Aug. 27, 1940. C. E. FISHER 2,212,595

OPPOSED TWIN CYLINDER ENGINE

Filed March 9, 1939 2 Sheets-Sheet 1

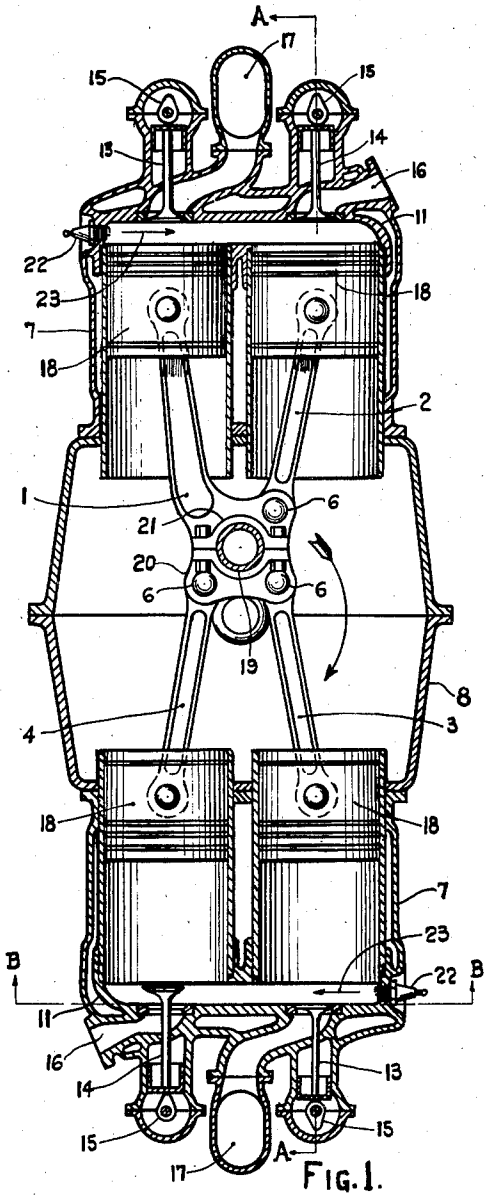



FIG. 1.

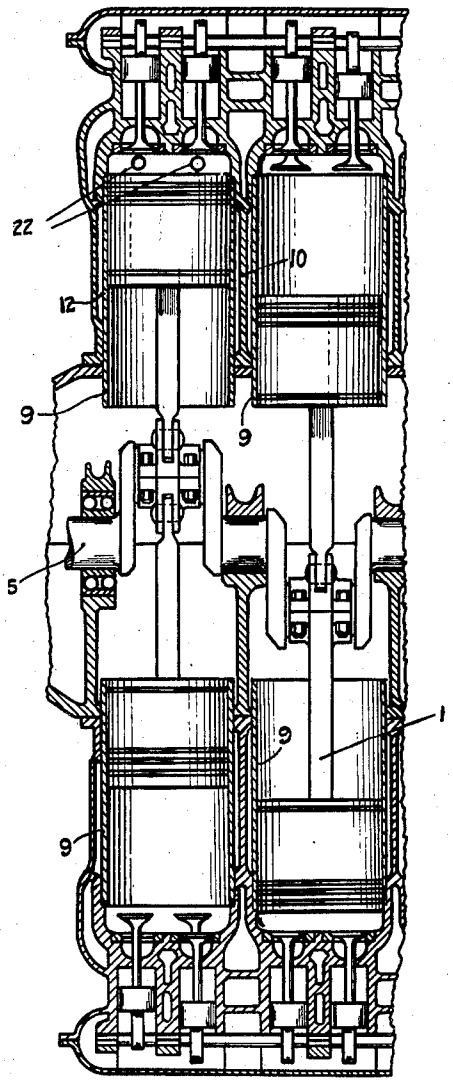



FIG. 2.

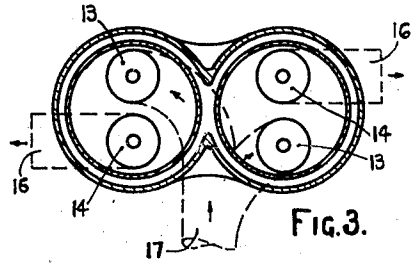



FIG. 3.

