Feb. 18, 1936.

H. JUNKERS

2,031,318

ENGINE

Filed Nov. 9, 1929

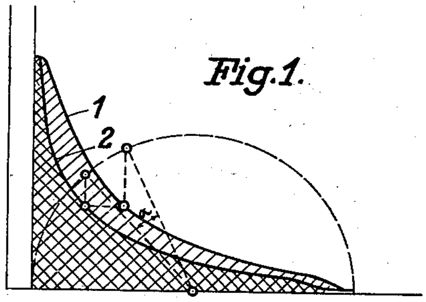

Fig. 1.

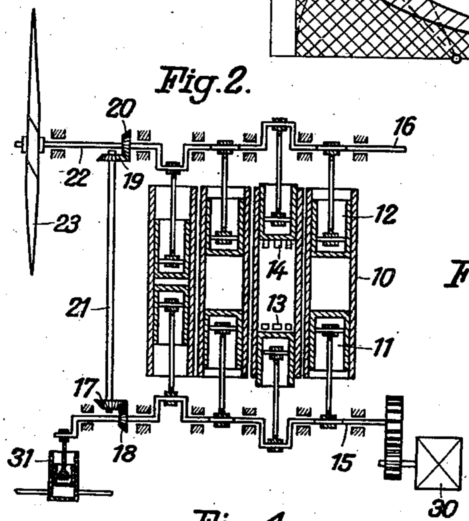

Fig. 2.

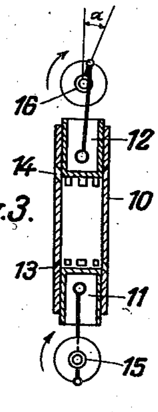

Fig. 3.

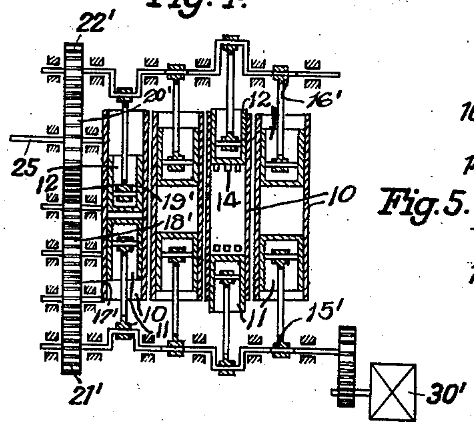

Fig. 4.

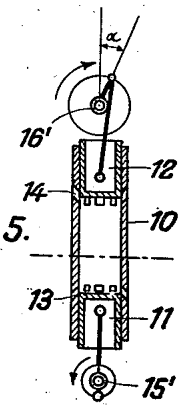

Fig. 5.

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UNITED STATES PATENT OFFICE

2,031,318

ENGINE

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Application November 9, 1929, Serial No. 406,090
In Germany November 20, 1928

4 Claims. (Cl. 123—51)

My invention refers to engines and more especially to the kind of engines in which two pistons are arranged in each cylinder for reciprocation in opposite directions, these pistons acting on two separate crank shafts, one at each end of the piston, which are positively coupled with each other by means of suitable gearing, such as toothed wheels, chains, crank gear, or the like.

If the power generated by the engine is transmitted only by one of these shafts or by a part of the intermediate gearing adjoining one of the shafts, these gears are called upon to transfer that half of the output, which is transmitted by the second shaft, towards the first crank shaft, and are therefore required to be comparatively heavy and large, so that considerable losses of power are incurred.

The present invention contemplates a considerable reduction of the percentage of power to be transmitted from the intermediate gearing to the place of consumption, in order to effect a saving of space, weight, cost, and power losses.

To this end I employ means well known per se for making the percentage of work to be transmitted by each of the two crank shafts unequal and I cause the major portion of the engine output to be taken off the more heavily loaded shaft, or if the intermediate gearing has the form of a toothed wheel gearing with a plurality of intermediate wheels arranged in series, from the axle of the toothed wheel directly adjoining this shaft. I thereby obtain that the power to be transmitted by the intermediate gearing is less than one half of the total power.

In order to obtain an unequal distribution of work onto the two crank shafts, I may for instance use the following means:

(*a*) In internal combustion engines, the cranks of those pistons, which transmit the major amount of power, are made to lead the cranks of the pistons transmitting the minor amount of power.

(*b*) Pistons having different strokes are employed;

(*c*) That crank shaft receiving the minor amount of power is utilized for operating the auxiliary devices to be driven by the engine, such as for instance the pumps for cooling water, combustion air, fuel, lubricant, etc., the electrical generator, and so on.

In the drawing affixed to this specification and forming part thereof, two modifications of an engine embodying my invention are illustrated diagrammatically by way of example.

In the drawing

Fig. 1 is a diagram which illustrates the unequal distribution of the output, which results in an internal combustion engine with double pistons from the leading of the crank for the exhaust piston.

Figs. 2 and 3 are an axial longitudinal section and an axial cross section, respectively, of the first, and

Figs. 4 and 5 are similar views of the second modification.

Fig. 1 illustrates the pressure-volume-diagrams corresponding to the thrust of an internal combustion engine having two pistons operating in opposite directions, the cranks of these pistons being staggered through a predetermined angle α relative to their extreme positions. The diagram surface bordered by the curved line 1 corresponds to the percentage of power which is transmitted to the piston controlling the exhaust ports, which is connected with the leading crank. The surface bordered by the curved line 2 corresponds to the percentage of power transmitted by the piston controlling the scavenging ports, this latter percentage being considerably lower than the one transmitted by the first mentioned piston. The relation between the two characteristics and the angle of lead α can easily be guessed from the diagram.

