PATENT SPECIFICATION

419,813

Convention Date (Italy): April 6, 1932.

Application Date (in United Kingdom): April 5, 1933. No. 10,224/33.

Complete Accepted: Nov. 5, 1934.

COMPLETE SPECIFICATION.

Improvements in Internal Combustion Engines of the Opposed Piston Type.

I, CESARE LONGOBARDI, an Italian Subject, of 48, Via Volturno, Rome, Italy, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to improvements in internal combustion engines of the opposed piston type.

One of the fundamental problems in such engines is the connection between the various pistons. If, as is known, the connection is effected by bars disposed in the interior of the cylinders considerable difficulties are encountered in preventing communication between the combustion chambers, especially in view of the high and variable temperatures in the cylinders.

Arrangements are also known in which the cylinder is not continuous but subdivided, and the pistons extend from the cylinders and are provided on the extending parts with pins for the attachment of connecting rods. These arrangements however have the drawback of material structural difficulties for keeping the various cylinders in position and guiding the connecting-rods, besides which the pistons reach considerable dimensions, and therefore great weight and inertia incompatible with high speed engines.

The object of the present invention is to avoid these disadvantages. An engine according to the invention comprises a plurality of pairs of pistons disposed within the same cylinder, adjacent pistons having an equal and opposite reciprocatory motion and limiting the individual combustion chambers, pins carried by the pistons and projecting laterally from the cylinder wall and two transmission members in the form of bars one of which connects all of the pins moving in the one direction, while the other bar connects all of the pins moving in the opposite direction, said bars being arranged externally of the cylinder and parallel to the direction of movement of the pistons.

Considering a four-stroke cycle engine comprising a single cylinder and eight pistons, the pistons which move in one direction being connected together by a set of connecting bars and the pistons which move in the other direction being also connected together by another set of connecting bars, four separate operating chambers A_1, A_2, A_3 and A_4 each comprising two pistons are formed. The connection of the bars to the pistons and the operation of the engine may be such that the suction strokes in the four chambers take place simultaneously, or such that the same strokes do not occur simultaneously but alternate in such a manner as to agree kinematically with each other. The strokes occurring in the respective chambers may be for instance as follows: A_1 suction stroke, A_2 expansion stroke, A_3 suction stroke, and A_4 expansion stroke. In this way two advantages are obtained, one relating to the equilibrium of the engine since each operating chamber functions no longer as a single cylinder but as a complex of two cylinders in the case of a four stroke cycle and as a complex of three cylinders in the case of a six stroke cycle. The other advantage relates to the strain of the connecting parts, since by conveniently alternating the strokes it is possible to distribute the strains produced by the strokes of two adjacent operating chambers and consequently between their connecting parts, instead of adding them all on the crank shaft. In the succession mentioned, for instance, the suction work is furnished by the expansions in the adjacent chambers and the corresponding strains are thus discharged on the relative connecting parts.

The embodiments above described may be applied to double-acting engines.

Any of the known cycles may be employed, the 6-stroke cycle being particularly suitable. In the case of the double-acting operation, by conveniently alternating the strokes of adjacent operating chambers, that is by producing in one chamber an expansion stroke and in the adjacent chamber a compression stroke, the resulting reduction of the strain on the parts is a particularly important advantage.

As to the cooling of the combustion chambers, the distribution, ignition and

[*Price* 1/-]

Price 4s 6d

injection, the normal arrangements may be employed, and with regard to lubrication the invention provides a great simplification owing to there being no necessity, at least for the intermediate pistons, of lubricating a gudgeon pin and connecting rod big-end as is ordinarily the case.

The engine may comprise as many pistons and hence operating chambers as is necessary to provide the desired efficiency.

The practical construction of the engine may take place in two fundamental ways.

According to the first construction the engine comprises a cylindrical casing having a rectilinear axis and pistons operating within it. Connecting bars, either solid or tubular and having any desired cross-section, have also a rectilinear axis and move reciprocally in a rectilinear direction, this movement being transmitted to two crank-shafts located at opposite ends of the casing, by means of connecting rods which may be arranged within the cylindrical casing and connected to the outermost pistons, or outside the cylindrical casing and suitably connected to the connecting bars. A single crank-shaft may also be employed by the use of auxiliary transmission gearing.

Instead of a connecting rod and crank-shaft transmission a rack and tooth wheel transmission may be employed.

According to the second construction the engine comprises an annular-shaped casing. Within this casing run the pistons, the latter being suitably shaped and connected to a series of connecting bars extending around the periphery of the casing.

