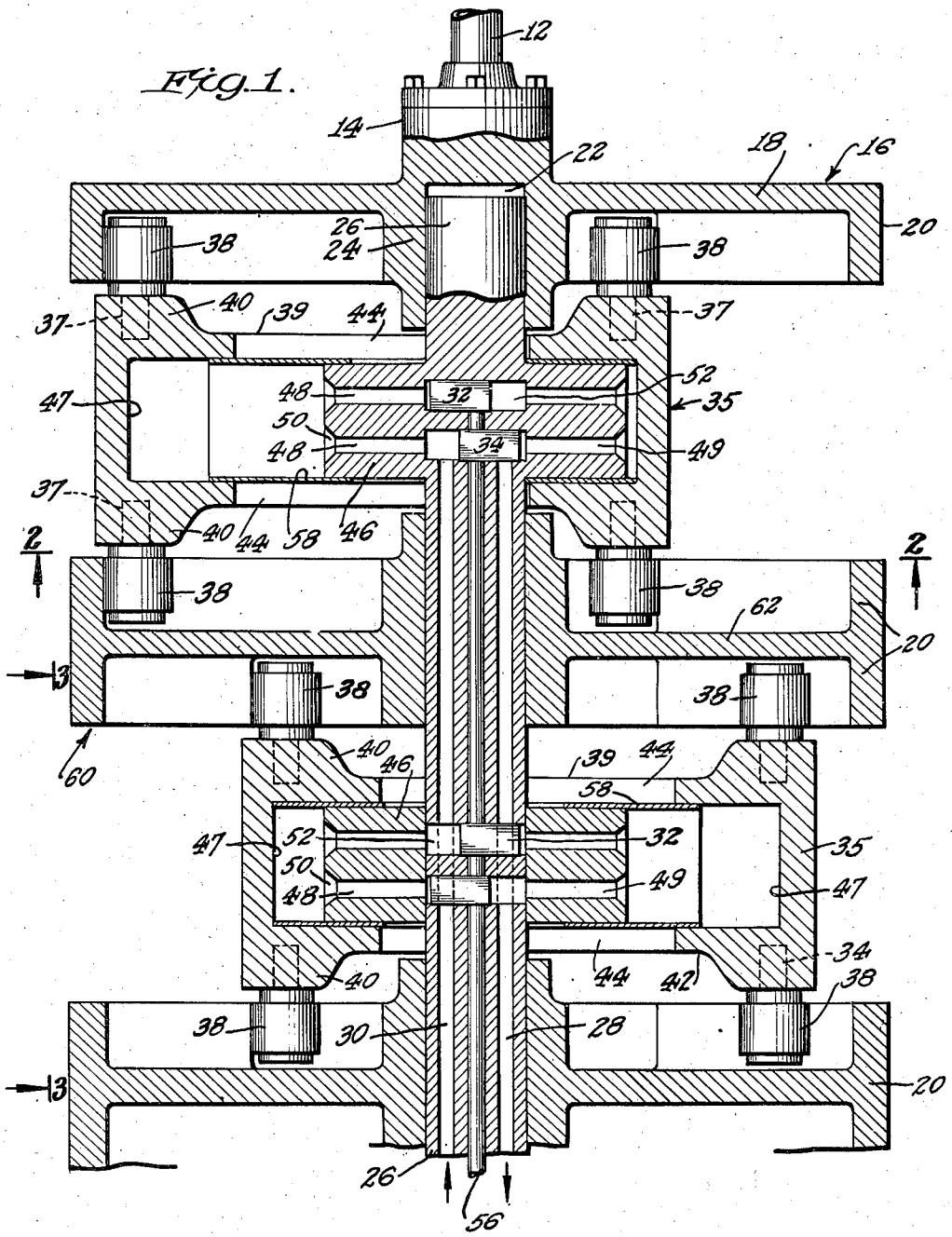
April 23, 1946. LE ROY SOHER 2,398,864

INTERNAL-COMBUSTION ENGINE

Filed Sept. 26, 1944 2 Sheets-Sheet 1

Fig. 1.



