Nov. 19, 1929. J. SZYDLOWSKI 1,736,639

DRIVING MECHANISM FOR INTERNAL COMBUSTION ENGINES

Filed May 26, 1927

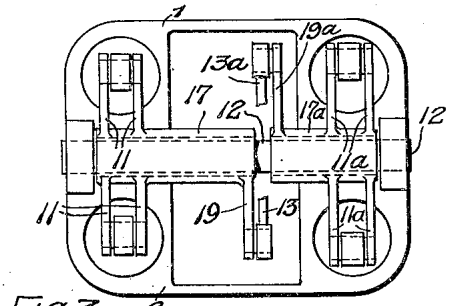


Fig.3.

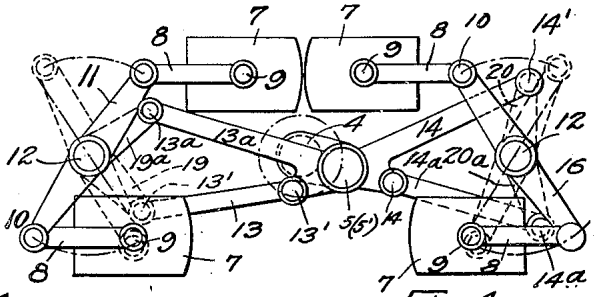


Fig.4.

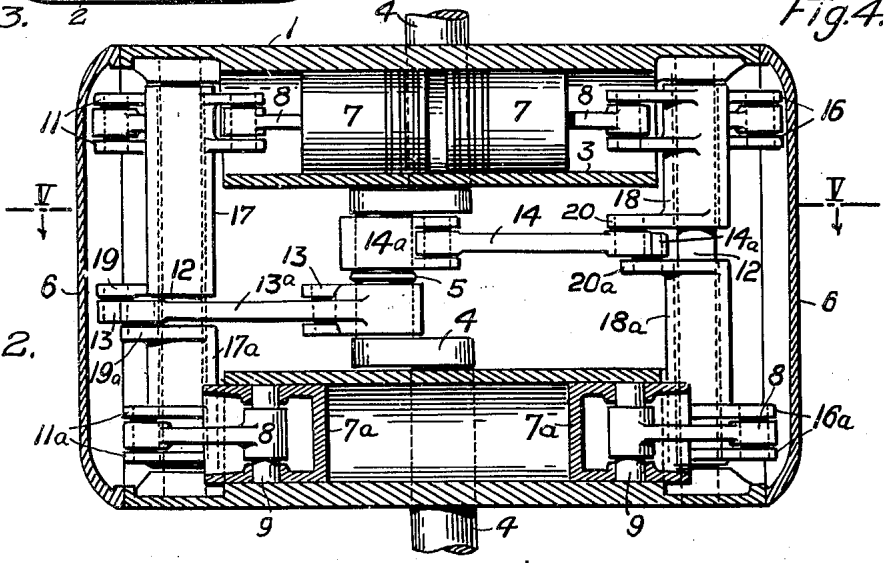
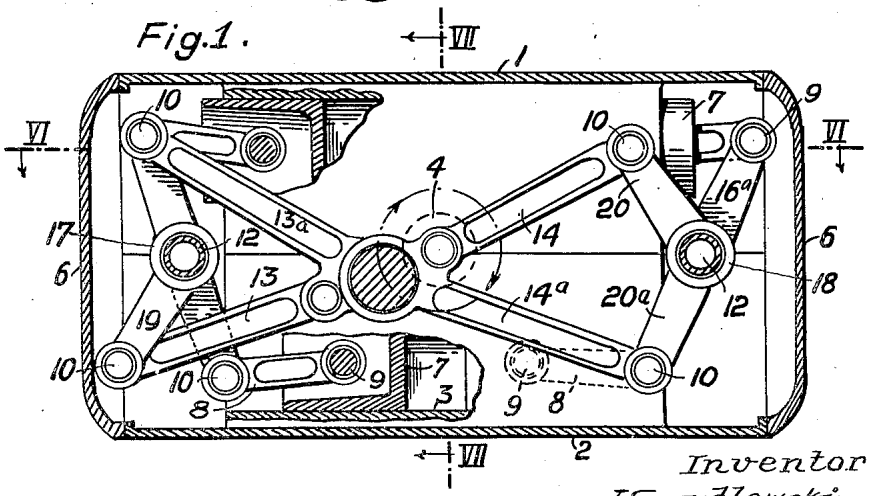


Fig.2.