The accompanying drawings show by way of example, two engines according to the invention:

Figure 1 is a longitudinal section of one cylinder of a four-stroke cycle single acting engine.

Figure 2 is a partial cross-section of the engine, and

Figure 3 is a plan view thereof, partly in section.

Figure 4 is a vertical section of a second engine,

Figure 5 is an elevational view of the engine, and

Figure 6 is a cross-sectional view of a detail thereof.

Referring to Figures 1 to 3, the engine comprises a series of cylinders 7 in each of which is disposed a plurality of pairs of pistons. The pistons 1 and 3 have an equal and opposite reciprocatory motion, all the pistons being provided with pins which extend through the walls of the cylinders 7. The pins of the pistons 1 are connected to bars 2, and the outermost of the pistons 1 is connected by a connecting rod 8 to the crank 9 of a crank-shaft 5. Similarly, the pins of the pistons 3 are connected to bars 4, the outermost of the pistons 3 engaging a connecting rod 10 connected to the crank 11 of a crank-shaft 6. The faces of adjacent pistons limit the combustion chambers C_1, C_2 and C_3.

Now referring to Figures 4 to 6, the cylinders 12 of the engine are of annular shape and comprise a series of pistons 13 and 15, having an equal and opposite reciprocatory motion. The pistons 13 are each provided at diametrically opposite points with pins which extend through the cylinder wall and engage connecting bars 14, 14^1 arranged parallel to the direction of movement of the pistons, the pistons 15 being likewise provided with diametrically opposite pins which engage bars 16, 16^1. The bars 14^1 carry pawls 19 which are adapted during the explosion stroke of the pistons 13 to engage and rotate a toothed drum 18 carried by a final drive shaft 20. The shaft 20 is connected by a chain 21 to a crank-shaft 22 having two connecting rods 23, 24 respectively connected to a piston 15 and a piston 13, this mechanism operating to effect return movement of the pistons 13 and 15 under the action of the rotation of the shaft 20, said rotation being transmitted from the bars 14^1 through the pawls 19.

The invention is not limited to an engine employing any particular working cycle, and can therefore be applied to a 2, 4 or 6 stroke engine whether working on liquid fuel (benzine, benzole, heavy oils and the like) or gaseous fuel.

The invention may also be applied to both stationary and movable plants, particularly engines for driving motor-vehicles, aircraft and water-craft.

In the case of aircraft, an engine with annular casings has remarkable advantages of compactness, and in the type with transmission by means of the central drum the advantage is obtained of a slowing-down of the propeller shaft. An engine with a casing having a rectilinear axis has the advantage of being arranged within the wing thickness, the load being thus distributed on a large surface and the concentrated load being consequently reduced. The engine owing to its shape and mechanical resistance may contribute either alone or together with a wing frame to the mechanical resistance of the wing; thus the material used in the plant and the weight are more efficiently utilised.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to

be performed, I declare that what I claim is:—

1. An internal combustion engine of the opposed-piston type comprising a plurality of pairs of pistons disposed within the same cylinder, adjacent pistons having an equal and opposite reciprocatory motion and limiting the individual combustion chambers, pins carried by the pistons and projecting laterally from the cylinder wall and two transmission members in the form of bars one of which connects all of the pins moving in the one direction, while the other bar connects all of the pins moving in the opposite direction, said bars being arranged externally of the cylinder and parallel to the direction of movement of the pistons.

2. An engine according to claim 1 in which the cylinder has a rectilinear axis, characterised in that the said bars transmit the motion to a crank-shaft by a crank device.

3. An engine according to claim 2, characterised in that the two outermost pistons are each connected by a connecting rod to a crank-shaft.

4. An engine according to any of the preceding claims comprising a plurality of cylinders, the outermost pistons of each respectively actuating common crank-shafts.

5. An engine as claimed in claim 1 or 4, characterised by a crank-shaft extending transversely through the casing and connected by connecting rods to two adjacent oppositely moving pistons constituting the two end pistons of the series, and by a drum disposed centrally within the casing and to which the motion of the crank-shaft is transmitted.

6. An internal combustion engine, substantially as described or substantially as shown on the accompanying drawings.

Dated this 5th day of April, 1933.

CESARE LONGOBARDI,
Per: Boult, Wade & Tennant,
111/112, Hatton Garden, London,
E.C. 1,
Chartered Patent Agents.