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OPPOSED TWIN CYLINDER ENGINE

Filed March 9, 1936 2 Sheets-Sheet 2

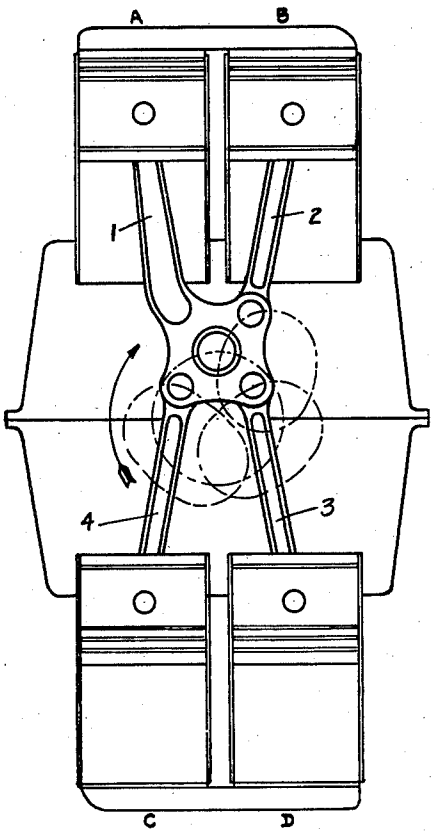



FIG. 4.

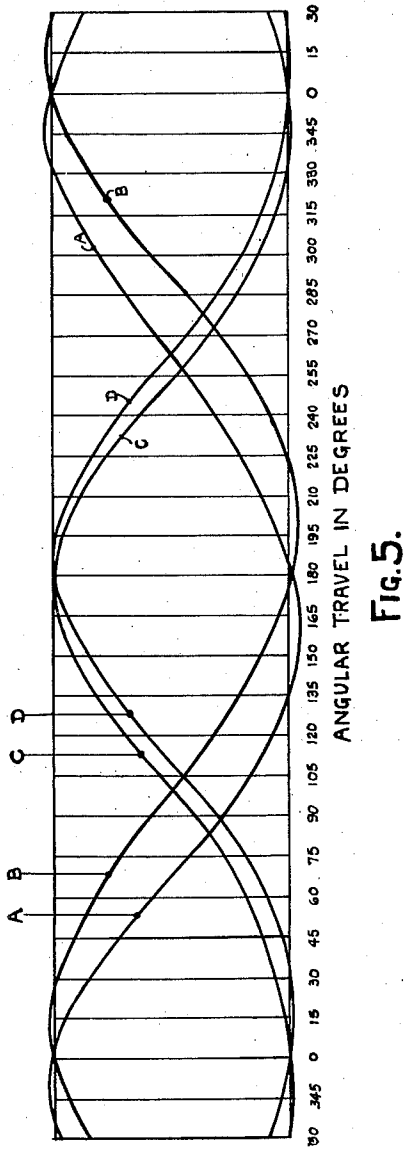



FIG. 5.

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Patented Aug. 27, 1940 2,212,595

# UNITED STATES PATENT OFFICE

2,212,595

## OPPOSED TWIN CYLINDER ENGINE

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Application March 9, 1936, Serial No. 67,956

11 Claims. (Cl. 123—53)

The present invention relates to internal combustion engines of the twin cylinder type, particularly where the twin cylinders are diametrically disposed with respect to the engine crank shaft.

Twin cylinder internal combustion engines broadly, have been known in the art for a number of years. They are characterized principally by their flexibility, low fuel consumption, high overall efficiency and desirable power-weight ratio. Examples of the known constructions are found in the patents to Herr, 1,841,119, issued January 12, 1932, and Köhler, 1,968,524, issued July 31, 1934 in which cases however, the arrangement of cylinders is confined to a single row. Such engines have been proposed for two and four cycle operation and the suggested constructions have included sleeve valve and Diesel types.

This twin cylinder principle has also been extended to radial engines as exemplified by the patent to Leadbetter et al., 1,301,141, issued April 22, 1919. This latter construction however, introduces the large frontal area and excessive drag inherent to all radial engines.

