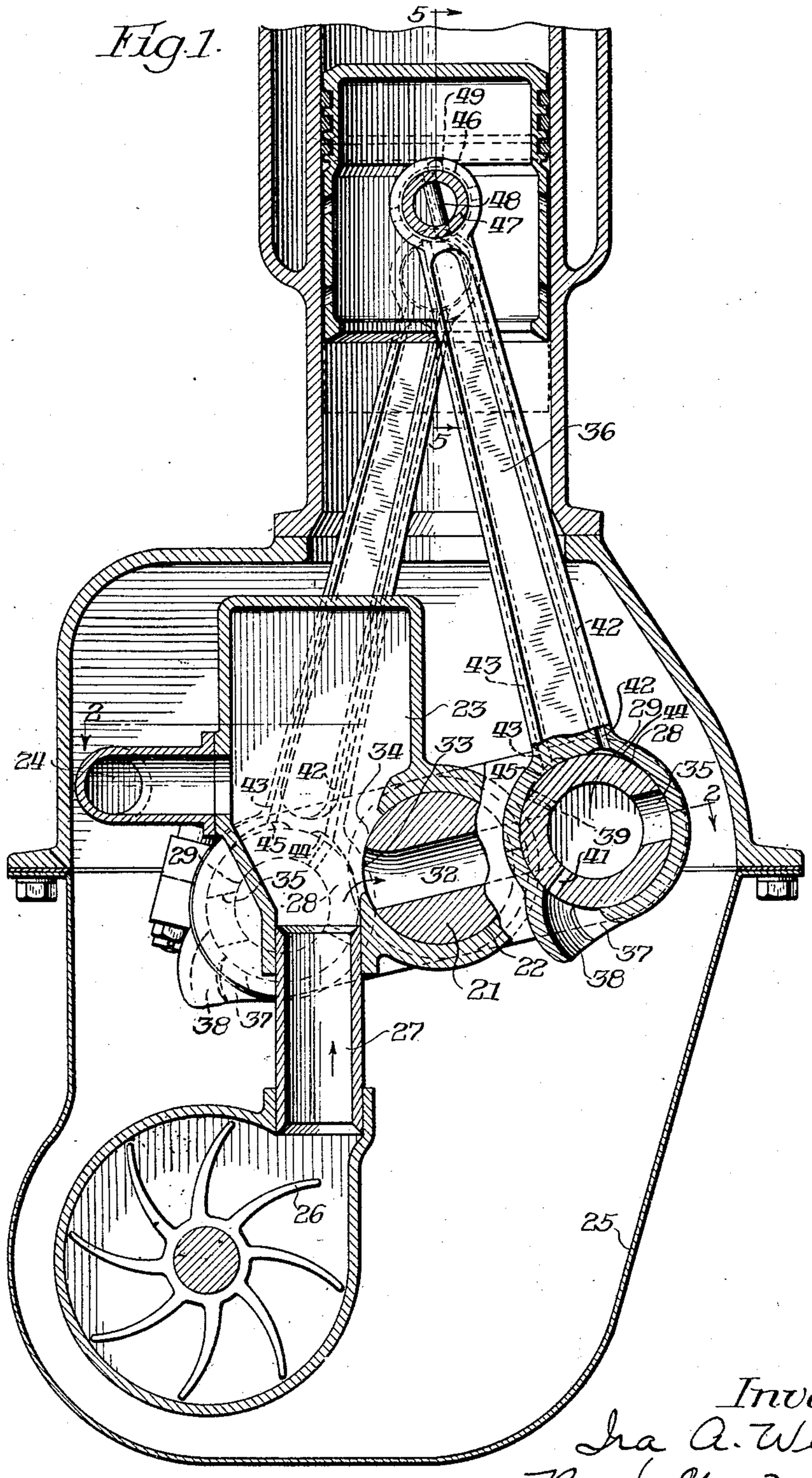
Oct. 7, 1930. I. A. WEAVER 1,777,341

ENGINE CRANK SHAFT BALANCER

Filed Sept. 6, 1927 2 Sheets-Sheet 1

Fig. 1.



Inventor.
Ira A. Weaver
By Walter M. Fuller
Atty.