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Filed Sept. 26, 1944 2 Sheets-Sheet 2

Fig. 2.

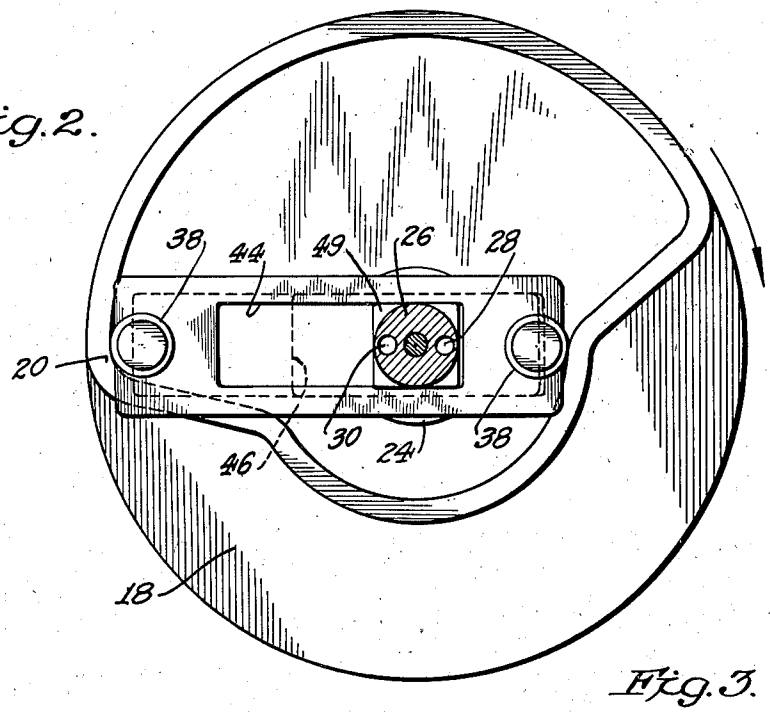


Fig. 3.

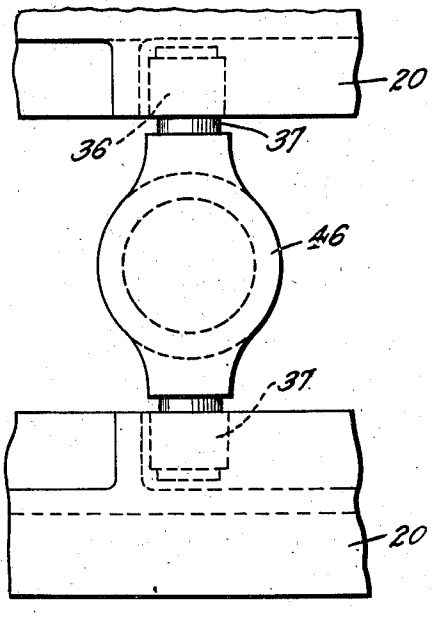
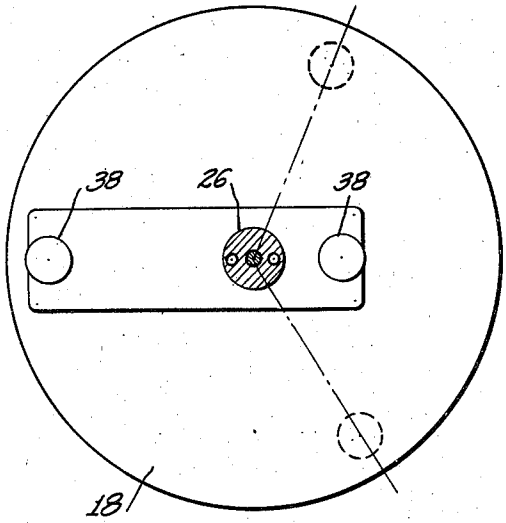


Fig. 4.