Another type of engine, employing what is known as opposed cylinders, has also been recognized for its advantages with respect to smooth and efficient operation, but in practice, the sizes of such engines are restricted by their weight per horse power and by their unsatisfactory heat dissipation. These opposed cylinder engines have been limited, as far as is known, to opposed single cylinders.

In air-craft engines especially, the problems of cooling, high power and economy are continually increasing with the demands for greater sizes, speeds and cruising areas.

By the present invention, the various advantages of the twin cylinder engine and the opposed cylinder engine are combined to produce what may be called an opposed twin cylinder engine. Perhaps the nearest approach to such a construction in the prior art will be found in the Leadbetter patent already referred to, the chief disadvantages of which, especially for aircraft have already been alluded to. An engine of the opposed twin cylinder type on the other hand, readily adapts itself to horizontal installation in an airplane wing between the front and rear spar, for example, whereupon all undue drag is eliminated.

Some of the features contributing to the lower weight per horse power and increased operating efficiency of an engine of the present construction, are the need for but a single crank shaft, the adequacy of a small crank case, the requirement of but one spark plug (in engines using electric ignition) per cylinder, the requirement of a smaller volume of cooling liquid (where liquid cooling is employed) due to the substantial I-shape of the engine, the possibility of using thin finned cylinder barrels, and a connecting rod arrangement whereby fewer main connecting rods are necessary, and accordingly, a reduced number of bearing caps will be required.

The object of this invention is, therefore, to produce an engine of the opposed twin cylinder type wherein one or more units, each comprising four cylinders, has its cylinders arranged in pairs, which pairs are symmetrically disposed with respect to the engine crank shaft in such a way that a line passing through the crank shaft axis and the center line of the one pair of cylinders, is coincident with the center line of the other pair of cylinders. Each pair of cylinders is preferably provided with a common combustion chamber and common ignition means. The pistons in each cylinder of the four comprising a unit are operatively connected with the crank shaft, and preferably to a single crank pin on the crank shaft, so that each unit of four cylinders will comprise a master connecting rod to which the other three connecting rods are articulated. For purposes of balancing the masses and forces, a particular unit will preferably have its master connecting rod diagonally arranged with respect to the master rod of any preceding and succeeding units.

In the accompanying drawings:

Fig. 1 is a sectional elevation of one embodiment of the present invention;

Fig. 2 is a longitudinal section, partially broken, taken along line A—A of Fig. 1;

Fig. 3 is a sectional plan view taken along line B—B of Fig. 1;

Fig. 4 is a diagrammatic view of an engine unit; and

Fig. 5 depicts by curves the relative travel of the pistons of an engine unit.

An engine unit composed of four cylinders, or two twin cylinders, is shown in Fig. 1 of the drawings, and in Fig. 2, two such units are shown in banked relation. In some instances a complete engine might be defined by the number of cylinders represented by these figures respectively, while in other cases, an engine may consist of any desired number of such units.

Each unit comprises two cylinder blocks 7 mounted at their bases upon a crank case 8, each

cylinder block containing at least one twin cylinder 9, the two cylinders constituting a twin cylinder preferably having their axes parallel. A division wall 10 separates the cylinders of one unit from those of an adjacent unit, the number of such adjacent units in banked relationship depending upon the desired horse power. As shown, a cylinder head 11 common to the two cylinders constituting a pair provides a common combustion chamber and in this particular form, it is integral with the cylinder block. Cooling jackets are provided in the head and block defining a passage 12 for the circulation of cooling liquid, which passage extends between the two cylinders of a pair.

Two intake valves 13 and two exhaust valves 14 are provided for each pair of cylinders, and their arrangement as shown in Fig. 3 is preferably such that one intake and one exhaust valve are positioned above each cylinder, the valves being driven by over head cam shafts 15 which are in turn driven from the crank shaft in a suitable manner. With particular reference to Fig. 3 it will be noted that the exhaust ports 16 are located with respect to the cylinders so as to deliver the exhaust gases to the outside air through the shortest possible path and consequently with least resistance. The intake ports 17 are arranged so as to deliver the combustible charge towards the center of each cylinder in such a manner that the cooling characteristic of the head will be greatly enhanced.