Oct. 7, 1930. I. A. WEAVER 1,777,341

ENGINE CRANK SHAFT BALANCER

Filed Sept. 6, 1927 2 Sheets-Sheet 2

Fig. 2

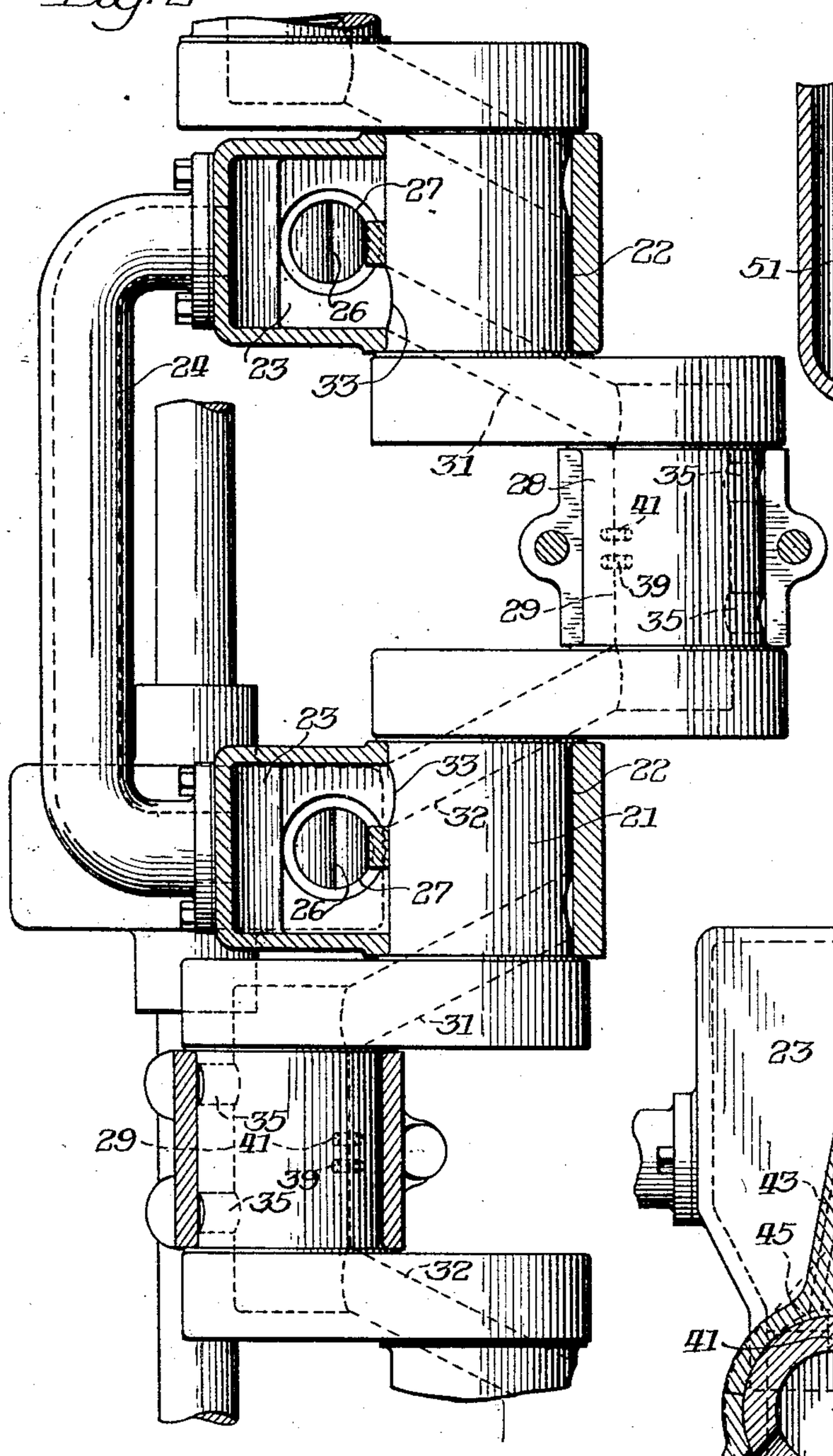


Fig. 5.

