Nov. 7, 1939. J. BUGATTI 2,179,030

MULTICYLINDER ENGINE

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Fig. 1

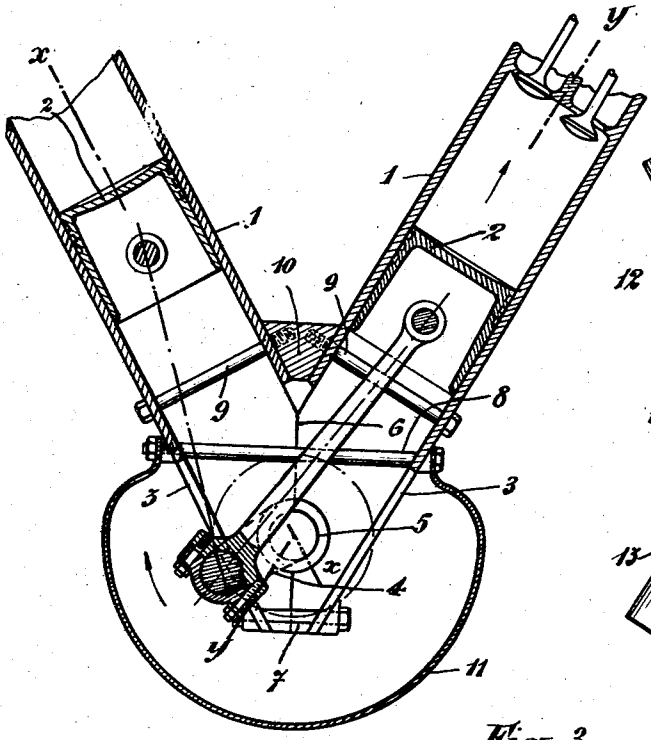



Fig. 2

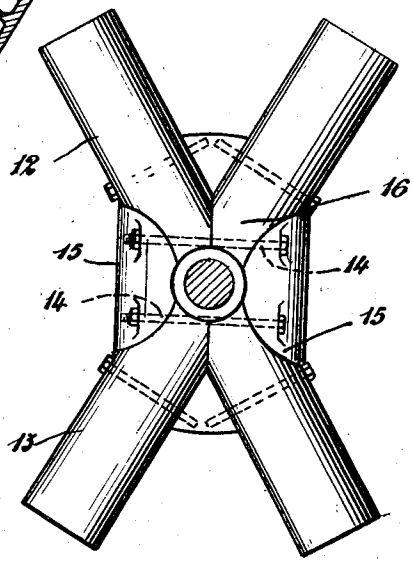
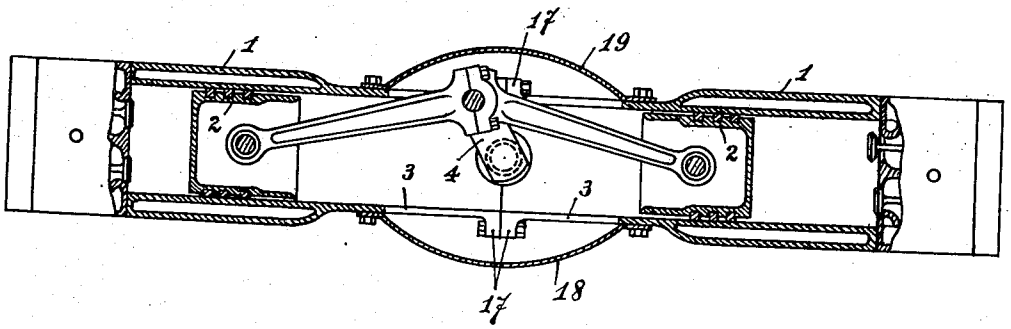



Fig. 3.




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Fig. 4.