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INTERNAL-COMBUSTION ENGINE

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Application September 26, 1944, Serial No. 555,784

15 Claims. (Cl. 123—50)

This invention relates to improvements in internal combustion engines and, more particularly, to motors adapted to use heavy fuel oil.

One object of the invention is a cam-driven motor having one or more fixed pistons and moving cylinders and a rotary flywheel cam structure.

In one of its aspects the present invention comprehends the utilization of three or more, in odd numbers, motor units having fixed pistons and oscillating cylinders in conjunction with freely rotatable internal cam-faced flywheels constituting mechanical impedances.

A further object of the invention is an engine providing a plurality of explosions per revolution of the output shaft.

It is also an object of the invention to provide a heavy oil or reciprocating rotor for use in a motor having, preferably, an odd number of cylinders in which the cylinders of the motor may be cascaded or arranged parallel to one another in separate or superimposed strata and angularly disposed with respect to one another.

Another object of the present invention is to provide a novel multi-cylinder motor, the several cylinders being mounted for reciprocation on fixed pistons contained on a fixed shaft and the cylinder units intercoupled through freely rotatable coupling members having mechanical inertia.

The cylinders of such a motor may be three, five, seven or nine in number, for example, or as many as required, whereby a constant pressure is produced on the cam rotors.

With the novel construction herein the cam pressure rollers are in constant contact, and hammer blows are thereby eliminated so that the unit functions substantially silently. The motor of this invention is of an efficiency higher than that of the so-called crank-shaft type of motor.

A further object of the invention is a motor adapted to use heavy fuel oil of the Diesel type as distinguished from one requiring gasoline as a motor fuel.

These and other objects of the invention and the means for their attainment will be more apparent from the following detailed description taken in connection with the accompanying drawings illustrating one embodiment by which the invention may be realized and in which:

Fig. 1 is an axial sectional view showing the relationship of the cams to the motor cylinders and fixed pistons;

Fig. 2 is a transverse sectional view taken in the plane indicated by the line 2—2 of Fig. 1, looking in the direction of the arrows and showing details of the cam structure and the cylinder associated therewith;

Fig. 3 is a view taken in the plane indicated by the line 3—3 of Fig. 1, looking in the direction of the arrows and showing the piston in end elevation; and

Fig. 4 is a diagrammatic view showing a cylinder in full lines in one position of its reciprocation and, in broken lines, the relative axial position of the other two cylinders, there being illustrated a progressively increasing lead from one position to another and resulting in smooth operation and avoiding dead center.

The present tendency to eliminate crank shafts in high speed motors results from the excessive wear and tear caused by the movement of crank shafts at high speed. To overcome such excessive wear, the present invention is directed to cam-driven engine assemblies in which a cam-faced fly-wheel is driven directly by either piston or, as in the illustrated embodiment, by the cylinder block itself to avoid any reciprocation of moving parts such as crank shafts, which of course also have rotary components when in motion.

Referring now to Fig. 1, there is shown a driven shaft 12 which is shown as coupled to the hub 14 of a terminal cylinder cam-driven flywheel indicated generally at 16 and comprised of a disc-like wall section 18, see also Fig. 2, on which is carried the cam wall or surface 20. Axially, the cam disc 18 is formed with a cylindrical recess 22 defined by a cylindrical wall 24. The recess 22 receives one end of an axially extending fixed shaft 26 extending the length of the engine and serving as the carrying element for the structure providing the exhaust manifold 28 and intake manifold 30, and their respective valve structures serving as intake valves 32 and exhaust valves 34 for the respective piston and cylinder structures. The other end of the shaft, of course, is similarly received in a similar cylindrical recess formed in a cam disc flywheel in the other end of the engine, not shown, but conveniently similar to that illustrated in the upper member 24 of Fig. 1. It will be understood, of course, that suitable provision, common in the art, may be provided to evacuate products of combustion from the exhaust manifold 28 and to deliver fuel to the intake manifold 30.