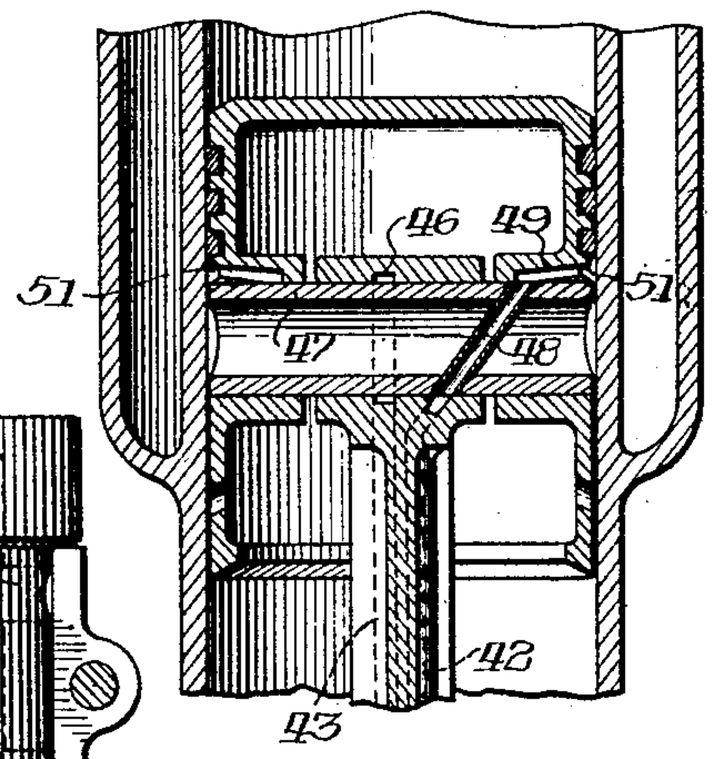


Fig. 3.

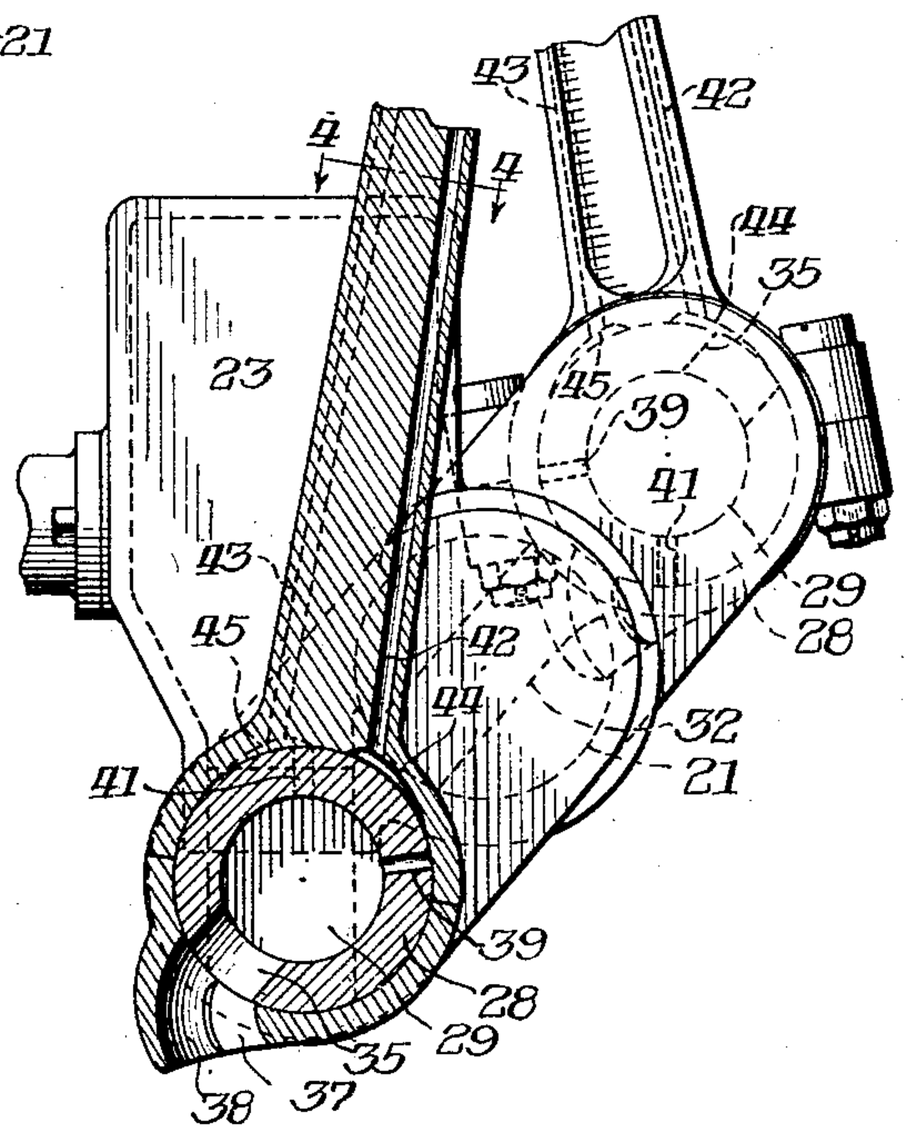
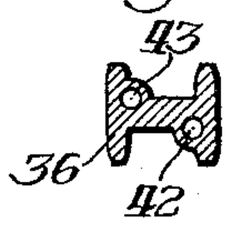