Reference has been directed, in pursuance of Section 7, Sub-section (4), of the Patents and Designs Acts, 1907 to 1932, to Specification No. 352,119.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1934.

Fig. 1

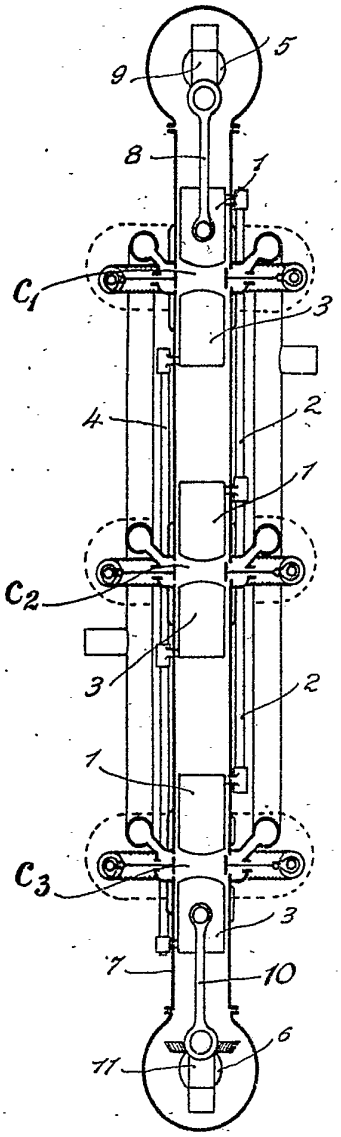


Fig. 2

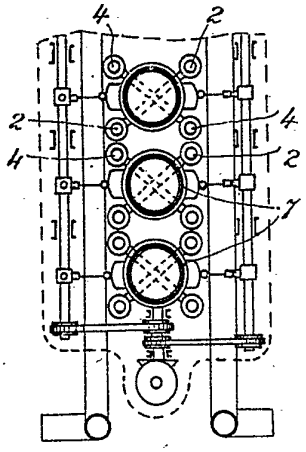


