Feb. 5, 1929. 1,701,360

L. N. CAUSAN

INTERNAL COMBUSTION ENGINE

Original Filed Aug. 26, 1926

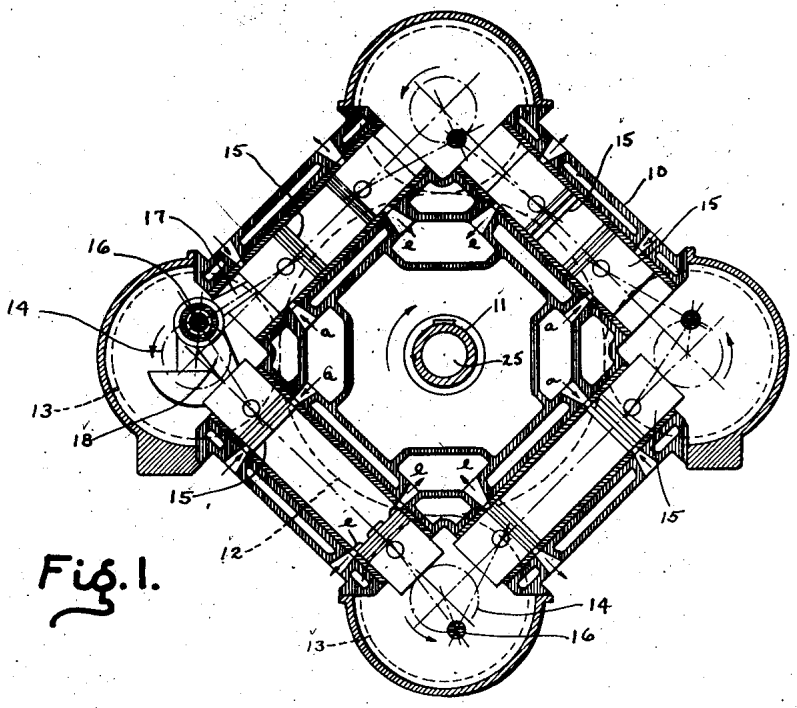

Fig. 1.

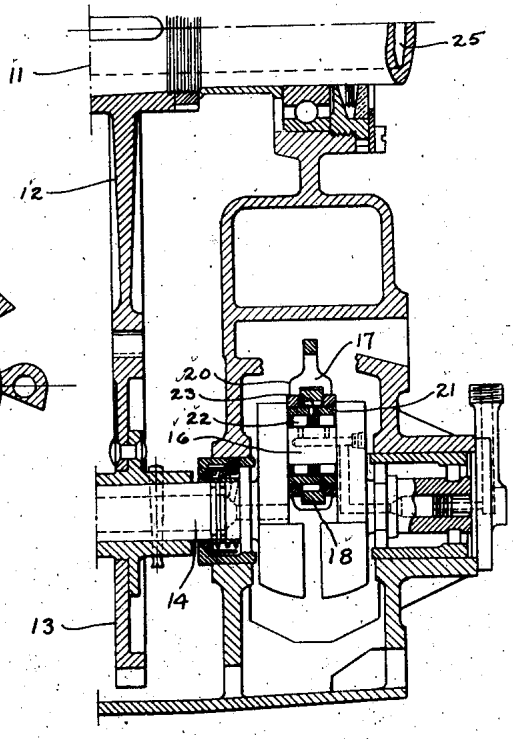

Fig. 2.

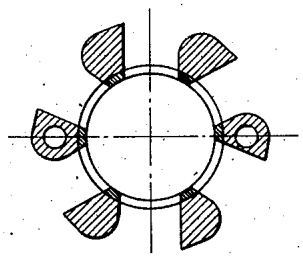

Fig. 3.

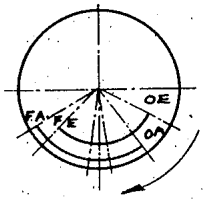

Fig. 5.

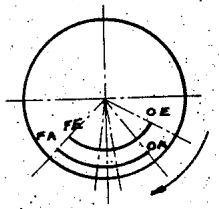

Fig. 4.

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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

Original application filed August 26, 1926, Serial No. 131,752. Divided and this application filed April 18, 1928. Serial No. 270,976.

This application is a division of my application Serial No. 131,752, filed in the United States Patent Office August 26, 1926, and it relates to an engine of the square or polygonal opposed piston two-stroke type and it has for an object to provide apparatus of this character which embodies an improved construction and arrangement of parts.