Fig. 4.



Inventor.
Ira A. Weaver
By Walter M. Fuller
Atty.

Patented Oct. 7, 1930 1,777,341

UNITED STATES PATENT OFFICE

IRA A. WEAVER, OF SPRINGFIELD, ILLINOIS

ENGINE-CRANK-SHAFT BALANCER

Application filed September 6, 1927. Serial No. 217,665.

My invention relates to effective means for wholly or partly balancing crank-shafts, particularly those having a plurality of reciprocatory pistons joined thereto through the usual connecting-rods, such as are found in internal-combustion engines and similar structures.

It is well known that, in multi-cylinder, internal-combustion motors, the pistons which are connected to the crank-shaft at points one hundred and eighty degrees apart do not balance one another, for the reason, that, as they approach and recede from their opposite, dead-center positions, they are traveling at different speeds owing to the unlike angular relations of their connecting-rods.

To balance such a pair of pistons and their connecting-rods and cranks, it is essential to add a weight temporarily to each united piston, connecting-rod and crank during a portion only of their travel, so that each such connected system has a weight automatically added to it and similarly removed or disconnected from it during each revolution to produce the required result.

In the preferred embodiment of my invention, such weight is in the form of lubricating oil which is fed into a cavity in the hollow, crank portion of the crank-shaft at the proper moment and permitted to be discharged therefrom at the correct time to effect the desired balancing action.

Also, in such selected embodiment, the delivery of the balancing oil from the shaft creates more or less of a suction imposed on a groove around the piston or pistons to withdraw therefrom any excess of lubricant, thus preventing its finding entrance into the firing or explosion chamber of the cylinder, where it would produce the well-known, detrimental results, such as fouling the spark plugs, adhering to valves and their seats, producing a smoky exhaust, etc.

In order that those skilled in this art may fully understand the invention, both from structural and functional viewpoints, in the accompanying drawings, forming a part of this specification, I have illustrated in detail a present desirable incorporation of the invention in physical form, the same parts throughout the several views being supplied with like reference numerals for simplicity.

In these drawings,—

Fig. 1 is a vertical cross-section through a multi-cylinder engine incorporating the new balancing construction;

Fig. 2 is a fragmentary, horizontal section on line 2—2 of Fig. 1;

Fig. 3 is a partial view, showing the crank-shaft and connecting-rods in a different position from that presented in Figure 1;

Fig. 4 is a cross-section through one of the connecting-rods, on line 4—4 of Fig. 3; and

Fig. 5 is a fragmentary, vertical section through one of the cylinders and its piston.

Referring to these drawings, it will be observed that the engine crank-shaft, characterized as a whole 21, is revoluble in a plurality of main bearings 22, 22, each communicating with its individual oil-chamber 23, the number of such chambers being connected together by a conduit or pipe 24, whereby they all receive an adequate supply of lubricant, each such chamber preferably having an air cushion in its upper part above the oil, for equalizing purposes.

Oil in the engine crank-case 25 is fed directly to one or more of such oil compartments by a suitably-driven pump 26, of any appropriate design, which delivers the oil thereto through a pipe 27.

