

June 20, 1939.

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2,163,052

EXPLOSIVE ENGINE

Filed April 6, 1937

2 Sheets-Sheet 1

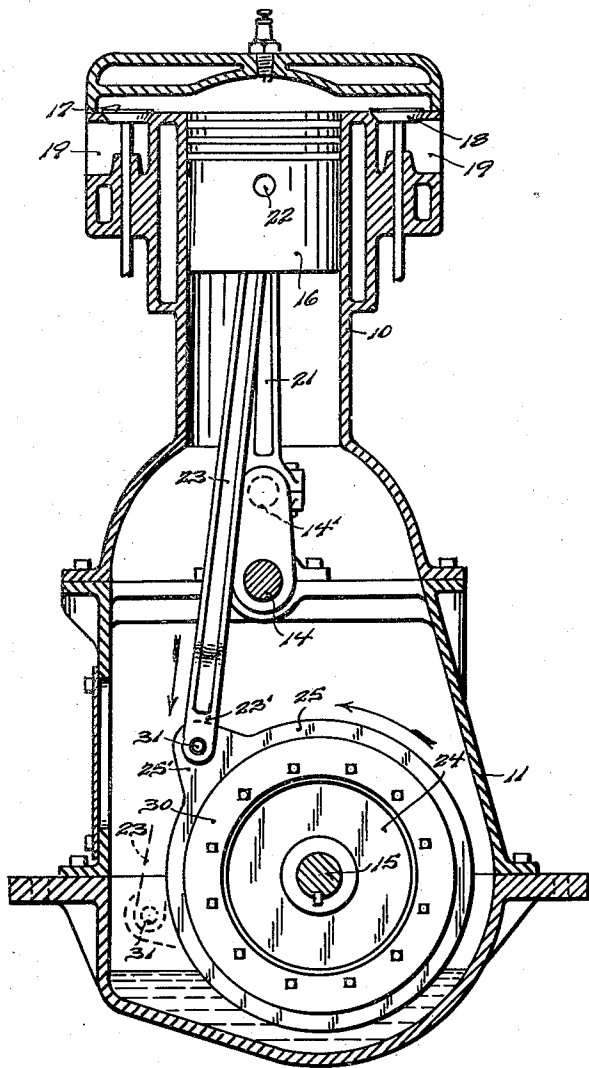


Fig. 1.

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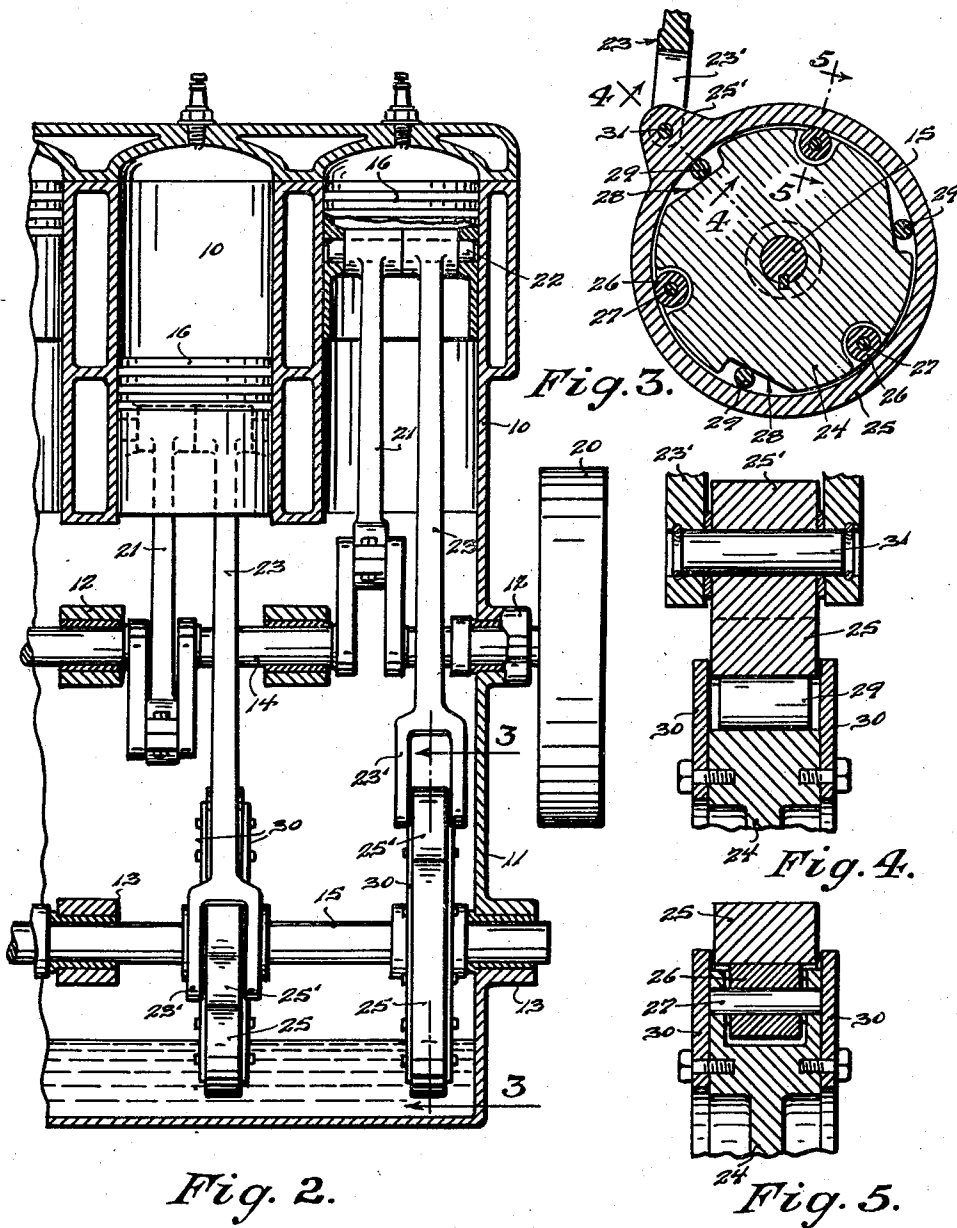
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EXPLOSIVE ENGINE