While it is contemplated that the simplest form of the engine forming the subject matter of this invention would be comprised of three cylinders, only two such cylinders are illustrated, it being understood that any number of cylinders, and preferably any odd number of cylinders, may be utilized in the structure wherein the elements, as illustrated, are reproduced in the general arrangement and disposition illustrated by the exemplification of Fig. 1. Referring now to the cylinder 35 illustrated at the top of Fig. 1 which is exemplary of all of the cylinders, the ends of the cylinders 35 are provided with pins 37 on which are mounted rollers 38 adapted to bear against the cam wall 20 as shown in Figs. 1 and 2. Each cylinder is thus reciprocable across the axis of shaft 26 and comprises an elongated tubular intermediate portion 39 and opposite end lugs 40

which carry the registering pins 37 extending in opposite directions and on which are mounted the rollers 38 travelling in and guided by the cam grooves.

Axially opposite portions of the cylinders are sloted in the axial plane as indicated at 44, and through these slots in the walls of the cylinders, the latter clear the shaft 26 containing the intake and exhaust manifolds and the intake and exhaust valves. Integral with the fixed shaft or otherwise secured thereto are a plurality of pistons 46, one of which is disposed in each cylinder. Each piston is fixed, it being apparent that the cylinder block will be caused to reciprocate on the fixed piston by reason of the explosive action of the gases in the piston acting on a surface 47 of the cylinder and thereby causing the rollers 38 to bear against the cam wall 20, the thrust thereon causing the cam wall and the disc or flywheel 18 to turn.

The piston is so disposed as to terminate predetermined distances from the respective end walls of the cylinder to provide, at one end, a combustion chamber within which the charge may be compressed and, at the other end, the piston is usually spaced a considerable distance from the end of the cylinder in accordance with the path of movement of the cylinder when reciprocated under the influence of the exploding gases. As shown, each piston is provided with two longitudinally extending passages 48, 49 illustrated as having frusto-conical ends 50 and communicating centrally of the piston with valve chambers 52 in which are mounted the valves 32, 34 controlling the intake and exhaust from each cylinder through the intake passage and the exhaust passage respectively. Thus, as illustrated at the upper piston in Fig. 1, the intake passage 30 is closed by the valve element 32 and the exhaust valve 34 in the other passage 28 is open, whereby products of combustion may be evacuated. The valves are mounted on the valve-actuating shaft 56 axially disposed within the shaft 26. The slots 44 through which the cylinders clear shaft 26 are closed in part by sleeves 58, the length of which is sufficient to at all times overlap the ends of the fixed pistons 46, thereby preventing the escape of products of combustion or fuel during operation.

The intermediate cam discs or flywheels, one of which is illustrated in full at 60, are formed with cam tracks 20 upon opposite faces, two cam tracks for the respective opposite cam members being defined by a central transverse wall or septum 62 forming the dividing element between parts of the cam-faced flywheels or discs which are associated with the respective adjacent motor units.

It will thus be seen that the disposition of the cylinders is such that there is one cylinder in each plane and the cylinders are equiangularly spaced about the common fixed shaft so as to provide uniform pressure on the cams of the flywheel assembly. Cam contour may be readily determined to accomplish the results desired. In Fig. 4 there is diagrammatically represented the relative position of the three cylinders of the engine illustrated in Fig. 1 during one revolution of the output shaft 12. Thus, when the uppermost cylinder occupies the full-line position in Fig. 4, the other two cylinders should occupy the position indicated by the center line and rollers shown in dotted lines, the lag of the respective cylinders being diagrammatically illustrated by the broken lines.

