Jan. 5, 1937. M. J. GOLDBERG 2,067,049

INTERNAL COMBUSTION ENGINE

Filed April 23, 1934 3 Sheets-Sheet 1

Fig. 1

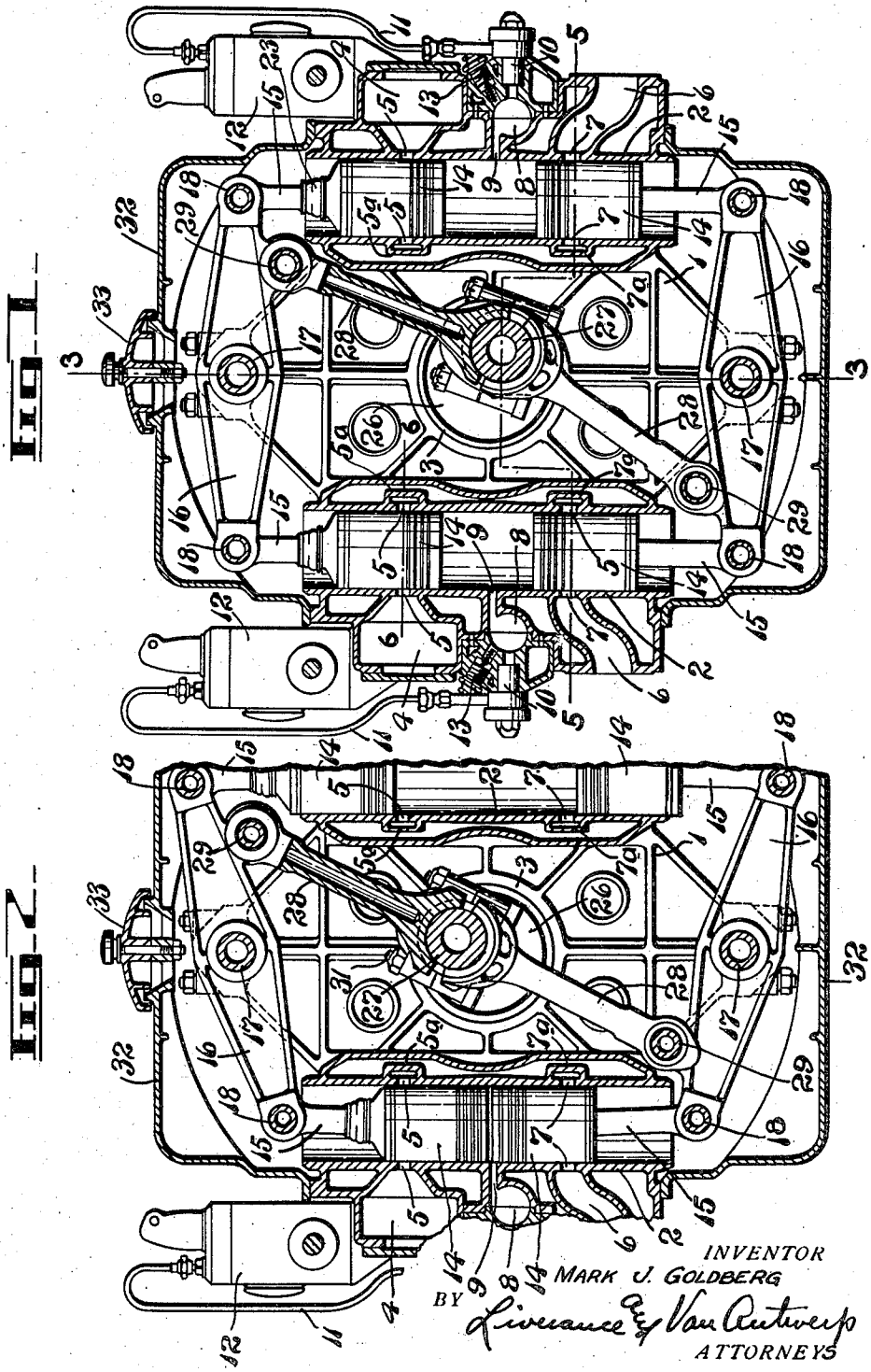

Fig. 2

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Fig. 3.