Each cylinder is provided with a piston 18 for cooperation with a crank shaft passing through the crank case and carrying a suitable number of crank pins 19, one for each unit. One piston of each unit of four cylinders is provided with a master connecting rod which cooperates with a bearing cap 20 and bearing 21 for assembly on the crank pin 19. The three remaining pistons of each unit are provided with connecting rods 2, 3 and 4 which are articulated to the master connecting rod assembly by suitable link pins 6.

The cylinder head common to each pair of cylinders provides the latter with the common combustion chamber at one side of which, suitable spark plugs 22 have been indicated. There are preferably two spark plugs for each twin cylinder, or in other words, one spark plug per cylinder and they are preferably arranged at that side of the cylinder which will upon ignition, produce a flame travel across the pistons of a pair of cylinders in a direction corresponding to the rotational direction of the crank shaft. An arrow in Fig. 1 clearly depicts a clockwise rotation of the crank shaft, while arrows 23 indicate the direction of flame travel from the spark plug across the cylinders.

It will be noted with respect to Fig. 4 that the paths of the link pins 6 approach ellipses. This figure depicts the pistons as A, B, C and D for the purpose of representing their relative travel in the curves of Fig. 5. The consequent motion serves to increase the piston speed during the firing stroke and yield a higher heat efficiency. Another effect is an increase in time for intake and exhaust with a resultant increase in volumetric efficiency.

In an engine built up of a series of these units, alternate units will preferably have their master connecting rods diagonally disposed for the purpose of balancing the forces and stabilizing operation.

Whereas only one arrangement of the engine with its master and articulated connecting rods has been shown and described, it will serve adequately as an example of the present invention. The appended claims are intended to cover all equivalents as would be suggested to a worker in the art.

I claim:

1. An engine of the twin cylinder type comprising a crank shaft and plurality of units, each of said units having four cylinders arranged in pairs, the cylinders of each pair having parallel axes which are coincident with the axes of the cylinders of the other pair, a piston in each cylinder, a master connecting rod connecting one piston of each unit with a pin on said crank shaft, the remaining pistons having connecting rods articulated to said master connecting rod, alternate units having their master connecting rods diametrically disposed.

2. A unit for an engine of the twin cylinder type comprising two pairs of cylinders disposed at 180° with respect to a crank shaft, pistons in said cylinders operating upon a single crank on the crank shaft, the cylinders of each pair having a common combustion chamber, the igniting means for each pair of cylinders being so disposed that upon ignition, the direction of flame travel corresponds to the direction of rotation of said crank shaft.

3. A balanced engine of the twin cylinder type composed of a plurality of four-cylinder units, each unit comprising a crank shaft having a pin and two pairs of twin cylinders disposed about said crank shaft at 180° to one another, each pair of cylinders having a common combustion chamber, pistons in said cylinders, a master connecting rod connecting one of said pistons to said crank pin, the remaining pistons having connecting rods which are articulated to said master connecting rod, the axes of the individual cylinders lying in a single plane perpendicular to the crank shaft axis, the cylinders of adjacent units being aligned longitudinally of the crank shaft and certain of said units having their master connecting rods in relatively staggered engine-balancing relationship.

4. A balanced engine of the twin cylinder type composed of a plurality of four-cylinder units, each unit comprising a crank shaft having a pin, two pairs of twin cylinders symmetrically disposed with respect to said crank shaft, the twin cylinders each comprising two cylinders having a common combustion chamber and arranged in a plane perpendicular to the axis of the crank shaft, pistons in said cylinders, a master connecting rod articulating one of said pistons to the crank pin and connecting rods articulating the other pistons to said master connecting rod, the cylinders of adjacent units being aligned longitudinally of the crank shaft and certain of said units having their master connecting rods in relatively staggered engine-balancing relationship.