A further object of my invention is to provide an opposed piston two-stroke engine of the square or other polygonal type having the cylinders provided with admission and exhaust ports so disposed and having the crank shafts so arranged that the cylinders will be effectively scavenged and supercharging will be effected.

A further object of my invention is to provide an engine having a polygonal arrangement of cylinders with crank shafts at the corners thereof connected mechanically to a driven member of hollow formation to provide for armament purposes.

These and other objects are effected by my invention, as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which

Fig. 1 is a sectional view of my improved engine;

Fig. 2 is a fragmentary sectional view of the apparatus shown in Fig. 1 and showing the gearing for connecting a crank shaft to the driven member;

Fig. 3 is a sectional view of a cylinder taken through ports;

Fig. 4 is a diagram showing closing of the admission and exhaust ports together; and

Fig. 5 is a diagram showing how the exhaust port controlling pistons lead the admission port controlling pistons.

Referring to Fig. 1, the engine taken as an example comprises one or more polygonal groups of cylinders 10, each group including an even number of cylinders, for example, four. A power shaft is shown at 11; and, at a suitable point thereof, is keyed a gear wheel 12 engaging four pinions 13 arranged symmetrically relatively to the axis of the engine and actuated by the crank shafts 14 of the engines. The gearing described could of course be replaced by any other means.

The engine properly so called, of which the shaft 11 is at the center (Fig. 1) comprises as above stated one or more groups of cylinders which are in the symmetrical position relatively to the vertical plane passing through the center of the said gearing.

As a whole, the engine thus comprises one or more polygonal groups of cylinders or elements 10, each group having an even number of cylinders, coacting with pistons 15, each cylinder having two opposed pistons, as above stated.

The connecting rods 17 and 18, connected to pistons 15 in adjacent cylinder end portions and coacting with a given crank 16 are disposed as follows: The rod 17 has a forked end 20 and is mounted upon the ring 21 (Figs. 1 and 2) which rolls upon the crank 16 through the medium of two roller bearings 22; the other rod 18 rolls upon the ring 21 and upon the roller bearing 23.

Each cylinder 10 is provided with exhaust ports *e*, *e* and with admission ports *a*, *a* the ports being covered and uncovered by the pistons. In Fig. 1, the two uppermost and the two lowermost pistons 15 control the exhaust ports *e*, *e* while admission through the ports *a*, *a* is controlled by the two pistons at the right and by the two pistons at the left. In other words, the exhaust ports *e*, *e* are located at alternate adjacent end portions of the cylinders and the admission ports *a*, *a* are located at the remaining adjacent end portions of the cylinders; and, in operation, the pistons 15 connected to alternate crank shafts 16 control the exhaust ports *e* while the pistons 15 connected to the remaining crank shafts control the admission ports *a*.

Upon reference to Figs. 1 and 5, it will be seen that alternate crank shafts 14 to which the pistons controlling the exhaust ports *e*, *e* are connected are arranged to lead angularly the remaining crank shafts to which the pistons controlling the admission ports *a*, *a* are connected. This leading feature is clearly indicated in Fig. 5 wherein the arc OE—FE represents opening of the exhaust ports *e*, *e* while the arc OA—FA represents opening of the admission ports *a*, *a*; and, from this diagrammatic view, it will be seen that the exhaust ports *e*, *e* are opened before and closed before the admission ports *a*, *a*. As the exhaust ports *e*, *e* open before the admission ports *a*, *a* it is possible for products of combustion to exhaust from the cylinders before scavenging medium is admitted through the admission ports *a*, *a*. Furthermore, as the

exhaust ports *e*, *e* are closed before the admission ports *a*, *a* are closed, it will be evident that medium continues to be admitted through the admission ports *a*, *a* after the exhaust ports *e*, *e* are closed, thereby producing a supercharging effect.

In Fig. 4, I show a mode of regulation wherein the admission and exhaust ports are closed at the same time.

The necessary angular setting of the crank shafts in order to obtain the relative opening and closing of the exhaust and admission ports, as indicated in Figs. 4 and 5, is secured either by slight angular displacement of the cranks or by a slight displacement of the cylinders.

A compressor of any suitable type (not shown), may be used to supply medium for entry through the admission ports *a*.

The driven shaft 11 is preferably made hollow as indicated at 25 in order to provide for the passage of a gun barrel or projectiles fired therefrom. This is a particularly desirable feature of construction where the engine is to be used for military aviation purposes.