Fig.1.



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UNITED STATES PATENT OFFICE

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DRIVING MECHANISM FOR INTERNAL-COMBUSTION ENGINES

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The engines working in two-stroke cycle and of these engines with pistons working in opposite directions are best adapted to fulfill the condition to create internal-combustion engines of maximum efficience, lightest weight and greatest simplicity. The engines with pistons working in opposite directions present, in comparison with a two stroke cycle engine of commonly used type, the advantage that the cylinder-covers are dispensed with, the pistons work at slower speed at equal efficiency, and present the possibility of varying the amount of the charges by displacing the cranks which control the two pistons. These engines have nevertheless not been adapted in the measure to be expected. owing to the difficulty connected with the driving-mechanism, the commonly used driving-mechanisms being too complicated and too heavy.

This problem is solved by the present invention. The invention is based upon an arrangement known per se, wherein two cylinders are mounted transversely to the crank-shaft above and below the same, the movement of the pistons working in opposite directions being transmitted to the crank-shaft by rocking levers which connect the one with the other each one two pistons.

The present invention is distinguished from engines of known type in that each two pairs of pistons on both ends of the cylinders are coupled to the common crank pin by independent oscillating levers and separate driving or crank rods, the said power transmitting means consisting of two independent oscillating levers at each end of the cylinders, each provided with a lever fixed thereon and the free end of which is connected with a crank rod. The crank rods of each end of the cylinders form always a main crank rod and an auxiliary crank rod pivoted to the main crank rod near the crank pin. The whole arrangement is such that the oscillating levers operate in staggered relation and cause the working cycles within the four cylinders forming a set to differ in time, so that compression, ignition, expansion and exhaust take place in the four cylinders in sequence. As each pair of pistons transmits its power to the crank shaft independently of the other pairs of pistons a constant uniform stress is exerted upon all parts of the driving gear.

The invention further consists in that the free end or hinge point of the fixed lever on the oscillating levers is displaced inwardly towards the crank shaft and inwardly towards the fulcrum of the oscillating lever to an extent such that the hinge points of two levers in their extreme positions are situated on a straight line passing through the axis of the crank shaft. Thereby the detrimental side pressure to the cylinders is eliminated.

Several embodiments of the invention are shown, by way of example, in the acompanying drawings in which

Fig. 1 shows in longitudinal section on line V—V of Fig. 2 a modified form of construction.

Fig. 2 is a longitudinal section on line VI—VI of Fig. 1.

Fig. 3 shows in end elevation, the casing cover being removed, the driving mechanism shown in Fig. 1.

Fig. 4 shows a different form of construction in diagrammatical view, in which the hinge points of the connecting rods to the rocking levers are displaced in inward direction.

In the form of construction shown in Figs. 1 to 3 the crank-case consists of an upper portion 1 and of a lower portion 2, and it is closed at the two ends by the covers 6. The cylinders 3 are cast in the case 1, 2. The crank-shaft 4 is mounted between the halves 1 and 2 of the case and has a crank-pin 5. The transmission of the movement of the pistons 7, reciprocating in the cylinders 3, upon the crank-shaft 4 is effected by means of short piston- or connecting-rods 8 which, hinged at 9 to the pistons 7 are coupled to oscillating levers.

The hinge connection of the four pistons at each side of the crank-shaft 4 takes place in two groups by means of two rocking-levers 11, 11^a or 16, 16^a which are arranged on separate hubs 17, 17^a and 18, 18^a oscillatably mounted on the journals 12 and fur-

ther by means of two connecting rods 13, 13^a and 14, 14^a which are hingedly connected at the one end to levers 19, 19^a or 20, 20^a of the hubs 17, 17^a and 18, 18^a of the rocking-levers or oscillating levers and at the other end to the common crank 5. The arrangement is such that every two pistons 7 movable in different cylinders 3, the one of said pistons being above and the other underneath the crank-shaft 4, form one group and are hingedly connected to the common crank-pin 5 through a common rocking-lever 11, 11^a respectively 16, 16^a and through a common connecting rod 13, 13^a respectively 14, 14^a. Therefore, the working cycles of the four cylinders take place at different times. This presents the advantage, that the stress to which the driving mechanism is submitted amounts to very little, and that thereby the turning moment of the driving-shaft 4 becomes at the same time much more uniform. To the connecting-rods 13^a, 14^a the connecting rods 13, 14 are hingedly connected near the crank pin 5. The angle between the connecting-rods 13 and 13^a respectively 14 and 14^a necessitates a phase-displacement between the rocking-levers 11 and 11^a respectively 16 and 16^a and consequently also between the corresponding pairs of pistons 7.