Thus all of the compartments are assured of an adequate supply of lubricating oil at all times, under proper pressure.

Each offset or crank portion 28 of the shaft has a longitudinal cavity or chamber 29 therein connected at its opposite ends to oblique channels 31 and 32 having terminal ports 33, which, during the revolution of the shaft, are brought into register and communicate with ports 34 of the main bearings which constitute the delivery or discharge passages of the oil chambers.

Each shaft section 28 has two, radial, longitudinally-separated ports 35, 35 connecting with its chamber 29 and extended outwardly to the surface of the part 28, the lower end of the connecting-rod 36 encasing such portion of the shaft having a plurality of adjacent,

curved, discharge passages 37 and 38, which, during the rotation of the shaft, come into register intermittently with the ports 35, 35, thus permitting the quick delivery of the oil contents of the chamber 29 and its connected conduits 31 and 32, under the action of centrifugal force, back into the engine crank-case.

Each shaft part 28 also has two, smaller ports 39 and 41 connecting with the corresponding compartment 29 and leading to the outer surface of the shaft-section 28.

The associated connecting-rod has two, longitudinal bores or passages 42 and 43 terminating inside of the connecting-rod bearing receiving the shaft-section 28 in a pair of nonaligned cavities 44 and 45, the conduit 42 connecting with the recess 44, and the passage 43 communicating with the space 45, the two cavities being in rotary alignment with the two ports 39 and 41, so that as the crank-shaft revolves, the port 39 will for a time connect with cavity 45 and passage 43, and thereafter for a period the companion port 41 will connect with the recess 44 and its passage 42.

At its top, the connecting-rod passage 43 is joined to an annular channel or groove 46 in the inside of the bearing at the upper end of the corresponding connecting-rod, which is rockable on the wrist or piston pin 47, and the companion passage 42, by means of an oblique tube 48 through the wrist pin 47 and a connecting passage 49 in the piston, is joined to a shallow, circumferential, oil-collecting groove or channel 51 extended completely around the outside of the piston just below the lowermost piston-ring.

The improved appliance operates substantially as follows:

All of the chambers 23 are constantly charged with an adequate quantity of oil by the operation of the pump 26 and the connecting pipe 24, as will be readily understood.

During the reciprocation of the pistons, the rotation of the crank-shaft and the complementary movements of the connecting-rods, when any pair of ports 33, 33 come into register with the corresponding bearing ports 34, 34, the chamber 29 and its passages 31 and 32 become filled with oil by reason of the pressure exerted on the latter in the correlated chambers 23, 23, such oil adding a definite balancing weight to the crank portion of the crank-shaft and associated members.

By the time the crank-shaft reaches its lowermost or one hundred and eighty degree position, its chamber and the connecting passages in its cheeks are completely filled and the intake ports 33 closed.

During this time interval the retardation of the associated piston has exerted a force on the crank-shaft tending to accelerate its speed of revolution, and this force is at least partially counteracted or counterbalanced by the additional force required to accelerate the weight of oil in the crank-section of the shaft.

During the continued rotation of the shaft, for a period of time, the port 39 registers with the recess 45 and its passage 43, and during such interval a small quantity of the oil in chamber 29 is forced out of the latter and through the conduit 39, 45, 43 and 46, thus assuring adequate lubrication, under appropriate pressure, to the wrist pin and its connecting-rod bearing.

When the crank-shaft ports 35, 35 come into register with the ports 37 and 38, the oil in chamber 29 is discharged therethrough by centrifugal force into the crank-case, and, owing to the direction and curvature of the passages 37 and 38, the discharging oil, by reacting against the walls of such conduits, dampens the whip of the crank-shaft due to torsional vibration, which, if permitted to exist, is detrimental to the timing gears.

Thus the addition of oil to the crank-shaft and its removal therefrom are so timed and proportioned as to balance the shaft and its associated reciprocatory elements and to reduce the torsional whip or strains or vibrations.