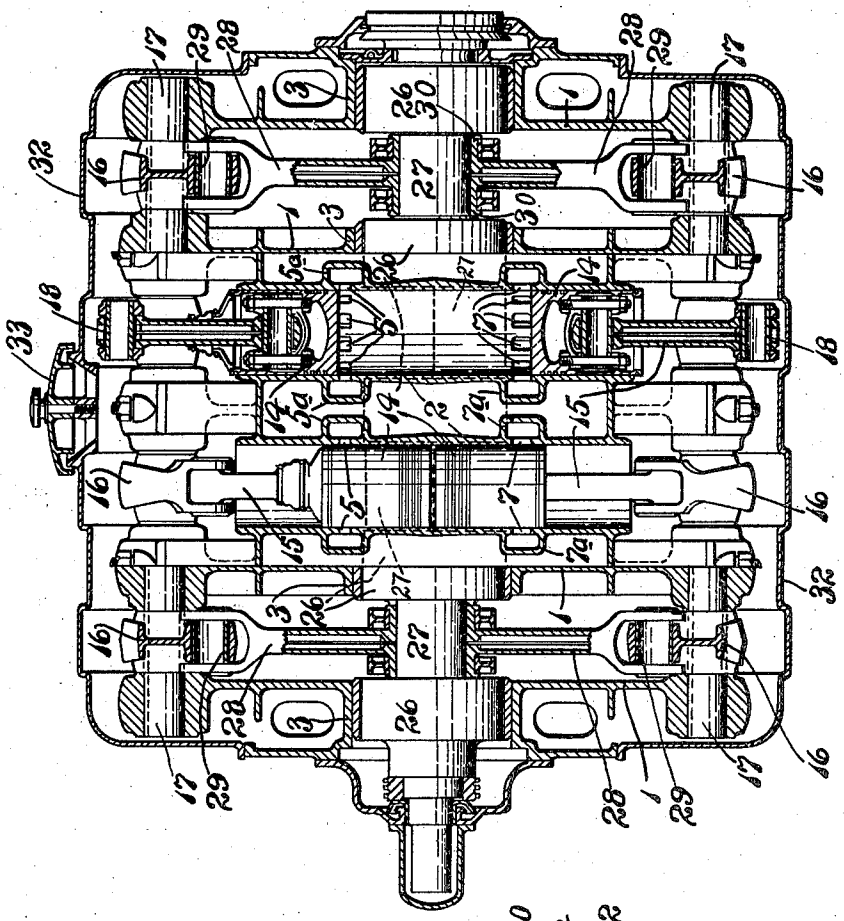

Fig. 4.

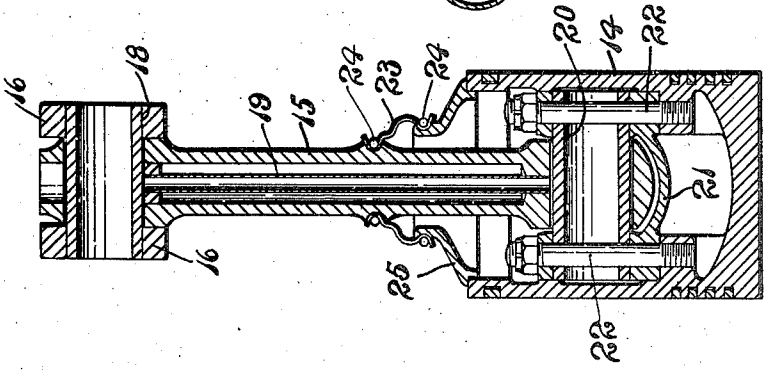

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Fig. 5.