Fig. 4 shows a form of construction of the arrangement shown in and described with regard to Figs. 1 to 3 in which the working cycles of the corresponding four cylinders are timely different.

The inward displacing of the pivot-points 13′, 14′ or $13^{a'}$, $14^{a'}$ can be obtained by according rotation of the levers 19, 20 or 19^a, 20^a or by providing suitable hinge-eyes on the rocking lever 11, 16 or 11^a, 16^a.

In Fig. 4 the free ends of the levers fixed on the naves of the oscillating levers 11, 16 and so on or the hinge points 13′, 14′ at which the main crank rods 13, 14 and also the auxiliary connecting rods 13^a, 14^a are hingedly connected to the rocking levers 11, 16 and 11^a, 16^a are displaced in inward direction with regard to the pivot points 10 to which the piston rods 8 are hinged which are coupled with the same oscillating levers. By displacing inwardly these hinge points 13′, 14′, $13^{a'}$, $14^{a'}$ the maximum stresses of the entire driving mechanism, counted from the piston rod, are reduced and further the distributing conditions are altered. When this inward displacing is extended so far that the extreme positions of the pivot points 13′, 14′, $13^{a'}$, $14^{a'}$, are situated in an imaginary straight line extending through the pivot point of the crank shaft, the connecting rods and the crank shaft are submitted, by the two pistons hingedly connected to one and the same rocking lever, to a stress of the same value when said pistons are in the corresponding expansion positions. The duration of the expansion stroke becomes further equal to that of the compression stroke.

In order to obtain the effect of the independent oscillating levers, coupled with the crank rods it is not unconditionally necessary to pivot the auxiliary crank rods to the main crank rods; they may also be immediately pivoted to the common crank pin, such that the four crank rods are pivoted to one common crank pin.

I claim:—

1. An internal combustion engine comprising in combination four cylinders arranged in opposed parallel spaced relation, a pair of pistons for each cylinder and adapted to travel in opposite directions therein, a crank shaft journaled between and extending transversely of said cylinders, rocking levers at each end of the cylinders, each of said rocking levers being pivotally connected to one of the pistons in one cylinder and to the adjacent piston of the opposed parallel cylinder, main crank rods connecting said rocking levers to the crank shaft, auxiliary crank rods having one of their ends pivoted to said main crank rods adjacent their point of connection with the crank shaft, and short levers pivoted to the free ends of said auxiliary crank rods and to said rocking levers whereby each pair of pistons transmits its power to the crank shaft independently of the other pairs of pistons and compression ignition expansions and exhaust takes place in sequence in the four cylinders.

2. An internal combustion engine comprising in combination four cylinders arranged in opposed parallel spaced relation, a pair of pistons for each cylinder and adapted to travel in opposite directions therein, a crank shaft journaled between and extending transversely of said cylinders, rocking levers at each end of the cylinders, each of said rocking levers being pivotally connected to one of the pistons in one cylinder and to the adjacent piston of the opposed parallel cylinder, main crank rods connecting said rocking levers to the crank shaft, auxiliary crank rods having one of their ends pivoted to said main crank rods adjacent their point of connection with the crank shaft, the free ends of said auxiliary crank rods mounted to be moved inwardly towards the crank shaft and inwardly towards the fulcrum of the rocking levers and to be situated at their extreme position on an imaginary straight line passing through the axis of the crank shaft, and short levers pivoted to the free ends of said auxiliary crank rods and to said rocking levers whereby each pair of pistons transmits its power to the crank shaft independently of the other pairs of pistons and compression ignition, expansions and exhaust take place in sequence in the four cylinders.

In testimony whereof I affix my signature.

JOSEF SZYDLOWSKI.