Such discharge or delivery of the oil from the shaft tends to create a vacuum in the crank-shaft chamber 29, with the result that the excess lubricating oil in the associated piston-groove 51 is drawn down through the connected conduits 49, 48, 42, 44, 41, 29, 35, 37 and 38, and delivered into the crank-case, or, in case absolutely all of the oil is not completely discharged from the chamber 29, it will be trapped therein, thus assuring the prevention of its travel in excess quantity upwardly by the piston-rings into the firing or combustion chamber of the cylinder.

Although a single embodiment only of the invention has been illustrated and described, it will be clear that the invention, as defined by the appended claims, is susceptible of a variety of embodiments, and many changes may be made in that presented herein without departure from the heart and essence of the invention and without the sacrifice of any of its material benefits and advantages.

I claim:

1. The combination of a cylinder, a piston reciprocatory therein, a wrist-pin in said piston, a revoluble crank-shaft having a hollow crank section, a connecting-rod having bearings receiving said wrist-pin and crank section and having a longitudinal conduit connecting its wrist-pin bearing with said hollow crank section, and means to force lubricating oil under pressure into said hollow crank section and to discharge it therefrom during the rotation of the shaft, some of said oil passing through said connecting-rod conduit to lubricate said wrist-pin.

2. The combination of a cylinder, a piston reciprocatory therein and having an external

oil-collecting groove, a revoluble crank-shaft having a hollow crank-section, a connecting-rod joining said piston and crank section and having a conduit connecting said piston-groove and the chamber of said crank-section, and means to feed balancing oil into and to remove it from said chamber during revolution of the shaft, the discharge of such oil draining the contents from said piston-groove.

3. The combination of a cylinder, a piston reciprocatory therein, a revoluble crank-shaft, a main-bearing for said crank-shaft having a port, said crank-shaft having a chambered crank-section co-operating with the port in said main-bearing, means to supply balancing liquid under pressure to said bearing port, a connecting-rod joining said piston and said crank-section of said shaft, and means to discharge the liquid from said crank-section.

4. The combination of a plurality of cylinders, pistons reciprocatory in said cylinders, a revoluble crank-shaft having a hollow crank-section, connecting-rods joining said pistons and crank-shaft, means to feed a balancing liquid into said crank-section during the revolution of the shaft, and means to discharge said liquid from said section during rotation of the shaft and employing such discharge to dampen the whip of said crank-shaft.

5. In an internal-combustion engine and the like, the combination of cylinder-means, piston-means reciprocatory therein, a revoluble crank-shaft, connecting-rod means operatively joining said piston-means and crank-shaft, and means to add a balancing weight to and to remove it from a portion of said crank-shaft outwardly beyond its axis during the rotation of the shaft.

6. In an internal-combustion engine and the like, the combination of cylinder-means, piston-means reciprocatory therein, a revoluble crank-shaft, connecting-rod means operatively joining said piston-means and crank-shaft, and means to add a balancing liquid weight to and to remove it from a portion of said crank-shaft outwardly beyond its axis during the rotation of the shaft.

7. In an internal-combustion engine and the like, the combination of cylinder-means, piston-means reciprocatory therein, a revoluble crank-shaft, connecting-rod means operatively joining said piston-means to the crank-means of said shaft, and means to add a balancing weight to and to remove it from said crank-means of, and during the rotation of, said shaft.

8. In an internal-combustion engine and the like, the combination of cylinder-means, piston-means reciprocatory therein, a revoluble crank-shaft, connecting-rod means operatively joining said piston-means to the crank-means of said shaft, and means to add a balancing liquid weight to and to remove it from said crank-means of, and during the rotation of, said shaft.

9. In an internal-combustion engine and the like, the combination of cylinder-means, piston-means reciprocatory therein, a revoluble crank-shaft, connecting-rod means operatively joining said piston-means to the crank-means of said shaft, a portion at least of said crank-means being hollow, and means to feed a balancing liquid into and to remove it from said hollow crank-means during the rotation of the shaft.

10. In an internal-combustion engine and the like, the combination of cylinder-means, piston-means reciprocatory therein, a revoluble crank-shaft, connecting-rod means operatively joining said piston-means to the crank-means of said shaft, a portion at least of said crank-means being hollow, and means to feed balancing lubricating oil into and to remove it from said hollow crank-means during rotation of the shaft.

In witness whereof I have hereunto set my hand.

IRA A. WEAVER.