Fig. 3

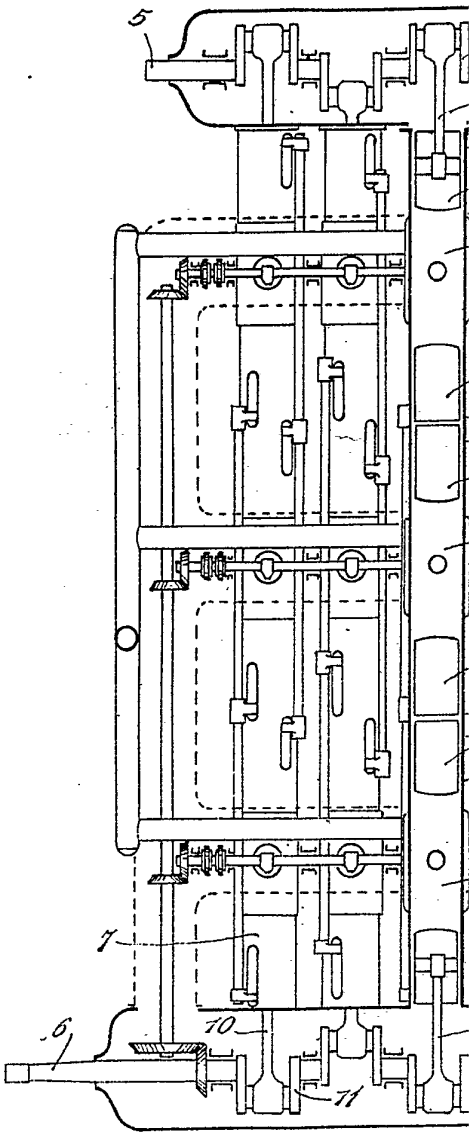


Fig. 6

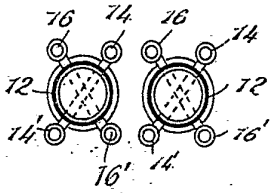


Fig. 3

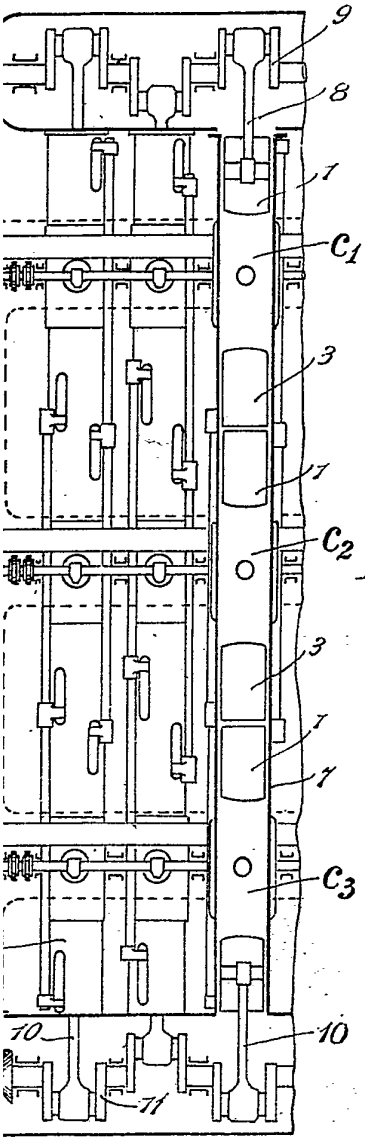


Fig. 4

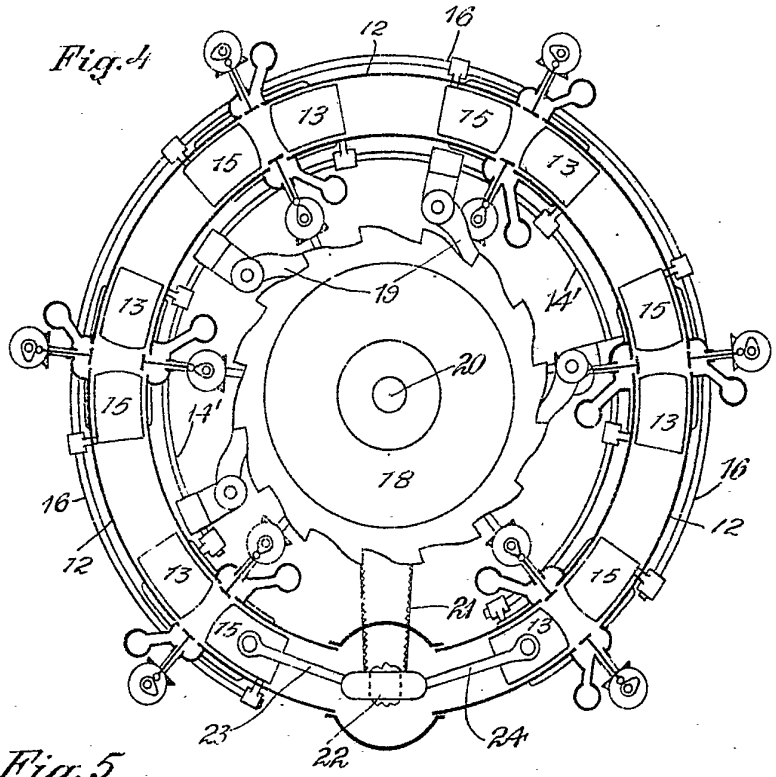
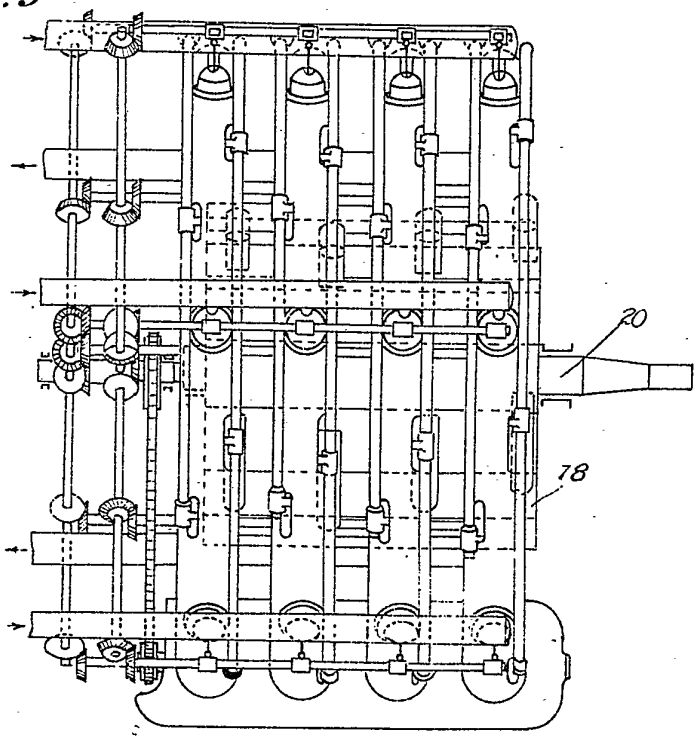


Fig. 5



Malby & Sons, Photo-Lith.