Filed April 6, 1937

2 Sheets-Sheet 2



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2,163,052

EXPLOSIVE ENGINE

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Application April 6, 1937, Serial No. 135,233

4 Claims. (Cl. 74—126)

This invention relates to engines and as particularly applied herein to internal combustion engines. The principal object is to improve the efficiency of the engine and this I achieve by the utilization of independent crank shafts, one operating as a load and the other as a momentum shaft only, so associated with a reciprocating-type piston that the torsional leverage by which the piston transmits energy to the load shaft is maintained at peak efficiency throughout the power stroke of the engine cycle.

More particular objects and advantages will, together with the foregoing, become apparent in the course of the following description and claims, the invention consisting in the novel construction, adaptation, and combination of parts hereinafter described and claimed.

In the drawings:

Figure 1 is a transverse vertical section taken through an engine embodying my invention.

Fig. 2 is a fragmentary longitudinal vertical section thereof.

Fig. 3 is a detail transverse vertical section taken on the line 3—3 of Fig. 2; and

Figs. 4 and 5 are detail longitudinal vertical sections taken to an enlarged scale on the lines 4—4 and 5—5, respectively, of Fig. 3.

For purposes of illustration, I indicate an engine operating on a four-stroke cycle, a cycle which to obtain a continuous power impulse finds its greatest effectiveness where four or more cylinders are employed.

The numeral 10 in the drawings denotes these cylinders and indicated by 11 is a suitable base therefor which provides bearings 12 and 13 which operate to revolvably support crank shafts 14 and 15, respectively. These cranks, according to the present invention, are in vertically off-set relation and the former lies in the longitudinal vertical center line of the several cylinders while the latter lies below and in a plane laterally off-set therefrom. Fitted in each of the cylinders is a piston 16 and associated therewith are intake and exhaust valves 17 and 18 which provide regulated communication between the combustion chamber of the cylinder and manifolds 19. While not illustrated, known or suitable structure is provided for operating the valves such as the conventional eccentrics on a driven cam shaft, which cam shaft as applied to the illustrated engine would be driven from the upper crank shaft 14.

This crank shaft 14 is of ordinary construction providing crank pins 14' and operates as a synchronizing momentum shaft only, carrying a fly wheel 20 which is splined or otherwise rigidly se-

cured thereon. Rods 21 connect said shaft with the pistons 16.

Indicated by 22 are the piston-carried wrist pins which receive the rods 21 and also engaging each of these wrist pins is a connecting rod 23 of greater length than the rod 21, said rods 23 lying in longitudinally-spaced proximate relation to the allied rods 21 and passing the crank shaft 14 at the side thereof opposite the longitudinal vertical plane of the lower crank axis. Said rods 23 have a very slight transverse movement which is to say that, considered in end elevation, the paths of reciprocatory movement of the lower ends 23' thereof are approximately rectilineal and in their hereinafter described manner of connection with the lower crank shaft 15 constantly lie in tangential relation, or approximately so, with respect to driving drums 24, one for each cylinder, which are fixed to the crank shaft 15.

Said referred-to connection employs a ring member 25 surrounding each of the drums and as an anti-friction mounting therefor the drums, at circumferentially-spaced intervals, are peripherally fitted with rollers 26 journaled on fixed pins 27. Also provided about the perimeter of said drums are uniformly-spaced and inclined roller runways 28 and with each of such runways is associated a clutching roller 29, the action of which is to couple the ring member with the drum in one direction of movement and release the latter for free rotary travel in its opposite directive movement. 30 designates flange-forming side plates bolted to the drum to retain the ring member.

Provided on each of the ring members is an ear extension 25' and for connection purposes with the rod 23 I form said lower ends 23' of the latter as a fork, introducing the fork over the ear extension and connecting the same with a wrist pin 31.