5. A balanced engine of the twin cylinder type composed of a plurality of four-cylinder units, each unit comprising a crank shaft having a crank pin and two pairs of substantially parallel cylinders diametrically disposed with respect to the axis of the crank shaft, each pair having a common combustion chamber, the axes of all of said cylinders lying on a single plane transverse to said crank shaft, each cylinder having a piston, and each piston having a separately articulated connecting rod operatively connected to said crank pin, one of said connecting rods being directly connected to said crank pin, the other

connecting rods being articulated to the first, the cylinders of adjacent units being aligned longitudinally of the crank shaft and certain of said units having their master connecting rods in relatively staggered engine-balancing relationship.

6. A substantially flat balanced engine of the twin cylinder type composed of a plurality of four-cylinder units, each unit comprising a crank shaft having a pin and four co-planar cylinders arranged in substantially parallel pairs on opposite sides of said crank shaft, each pair having a common combustion chamber, said cylinders containing pistons operatively connected through connecting rods to said pin, the axes of one pair of said cylinders corresponding with the axes of the other pair of cylinders respectively, said axes being symmetrical with respect to said crank shaft and lying in a plane transverse to said crank shaft, one of said connecting rods being directly connected to said pin, the other of said connecting rods being connected to the first, the cylinders of adjacent units being aligned longitudinally of the crank shaft and certain of said units having their master connecting rods in relatively staggered engine-balancing relationship.

7. A substantially flat balanced engine of the twin cylinder type composed of a plurality of four-cylinder units, each unit comprising two pairs of cylinders symmetrically disposed at 180° with respect to a crank shaft, pistons in said cylinders operating upon a single crank on the crank shaft, the cylinders of each pair having a common combustion chamber, the axes of all of said cylinders lying in a single plane transverse to said crank shaft, a master connecting rod connecting one of said pistons to said crank, and articulating rods connecting the remaining pistons to said master rod, the cylinders of adjacent units being aligned longitudinally of the crank shaft and certain of said units having their master connecting rods in relatively staggered engine-balancing relationship.

8. A balanced engine of the twin cylinder type composed of a plurality of four-cylinder units, each unit comprising a crank shaft with respect to which two pairs of cylinders are diametrically disposed, the cylinders of each pair being in communication, a piston carried by each cylinder, and connecting rods associating said pistons through articulated joints to said crank shaft, the axes of all of said cylinders lying in a single plane transverse to said crank shaft, one of said connecting rods being directly connected to said crank shaft, the other of said connecting rods being connected to the first, the cylinders of adjacent units being aligned longitudinally of the crank shaft and certain of said units having their master connecting rods in relatively staggered engine-balancing relationship.

9. A substantially flat balanced engine of the twin cylinder type composed of a plurality of four-cylinder units, each unit comprising a crank shaft with respect to which two pairs of cylinders are symmetrically disposed, the cylinders of each pair having a common combustion chamber, the center line through one pair of cylinders being coincident with the center line of the other pair of cylinders, a piston in each cylinder, a master connecting rod connecting one of said pistons to said crank shaft and connecting rods associating each of said other pistons with said master connecting rod, the axes of all of said cylinders lying in a single plane transverse to said crank shaft, the cylinders of adjacent units being aligned longitudinally of the crank shaft and certain of said units having their master connecting rods in relatively staggered engine-balancing relationship.

10. A balanced engine of the twin cylinder type composed of a plurality of four-cylinder units, each unit comprising a crankcase, a crankshaft having a crankpin, parallel interconnected cylinders having a common combustion chamber disposed on diametrically opposite sides of the crankcase, pistons in each of the cylinders, a master connecting rod interconnecting one of said pistons and the crankpin, and a plurality of articulated connecting rods interconnecting the other pistons and said master rod, the cylinders of adjacent units being aligned longitudinally of the crank shaft and certain of said units having their master connecting rods in relatively staggered engine-balancing relationship.

11. A balanced engine of the twin cylinder type composed of a plurality of four-cylinder units, each unit comprising a crankcase, a crankshaft having a crankpin, parallel interconnected cylinders having a common combustion chamber disposed on opposite sides of the crankcase, pistons in each of the cylinders, a master connecting rod including a bridge rocker interconnecting one of the pistons and the crankpin, and a plurality of articulated connecting rods interconnecting the other pistons and the bridge rocker, the cylinders of adjacent units being aligned longitudinally of the crank shaft and certain of said units having their master connecting rods in relatively staggered engine-balancing relationship.

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