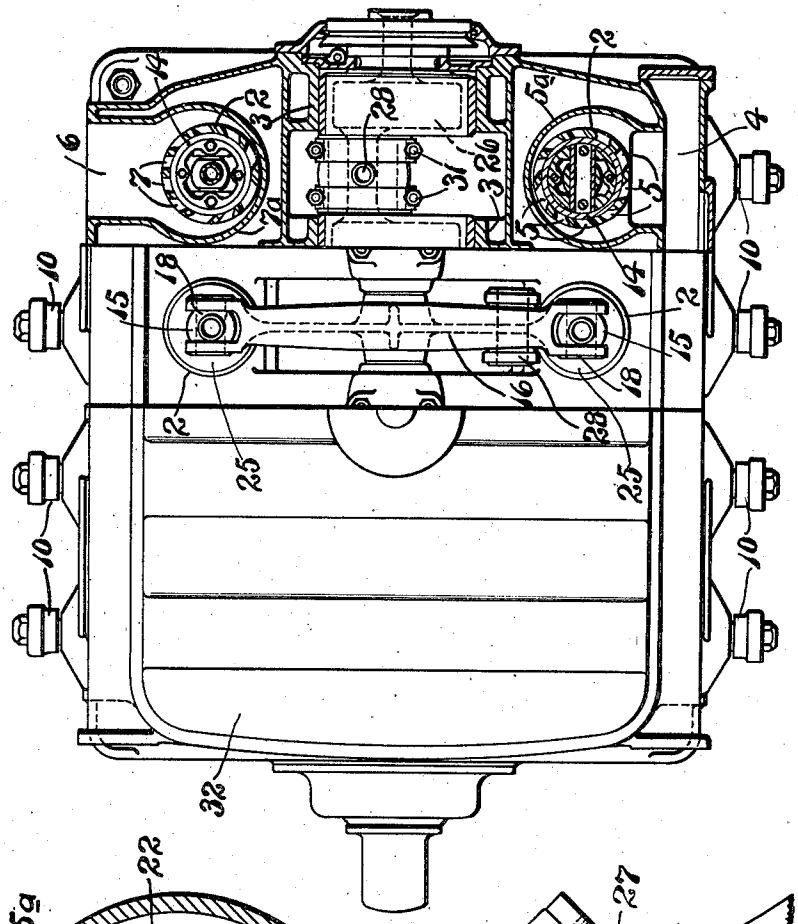


Fig. 6.

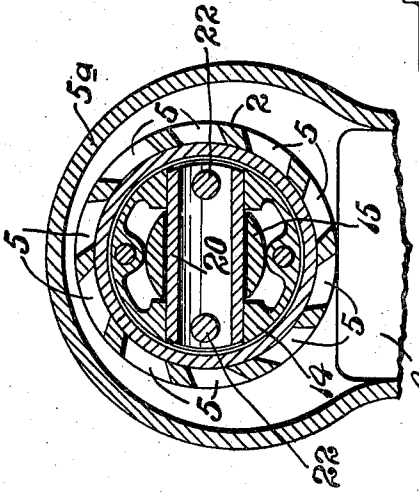
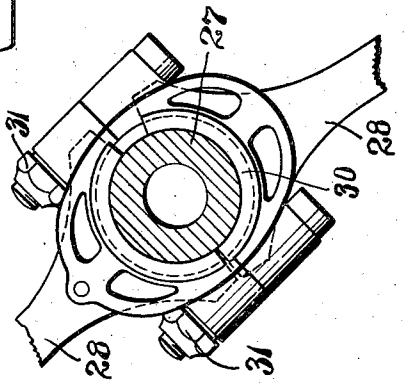


Fig. 7.



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Patented Jan. 5, 1937 2,067,049

UNITED STATES PATENT OFFICE

2,067,049

INTERNAL COMBUSTION ENGINE

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3 Claims. (Cl. 123—51)

This invention relates to internal combustion engines and, more particularly, to engines of the two-cycle type wherein two pistons operate in opposed movement in each cylinder of a plurality of cylinders located at opposite sides of a common crank shaft; and in which the crank shaft is operated by connecting rods attached to rocking levers which in turn are attached, through suitable connecting rods, to pistons, there being a piston connected to each end of each rocking lever, said pistons being located one at one side and the other at the opposite side of the crank shaft.

The present disclosure shows an engine particularly designed for Diesel operation though the engine is not limited to Diesel operation alone.