It is obvious that equivalent means may be devised to alternately couple and release the connecting rod 23 to and from the crank shaft 15 in a manner acting to transmit driving action to the shaft in the down-stroke travel of the piston while permitting free retraction of the connecting means in the following up-stroke of the piston travel. Such equivalent mechanism might, for example, employ a drum and a ratchet shoe and I mention, further, that it is feasible to actuate clutching rollers, similar to those shown, or other suitable coupling means by timed magnetic attraction, in which event the piston-driven rod 23 would be coupled to the crank shaft 15 in the power stroke of the piston only.

Considering the radial distance between the axis of the shaft 15 and the wrist pin 31 as a crank arm and this crank arm and the connecting rod 23 as two sides of a triangle, the angle thereby formed should, at the upper limit of the piston travel, be not more than 135° and preferably the length of the crank arm should be not less than the piston stroke to thereby have the connecting rod 23 throughout its driving down-stroke movement lie relatively tangent to a circle taken through the pin 31 and about shaft 15 as an axis. In a manner believed to be apparent, a reduction in ratio favoring the length of the crank arm over piston stroke proportionately increases the power output while reducing the speed of rotation of shaft 15.

It is particularly to be noted that the momentum shaft 14, being free of the work load, balances the cyclical action of the engine without the adverse effect of load torque, also that the arrangement permits the load shaft 15 to be offset laterally from the longitudinal vertical center line of the cylinders sufficient to bring the connecting rod into and maintain the same in this vertical center line. The drawings represent the piston as being slightly canted from the plane of the connecting rod, a cant which can be overcome by employing independent crank shafts 14 for each of the pistons and connecting these independent crank shafts by suitable gearing to eliminate the main connecting shafts between the crank pins and thereby permit the rod 23 to pass through the axial line of such shafts.

It should be apparent that I intend to imply no limitations from the illustrated embodiment excepting as the hereto annexed claims shall necessarily be confined to the advance over prior teachings in the art.

What I claim is:

1. In an engine, in combination with a reciprocating piston and a cylinder therefor having valved intake and exhaust ports by which fuel for combustion purposes is admitted to and the products of combustion discharged from the combustion chamber thereof, a momentum crank shaft and a load crank shaft revolubly supported to lie in vertically stepped relation below the cylinder to locate the axis of the former approximately in the longitudinal vertical center line of the cylinder and the axis of the latter therebelow and in laterally off-set relation to said vertical center line, a rod providing constant direct-drive connection between the piston and the momentum shaft, and an associated rod providing direct-drive connection from the piston to the load shaft in one stroke of piston reciprocation only, the crank arm which connects the load shaft with the latter of said connecting rods being so chosen, for the purpose of constantly maintaining the connecting rod tangentially or approximately so to the circle of revolution taken through the crank pin and about the load shaft as an axis, that the piston stroke does not exceed the length of the crank arm and the angle

formed by a triangle of which said arm and the connecting rod comprise the two sides thereof does not, at the upper limit of the piston travel, exceed 135°.

2. In an engine, in combination with a reciprocating piston, a momentum crank shaft and a load crank shaft revolubly supported to lie in vertically stepped relation below the piston to locate the axis of the former approximately in the longitudinal vertical center line of the engine and the axis of the latter therebelow and in laterally offset relation to said vertical center line, and independent connecting rods driven directly by the piston and associated with the crank shafts to obtain a constant drive connection as between said piston and the momentum shaft and an intermittent drive connection as between the piston and the load shaft, the circle of movement of the crank arm which intermittently connects the load shaft to the piston-driven rod therefor having a diameter exceeding the stroke of the piston, and the crank arm being so associated with the connecting rod that the angle formed by a triangle of which the crank arm and the connecting rod comprise the two sides thereof is less than 180° at the upper limit of the piston travel.

3. In an engine, in combination with a reciprocating piston, a momentum crank shaft and a load crank shaft revolubly supported to lie in vertically stepped relation below the piston to locate the axis of the former approximately in the longitudinal vertical center line of the engine and the axis of the latter therebelow and laterally off-set from said vertical center line, and independent connecting rods driven directly by the piston and associated with the crank shafts to obtain a constant drive connection as between the piston and the momentum shaft and an intermittent drive connection as between the piston and the load shaft, the crank arm by which the intermittent drive of said last-named connecting rod is transmitted to the load shaft being so related to the connecting rod therefor and to the stroke of the piston as to constantly maintain said crank arm in diagonal relation to a vertical center line taken through the axis of the load shaft.

4. In an engine, in combination with a reciprocating piston, a pair of connecting rods driven directly by the piston, a revolubly supported momentum crank shaft connected by one of the connecting rods in constant-drive relation with the piston, and a revolubly supported load crank shaft connected by the other connecting rod in intermittent-drive relation with the piston, said intermittent-drive connecting rod and the crank arm by which the load shaft is driven therefrom being arranged in relation to one another and to the stroke of the piston such that the angle between said rod and arm is less than 180° throughout the reciprocatory activity of the piston.

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