[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 1

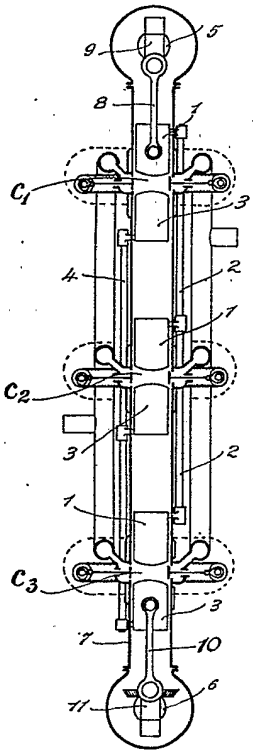


Fig. 2

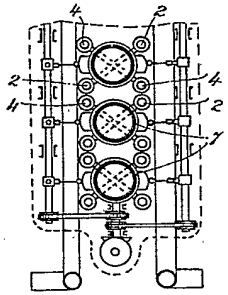


Fig. 6

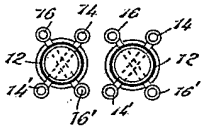


Fig. 3

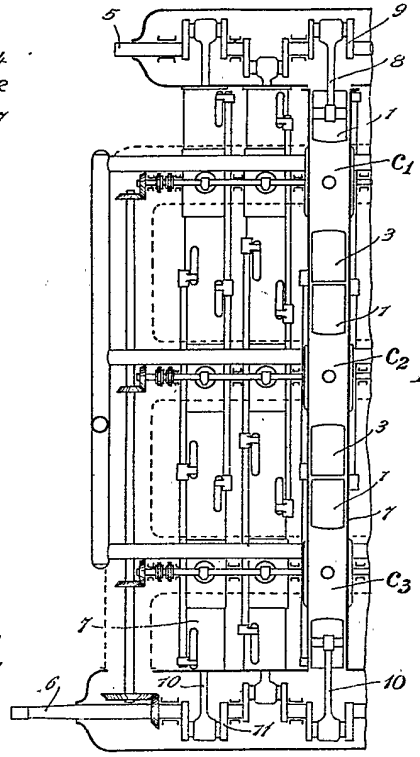


Fig. 4

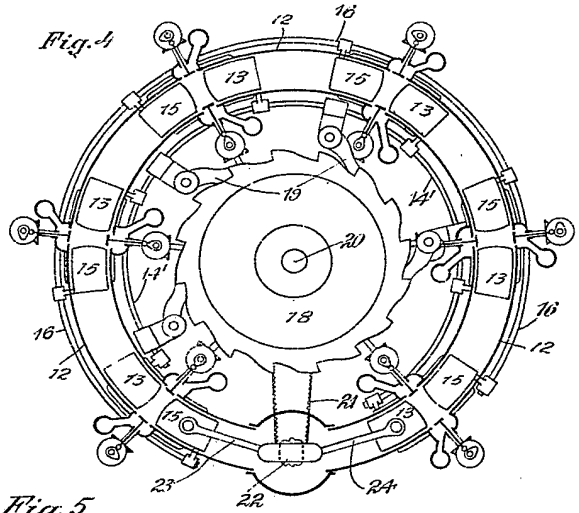
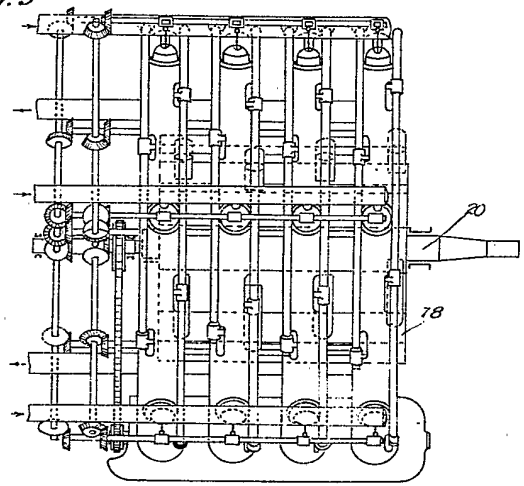


Fig. 5



Malby & Sons, Photo-Lith