One primary object and purpose of the present invention is to provide a novel construction of very compact form and in which the dimensions of the engine are restricted to substantially the absolute minimum with a saving of space and material. Of first importance is the novel location of the parts of a unit of the engine, all in the same plane of operation, whereby eccentric or other binding stresses do not occur, their possibility of occurrence being eliminated by reason of the novel construction which I have designed. Such parts of an engine unit consist of two cylinders, four pistons, two rocking levers and connecting rods between the rocking levers and the crank shaft and between the rocking levers and pistons.

Another object of the invention and a result attained thereby is a reduction in wear of both pistons and the cylinder walls through a very substantial diminution of angular thrust between the pistons and the cylinder wall. Wear is also decreased by reason of slower operation speeds with engines of the kind produced by my invention. A still further object is to provide a connection between the crank shaft and the rocking levers at points on the rocking levers between the pivotal mountings of said rocking levers and the attachment of the piston connecting rods to the rocking levers to provide a minimum crank throw with a resultant more perfect balance of the parts, a quieter running engine and a lessening of vibration, all tending to extend the life of the engine.

Many other objects and purposes than those stated will be apparent upon an understanding of the invention had from the following description, taken in connection with the accompanying drawings, in which,

Fig. 1 is a transverse cross section of the engine showing the pistons of one unit thereof in mid-position of their stroke travel.

Fig. 2 is a similar cross section with the pistons at one side at extreme outer positions and at the other side at extreme inner positions.

Fig. 3 is a longitudinal vertical section, substantially on the line 3—3 of Fig. 1, but with various parts of different units thereof shown in vertical section though offest from the plane of said line.

Fig. 4 is an enlarged sectional view of one of the pistons and its pivotal connection to a rocking arm.

Fig. 5 is a partial plan and longitudinal sectional view, the section being taken substantially on the plane of line 5—5 of Fig. 1.

Fig. 6 is a fragmentary enlarged horizontal sectional view substantially on the plane of line 6—6 of Fig. 1, and

Fig. 7 is an enlarged view of a detail of the connecting rod connections to the crank shaft.

Like reference characters refer to like parts in the different figures of the drawings.

In the construction of the engine, frames 1 are cast, two for each so-called unit of the engine spaced from each other. Integral with such supporting frames are vertical cylinders 2 at opposite sides of and between the frames 1 and cast integral therewith with the usual provisions for water jacketing for cooling. The spaced apart frames 1 carry, at their central portions, bearings 3 for parts of the crank shaft as will hereafter appear.

There may be a plurality of these units, each of which has two pistons, one at each side of the frames, said units being located in longitudinal alinement and with a frame 1 between adjacent units serving as a common support for the cylinders of said adjacent units. Above a horizontal plane midway between the ends of the cylinders is a chamber 4 located at the outer sides of the cylinders. Each cylinder has a plurality of openings 5 therein around the same so that air may be forced thereinto. The cylinder, around such series of openings 5, carries an integrally cast manifold 5a so that air pumped into the chamber 4 is forced into said manifold and through the openings 5 into the cylinder when the ports 5 are uncovered.

Likewise in a plane substantially the same distance below the median horizontal plane of the cylinders as the ports 5 are above, exhaust openings or ports 7 are made in each cylinder for the passage of exhaust gases outwardly through an exhaust manifold 6 which has a continuation 7a

similar to the manifold 5a surrounding each cylinder at said ports 7.

Substantially midway between the upper and lower ends of each cylinder a combustion chamber 8 is formed having an inlet therefrom at 9 into the cylinder. A fuel injection nozzle 10 is mounted so as to inject fuel which is carried thereto through a connecting pipe 11 from a fuel pump 12 into the combustion chamber at proper timed intervals. Each combustion chamber is provided with a resistance ignition coil plug 13 which, however, is not concerned with the present invention.