From the foregoing, it will be apparent that I have provided a square or polygon form of engine of the opposed piston type, each cylinder of which is provided with spaced admission and exhaust ports, such ports being controlled by the opposed pistons. In order to facilitate the exhaust of products of combustion from the cylinders and to provide an incidental scavenging effect, it is desirable that the exhaust port controlling piston of each cylinder shall lead the admission port controlling piston in order that the exhaust ports may open before the admission ports and close before the latter. To this end, I connect alternate crank shafts to the exhaust port controlling pistons and connect the remaining crank shafts to the admission port controlling pistons, the first crank shafts being given a suitable angle of lead with respect to the remaining crank shafts so that the exhaust port controlling pistons may lead the admission port controlling pistons to the desired extent. As each crank pin of a crank shaft is connected to a pair of pistons arranged in the adjacent ends of a pair of cylinders, it will be apparent that the leading effect which is referred to may be readily incorporated in an engine of this character merely by having alternate crank shafts lead the remaining crank shafts.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In an internal combustion engine having cylinders disposed in polygonal formation, each cylinder having spaced admission and exhaust ports, the exhaust ports being arranged at alternate adjacent end portions of the cylinders and the admission ports being arranged at the remaining adjacent end portions of the cylinders, opposed pistons in the cylinders for covering and uncovering the admission and exhaust ports, crank shafts connected to the pistons, and means for interconnecting the crank shafts for operation in unison and providing for the exhaust port controlling pistons leading the admission port controlling pistons so that the exhaust ports may open before the admission ports and close before the latter.

2. In an internal combustion engine, the combination of a plurality of alternately disposed cylinders and crank shafts arranged in polygonal formation with the crank shafts at corner regions thereof, each cylinder being provided with spaced admission and exhaust openings, the exhaust openings of the cylinders being arranged adjacent to alternate corner regions of the formation while the admission ports are arranged adjacent to the remaining corner regions of the formation, opposed pistons in the cylinders and connected to the crank shafts, and being arranged to cover and to uncover the admission and exhaust openings, and means for interconnecting the crank shafts for operation in unison and providing for the crank shafts to which the exhaust port controlling pistons are connected leading the remaining crank shafts to which the admission port controlling pistons are connected, whereby the exhaust ports of each cylinder are opened before the admission ports and are closed before the latter.

3. In an internal combustion engine, the combination of a plurality of cylinders disposed in polygonal formation, admission and exhaust ports provided in the respective end portions of each cylinder the admission ports of the cylinders being arranged at alternate adjacent end portions of the cylinders and the exhaust ports being arranged at the remaining adjacent end portions of the cylinders, crank shafts disposed at corners of the polygon, alternate crank shafts being arranged to lead the remaining crank shafts, opposed pistons in the cylinders arranged to cover and uncover the admission and exhaust ports, respectively, means for connecting the pistons controlling the admission ports to alternate crank shafts with two pistons connected to each crank portion, means for connecting the pistons controlling the exhaust ports to the remaining crank shafts with two pistons connected to each crank portion, the pistons associated with the exhaust ports being connecting to the leading crank shafts and the pistons associated with

the inlet ports being connected to the remaining crank shafts, whereby the exhaust ports are opened before the admission ports and are closed before the latter, and means for interconnecting the crank shafts for operation in unison.

4. In an internal combustion engine, the combination of an even number of cylinders arranged in polygonal formation and having substantially co-planar axes, each cylinder having spaced admission and exhaust ports, the exhaust ports being arranged at alternate adjacent end portions of the cylinders and the admission ports being arranged at the remaining adjacent end portions of the cylinders, opposed pistons in each cylinder and covering and uncovering the admission and exhaust ports thereof, respectively, crank shafts alternately arranged with respect to the cylinders and located at corners of the polygonal formation, alternate crank shafts located adjacent to exhaust end portions of the cylinders leading angularly the remaining crank shafts located adjacent to the admission end portions of the cylinders, said crank shafts having crank portions and each crank portion being connected to a pair of pistons located in adjacent cylinders, the crank portions of the leading crank shafts being connected to the exhaust port controlling pistons and the crank portions of the remaining crank shafts being connected to the admission port controlling pistons, whereby the pistons controlling the exhaust ports may lead the pistons controlling the admission ports in order that the exhaust ports may open before the admission ports and close before the latter, and means for interconnecting the crank shafts for operation in unison.

In testimony whereof, I have hereunto subscribed my name this second day of April, 1928.

LAURENT NEMORIN CAUSAN.