Referring now to Figs. 2 and 3, 10 are a plurality of juxtaposed cylinders, and 11, 12 are two pistons arranged in each cylinder for reciprocation in opposite directions. 13 are the intake ports for the scavenging air or mixture arranged at one end of the working chamber of each cylinder. 14 are the exhaust ports arranged at the opposite end of the working chamber. The pistons 11 controlling the scavenging ports 13 transmit power to the crank shaft 15, the pistons 12 controlling the exhaust ports operate the crank shaft 16. The two shafts are positively connected with each other by bevel gearings 17, 18, and 19, 20, respectively, and an intermediate shaft 21 in such manner that each crank of shaft 16 leads with regard to the crank, belonging to the same cylinder, of shaft 15 by a predetermined angle α (Fig. 3). The power generated by the engine is transmitted for instance to a water or air propeller 23 driven by the engine by means of an extension 22 of the crank shaft 16 arranged on the exhaust side. In consequence of this arrangement shaft 16 is acted upon with more than one half of the engine output, and in consequence thereof the intermediate gearing 17 to 21 is not called upon to transmit one half, but less than one half of the total output. In order to further reduce the power to be transmitted by this gearing, the auxiliary devices 30, 31, to be operated by the engine, are coupled with the shaft 15.

In the modification illustrated in Figs. 4 and 5, the pistons 12 controlling the exhaust ports 14 are again connected with crank shaft 16′, the pistons 11 controlling the scavenging ports 13 with crankshaft 15′. The two crank shafts are positively coupled by toothed wheels 17′, 18′, 19′, 20′, arranged in series, in such manner that the crank shaft 16′ leads with respect to the shaft 15′ by an angle α, whereby also an increased transmission of power to shaft 16′ is obtained. In order to further increase the percentage of power transmitted to shaft 16′, the radius of the cranks of shaft 16′ is made longer than the radius of the cranks of shaft 15′. Here power is transmitted by means of the extension 25 of the axle of the intermediate wheel 20′ directly adjoining crank shaft 16′, so that only this intermediate wheel is more heavily strained, while the other intermediate wheels 17′ to 19′ are much less loaded. According to the diameter of the toothed wheels 21′ and 22′ mounted on the crank shafts and of the intermediate wheel 20′ transmitting power, an increase or reduction of the number of revolutions can be obtained for the power transmitting axle 25 with respect to the crank shafts. Auxiliary devices 30′, which are to be operated by the engine, are here again connected to the crank shaft 15′.

The most advantageous embodiment of my invention comprises a twin-shaft, two-cycle internal combustion aeroplane engine, a plurality of juxtaposed cylinders having intake and exhaust ports, a pair of crank-shafts one mounted at each end of said cylinders rotating at the same speed, a pair of pistons mounted to reciprocate in each of said cylinders in opposite directions and operatively connected by means of crank arms to transmit power to said crank-shafts, one of said pistons being adapted to control said intake ports and the other being adapted to control said exhaust ports, means including crank arms of unequal crank throw producing an unequal distribution of power to said crank-shafts; the crank arms having the greater crank throw transmitting the major amount of power; a driven part coupled to both crank-shafts, and means for synchronizing the operation of said crank-shafts and for transmitting power from the crank-shaft receiving the minor amount of power to said driven part, said synchronizing means being of such weight and strength as to be adapted to transmit less than half of the total power delivered to said driven part, the crank-shaft receiving the major amount of power being more closely coupled to said driven part than said shaft receiving the minor amount of power. By the statement that the crank-shaft receiving the major amount of power is more closely coupled to the driven part than the shaft receiving the minor amount of power, I mean that the former shaft is closer to the driven part or is coupled therewith more directly or through fewer moving parts or through more sturdy mechanism.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described for obvious modifications will occur to a person skilled in the art.

I claim:—

1. In a twin-shaft, two-cycle, internal combustion engine, a plurality of juxtaposed cylinders having intake and exhaust ports, a pair of crank-shafts one mounted at each end of said cylinders rotating at the same speed, a pair of pistons mounted to reciprocate in each of said cylinders in opposite directions and operatively connected by means of cranks and crank arms to transmit power to said crank-shafts, one of said pistons being adapted to control said intake ports and the other being adapted to control said exhaust ports, means including leading and lagging cranks producing an unequal distribution of power to said crank-shafts, said leading cranks, being connected to the crank-shaft receiving the major amount of power, a driven part coupled to both crank-shafts, and means for synchronizing the operation of said crank-shafts and for transmitting power from the crank-shaft receiving the minor amount of power to said driven part, said synchronizing means being of such weight and strength as to be adapted to transmit less than half of the total power delivered to said driven part, the crank-shaft receiving the major amount of power being more closely coupled to said driven part than said shaft receiving the minor amount of power.

2. The engine of claim 1 wherein the driven part is mounted on the crank-shaft receiving the major amount of power.

3. The engine of claim 1 wherein said crank-shaft receiving the minor amount of power is coupled to more auxiliary machinery than said crank-shaft receiving the major amount of power.

4. The engine of claim 1 wherein said synchronizing means comprises a train of gears, the driven member being mounted on one of the shafts of said gears.

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