In five, seven or nine cylinder assemblies, the angle of thrust or pressure angle will, of course, vary. The cam rotors illustrated are devised for four-cycle operations, that is, in each complete rotation of a cam rotor, the associated cylinder will have completed two complete cycles of explosion, scavenging, intake and compression. As the cylinders 35 oscillate back and forth on the fixed piston 46, chamber 48, say, will have a first charge introduced therein, which is compressed and then ignited, following which it is scavenged and a new cycle repeated.

The superposition of the motor units, one above another, permits simple construction, and the use of quickly interchangeable parts, together with the added feature that the parts are of extremely light weight so that the overall weight of a unit is greatly reduced compared with similar units of like horsepower wherein crank shafts are used. At the same time, the cam track carrying discs serve as effective flywheels. The flywheels are coupled in cascade through the intermediate cylinders and form the sole power connection between the several cylinders. Additionally, it will be seen that as the non-rotating cylinders or motor units are coupled through flywheels mounted for free rotation on a common fixed shaft, and the flywheels have mechanical inertia, they will form, in effect, a viscous power coupling between the several motor units, and the momentum of the intercoupled flywheels will insure an automatic wipe-out of mechanical variations, due to speed or otherwise, in any or all of the motive units. The system, therefore, is self-compensating, due to its nature and substance, and due to the flexible intercoupling of multiple mechanical impedances comprising flywheels arranged in cascade, that is, arranged to deliver power from one to the other and not to a common output shaft.

It will now be appreciated that there has been provided a novel motor assembly in which a multiple motor unit is composed of members arranged one above the other and in which cylinders oscillate on fixed pistons and the cylinders engage cam surfaces of cam rotors in constant engagement so that no play between parts is possible. By the use of an odd number of cylinders in an assembly, the power factors are evenly distributed over the whole unit and no play is introduced into and between the parts.

It will be apparent that one of the cylinders illustrated, with a piston therein and wherein the explosions occur successively at opposite ends of the cylinder, may be readily utilized as an engine reciprocating on a single axis and serving as the motive power of many devices as, for instance, a reciprocating pump.

Details of the feed and exhaust are not shown as these are common in the art.

Various modifications will occur to those skilled in the art in the configuration, disposition and number of cylinders incorporated in the structure as well as the fuel feed and exhaust, and no limitation is intended by the phraseology of the foregoing description or illustrations in the accompanying drawing except as indicated in the appended claims.

What is claimed is:

1. A multiple cylinder engine, comprising an array of superposed motor units radially displaced with respect to each other in multiple planes, a common fixed shaft, each said motor unit comprising a fixed piston mounted on said common shaft, a reciprocable cylinder carried with each piston, cam rotors, means to mount said cam

rotors for rotation on said fixed shaft, said rotors having cam faces and driving connections between the reciprocating cylinders and the cam faces forming cascade power couplings of the several rotors.

2. A multiple cylinder engine, comprising an array of superposed motor units angularly displaced with respect to each other in multiple planes, a common fixed shaft, each said motor unit comprising a fixed piston mounted on said common shaft, an oscillatable cylinder block receiving each piston, flywheel comprising cam rotors, means to mount said flywheel or rotors for free rotation on said shaft, said rotors having internal cam faces, and functioning as flywheels, and driving connections between the oscillating cylinder block and the cam faces comprising rollers mounted on the ends of the cylinders and operatively engaging the cam faces.

3. A multiple cylinder engine, comprising an array of superposed motor units radially displaced with respect to each other, a common fixed shaft, each said motor unit comprising a fixed piston mounted on said common shaft, an oscillatable cylinder block carried with each piston, flywheels comprising cam rotors, means to mount said flywheels or rotors for free rotation on said shaft, said rotors having cam faces, and driving connections between the oscillating cylinders and the cam faces comprising rollers mounted on the ends of the cylinder blocks and operatively engaging the cam faces.

4. A multiple cylinder engine, comprising an array of an odd number of superposed motor units angularly disposed with respect to each other on a common fixed shaft, each said motor unit comprising a fixed piston mounted on said common shaft, an oscillatable cylinder mounted on each piston, flywheels having cam means mounted for free rotation on the shaft, said cam means having cam faces, and driving connections between the oscillating cylinders and the cam faces.