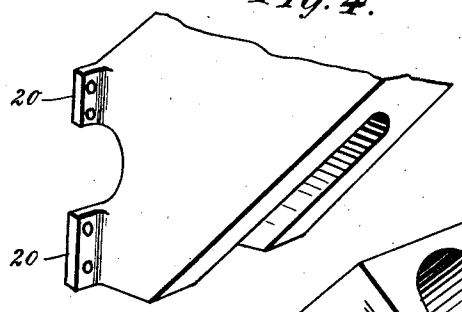



Fig. 5

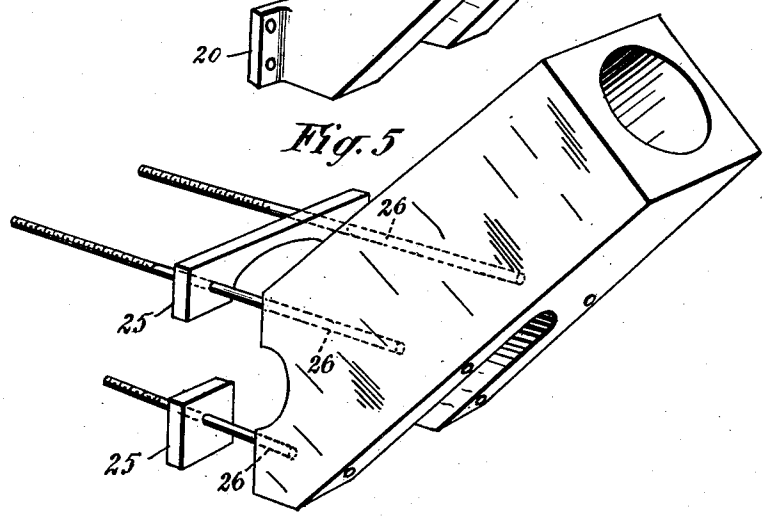
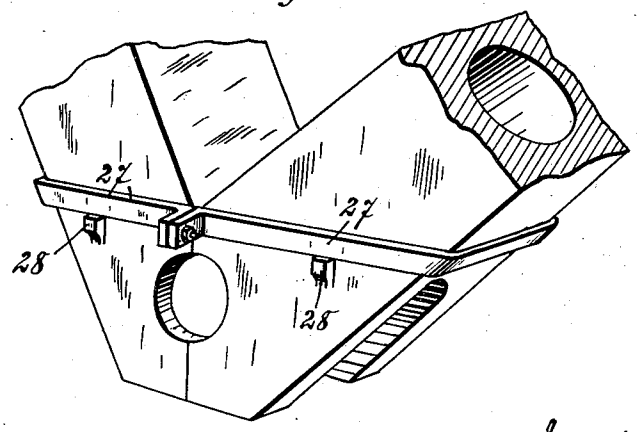



Fig. 6.




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Fig 7

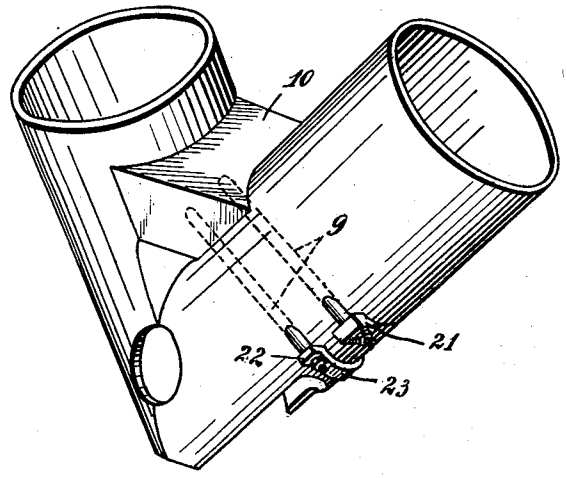



Fig. 9.

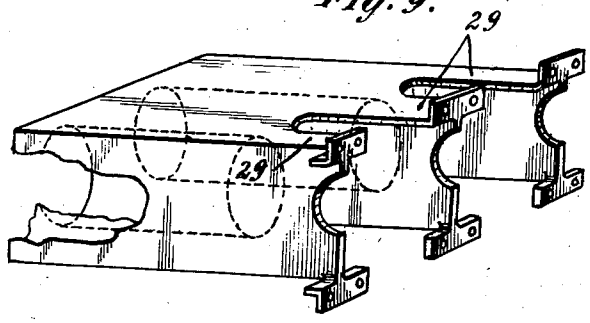
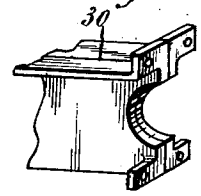



Fig. 10.