Two pistons 14 are mounted in each cylinder. The upper pistons have piston connecting rods 15 extending therefrom to opposite ends of an upper rocking lever 16 and the lower pistons have like connecting rods 15 extending to the opposite ends of a lower rocking lever 16. The rocking levers are mounted midway between their ends on horizontal pivots 17 which extend between adjacent frames 1 and the axes of which are located in the same vertical plane as the axis of the crank shaft. The outer ends of the rocking levers 16 are forked to make U-shaped yokes, the arms of which extend one at each side of the outer ends of the piston rods 15, there being a suitable pivot pin 18 extending through the sides of the yokes and the outer ends of the piston rods 15.

As shown in Fig. 4 each piston rod 15 is hollow and has a tube 19 therein to carry lubricant to a piston wrist pin 20 which is mounted and fixed in a detachable wrist pin bearing 21 secured in place by bolts 22, the wrist pin 20 passing through an end of a connecting rod 15. A flexible boot 23 is held by a spring wire ring 24, at one end on the connecting rod 15 and at the other on a shroud 25 fixed at the inner end of the piston 14 to prevent oil from dropping into the piston.

The crank shaft includes a plurality of disks 26 spaced from each other and connected by cranks 27 the axes of which are parallel to the axis of rotation of the crank shaft but eccentrically offset therefrom as shown. The disks 26 have a rotative mounting within the bearings 3 of the frames 1 previously described. The crankshaft is integrally formed and its length varies in accordance with the number of units utilized. Four units are disclosed in the drawings as will be described later. Two connecting rods 28 are each divided at their outer ends to make U-shaped yokes the sides of which pass one to each side of lugs projecting inwardly from the rocking arms 16 and are pivotally connected thereto by pivot sleeves 29. The connecting rods 28, in the position shown in Fig. 2, extend diagonally across and lie between adjacent frame members 1. That is, the respective outer ends of the connecting rods 28 are connected to the rocking arms 16 at opposite sides of their pivotal mountings 17. Also the connections of the rods 28 to the rocking arms 16 are between the pivotal mountings 17 for the rocking arms and the pivotal connections at 18 between the ends of the rocking arms and the piston connecting rods 15.

The inner ends of the connecting rods 28 are formed with lateral projections 30, concaved at their inner ends to fit the cranks 27 at opposite sides, around which divided clamping collars go which are connected together by bolts 31. This permits the two connecting rods 28 of a unit to lie in the same plane with each other and with the axes of the cylinders and pistons in the same vertical plane with the axes of the connecting rods 28 and of the piston connecting rods 15, without any offsetting of the rods 28 into different vertical planes with respect to each other or to the other parts noted.

It is also apparent that the connection of the outer ends of the rods 28 to the rocker levers 16, at points between the rocking axis of said levers and the outer ends of said levers permits the rocking levers to be positioned inward toward the cylinders and toward each other with a resultant economy of space and greater compactness of structure and at the same time mount the parts with their longitudinal axes all in the same vertical plane. This provides a structure in which lateral pressure of the pistons against the cylinders is reduced with elimination of wear and with a consequent economy in the use of lubricating oil.

I have illustrated an engine in which are joined together four of the complete units described thus providing eight cylinders and sixteen pistons. It is of course possible to extend the engine farther incorporating the structure of additional units. Likewise there may be a restricting to less than what has been termed the four unit structure, that is, to three or two or even one of the said units.

Cover plates 32 are secured at both the upper and lower sides of the engine. At the upper side they may be provided with openings to which covers 33 are applied.

Operation

In the operation of the engine, assuming the parts to be in the position shown in Fig. 1, in one cylinder there will be occurring a compression of air and in the other an explosion or burning of mixed fuel and air. For example, an explosion or burning of mixed fuel and air, if taking place in the right-hand cylinder of Fig. 1, forces the pistons 14 therein apart, rocking the upper lever 16 in a counterclockwise direction and the lower lever 16 in a clockwise direction. This forces the two pistons 14 in the left-hand cylinder toward each other, compressing air between said pistons to a very high degree of compression and with a resultant high temperature. When the operation has continued so that the parts are in the position shown in Fig. 2, the air between the pistons 14 in the left-hand cylinder has been compressed between said cylinders and into the combustion chamber 8, into which fuel is injected under high pressure. At the high temperature to which the air has been raised the fuel is spontaneously ignited, whereupon the products of combustion and the burning fuel pass through the inlet passage 9 between the ends of the two closely adjacent pistons 14 in the left-hand cylinder.