5. A multiple cylinder engine, comprising an array of an odd number of motor units angularly disposed with respect to each other at different angular relations, each said motor unit including a fixed piston mounted on a common fixed shaft, an oscillatable cylinder on each piston, a pair of cam-faced flywheel rotors mounted for rotation on the shaft and on the respective sides of the said cylinders, said rotors having internal cam faces, and rollers mounted on the ends of the cylinders and operatively engaging the cam faces.

6. A multiple cylinder engine, comprising superposed motor units angularly disposed with respect to each other, each said motor unit comprising a fixed piston, an oscillatable cylinder on each piston, a pair of cam rotors mounted for rotation on the shaft, the rotors between adjacent cylinders being unitary and double-faced, said rotors having internal cam faces, driving connections between the oscillating cylinders and the cam faces comprising rollers mounted on the ends of the cylinders and operatively engaging the cam faces, a fixed shaft, fuel inlet and exhaust conduits and conduit controls.

7. A multiple cylinder engine, comprising superposed motor units angularly disposed with respect to each other, each said motor unit comprising a fixed piston transversely mounted on a common fixed shaft, an oscillatable cylinder mounted on each piston, power-coupling means between adjacent motor units comprising a pair of cam rotors mounted for rotation on the shaft and on both sides of the said cylinders, the rotors between adjacent cylinders being unitary and comprising cams on remote faces thereof, said rotors functioning as flywheels, and driving connections between the oscillating cylinders and the cam faces.

8. A multiple cylinder engine, comprising superposed motor units angularly disposed with respect to each other, each said motor unit comprising a fixed piston mounted on a common shaft, an oscillatable cylinder mounted on each piston, a pair of cam rotors mounted for rotation on the shaft and on both sides of the said cylinders, the rotors between adjacent cylinders being unitary and comprising cams on remote faces thereof, said rotors functioning as flywheels, driving connections between the oscillating cylinders and the cam faces, and fuel inlet and exhaust conduits and controls in the said fixed shaft and pistons.

9. In an engine of the character described, in combination, a fixed piston, a relatively movable cylinder, shaft means on which the piston is mounted, inlet and exhaust passages in said shaft means, communicating connections between said passages and said cylinder, and a flywheel rotated by said cylinder.

10. In an engine of the character described, in combination, a driven output shaft, hub means on which the shaft is mounted, said hub means comprising a cylindrical bearing formed in a cam-faced rotor, a fixed shaft in the bearing, a piston fixed on the shaft, fuel inlet means for the piston, a cylinder reciprocable on the piston, and means carried by the cylinder to actuate the cam means.

11. In an engine of the character described, in combination, a fixed piston, a cylinder reciprocable on the fixed piston, fuel inlet means for the piston, and exhaust means for the piston whereby successive explosions of fuel respectively at opposite ends of the cylinder will cause reciprocation of the cylinder.

12. In an engine of the character described, in combination, a fixed piston, a cylinder reciprocable on the fixed piston, fuel inlet means for the piston, exhaust means for the piston whereby successive explosions of fuel respectively at opposite ends of the cylinder will cause reciprocation of the cylinder, and operative connections between the cylinder and work performing means.

13. In an engine of the character described, in combination, a plurality of oscillatable cylinder blocks mounted for oscillation on fixed pistons, a fixed shaft on which the pistons are mounted, the pistons being equiangularly disposed around the shaft and arranged in multiple planes, mechanical impedances mounted for rotation on the fixed shaft and rotatable by the said reciprocating cylinders, the said impedances constituting the sole power connection between the said several cylinders.

14. In an engine of the character described in claim 13, mechanical impedances comprising flywheels.

15. In an engine of the character described and claimed in claim 13, mechanical impedances comprising internal cam-faced flywheels forming viscous couplings between the cylinder units.

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