In the meantime the pistons in the right hand cylinder have moved to the position shown in Fig. 2, with the upper pistons above the ports 5 and the lower piston below the exhaust ports 7. The products of combustion from the left-hand cylinder pass outwardly through the ports 7 into the surrounding manifold 7a and thence out at the exhaust manifold 6. At the same time air under pressure from the chamber 4 passes through the several ports 5 into the cylinder below the upper piston 14, filling the cylinder with air which forces the products of combustion from the previous explosion out through the lower exhaust ports 7, thus completely scavenging the cylinder of the products of the previous explo-

sion, and supplying the cylinder with clean air which is compressed between the upper and lower pistons as the same move toward each other upon the forcing apart of the two pistons in the left-hand cylinder caused the burning or exploding mixture of fuel and air.

Accordingly, there is alternate movement of the pistons in one cylinder toward each other while in the opposite cylinder they move away from each other, with a rocking of the rocking levers 16 in opposition to each other which causes a rotation of the crank shaft, as is evident.

The construction described is practical and relatively simple in structure. By reason of its compactness, freedom from vibration, with relatively little side bearing and wear of the pistons on the cylinders, all coming from the construction described and the location of the moving parts substantially in the same vertical plane, a particularly practical and serviceable engine is produced and one with which great power may be developed with much less rotative speeds of the crank shaft than used in practical ordinary internal combustion engines. By reason of the two pistons in each cylinder traveling in opposite directions the speed of the pistons is much lessened with a further reduction in wear of both the pistons, piston rings and cylinder walls. The connection of the rods 28 inwardly from the adjacent ends of the rocker arms 16 reduces the crank throw and thus reduces vibration. All of these features combine to provide an engine of a very practical and serviceable nature.

The invention is defined in the appended claims and is to be considered comprehensive of all forms of structure coming within their scope.

I claim:

1. In an internal combustion engine of the class described, two vertical spaced apart parallel cylinders, vertical supporting frames spaced from and in parallel relation to each other carrying said cylinders, a crank shaft mounted between the cylinders and on the supporting frames and extending between said frames, a rocking lever pivotally mounted between its ends at both the upper and lower ends of said frames, two pistons in each cylinder, connections between the pistons and the adjacent ends of the rocking levers, connecting rods, one connected at its outer end to a rocking lever near one end thereof and the other connected at its outer end to the other rocking lever near the opposite end thereof, and at their inner ends connected to the crank shaft, said rocking levers lying between the spaced apart frames and disposed across and beyond the ends of said cylinders, the axes of the connecting rods and of the cylinders being in substantially the same vertical plane, each of said pivotal connections between the connecting rods and the rocking levers being located inwardly toward the crankshaft from a line extending medially through the adjacent rocking lever.

2. An engine of the class described comprising, a plurality of units including two end units, each of these units comprising two cylinders integrally connected by a frame, this frame having a crank shaft bearing therein intermediate said units located at right angles to the axes of the said cylinders, the said cylinders being parallelly positioned, said units being adapted to be placed side by side whereby the several crank shaft bearings are located in alined relationship and whereby the several cylinders are positioned in two alined rows, one row on each side of the axes of the crank shaft bearings, the crank shaft extending through the several crank shaft bearings, two pistons located in each of the cylinders, piston rods, one for each piston, extending outwardly from each set of pistons, a series of rocking levers equal in number to the number of units positioned on the respective frame members in alinement with the median of the several cylinders, a second series of rocking levers oppositely positioned to the first series, means for connecting the respective ends of the several rocking levers to the adjacent piston rods and means extending from one end of each of the rocking levers to the cranks on the crank shaft whereby the crank shaft is rotated.

3. An engine as set forth in claim 2 in which cover plates are provided for extending over and concealing the rocking levers and their appurtenances, said cover plates aiding in maintaining the side by side positioning of the several units.

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