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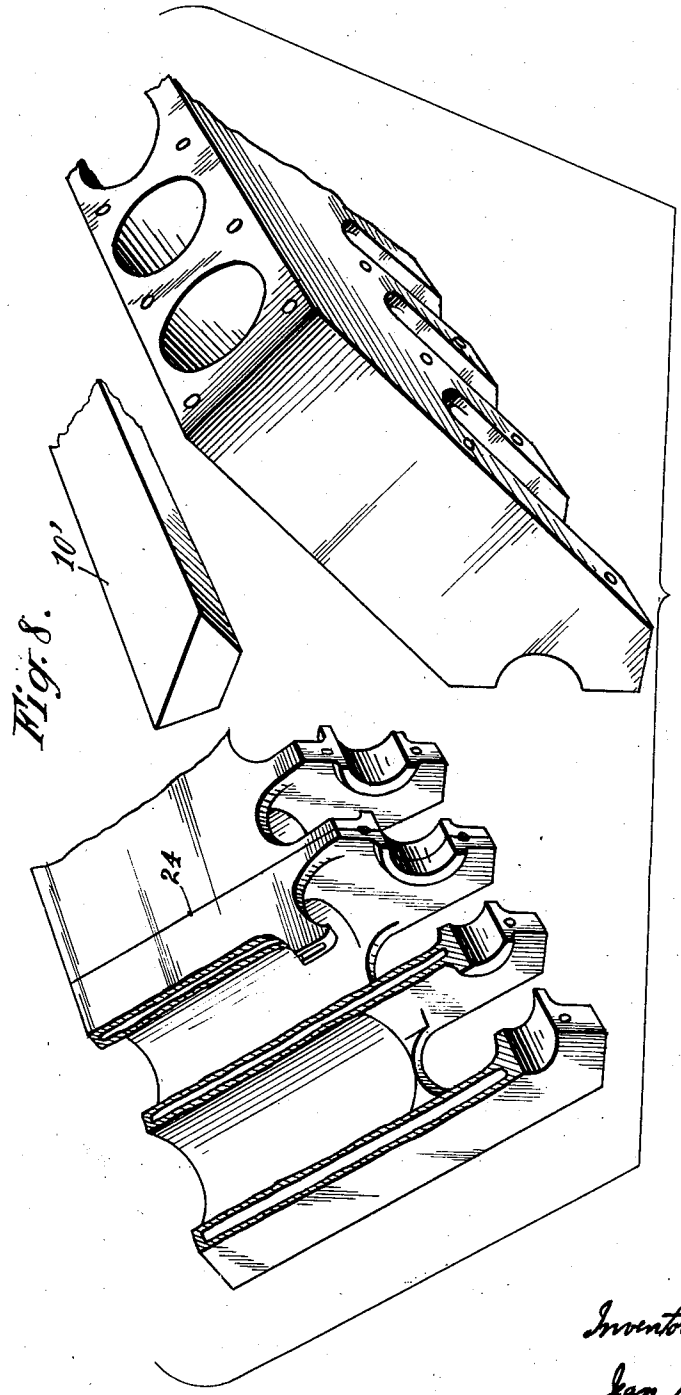



Fig. 8.

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# UNITED STATES PATENT OFFICE

2,179,030

## MULTICYLINDER ENGINE

Jean Bugatti, Molsheim, France

Application July 15, 1936, Serial No. 90,814
In France July 23, 1935

14 Claims. (Cl. 121—194)

It has already been proposed to provide the cylinders of explosion engines with extensions cast integral therewith and intended to support, in cooperation with collars bolted thereon, the bearings of the crankshaft. The bolts that serve to assemble the collars and the extensions of the cylinders are therefore subjected to rather severe stresses since they have to support not only the weight or most of the weight of the reciprocating parts of the engine, but also intensive and variable reactions when the engine is running.

In multicylinder engines, it is often necessary, for various reasons, such as technical reasons or reasons relating to the space occupied by the engine elements, to group the cylinders otherwise than in line and to choose for instance the star arrangement or the V arrangement.

The object of the present invention is to provide a multicylinder engine arranged in such manner as to substantially reduce its weight and in which the cylinders, although of the type above described, are devised in such manner as not to have, or to have but to a substantially lower degree, the disadvantages above mentioned.

The essential feature of the multicylinder engine according to the present invention lies in the fact that two cylinders occupying in this engine the relative positions of the branches of a V are assembled along corresponding skew or oblique surfaces provided in extensions belonging to these cylinders and that housings extending on either side of the line of contact or assembly are provided in the extensions of the cylinders for accommodating the bearings of the crankshaft. Owing to this arrangement, the bearings are held between two shells which are formed by the extensions of the twin cylinders and the adjunction of special bolts or other fixation means is unnecessary since the means for assembling the cylinders are sufficient.

Of course, the extensions of the cylinders are, if need be, suitably apertured at some points either for reasons of construction, or with a view to reducing the weight thereof and the assembly surfaces may, in this case, not be continuous. In a general manner, it is possible to apply to the engine according to the present invention the features set forth in United States Patent No. 1,316,420, French Patent No. 569,676, of August 10, 1923, and United States patent application Ser. No. 33,405, of July 26, 1935, now Patent No. 2,113,315.

Besides, the invention is not limited to the construction of V arranged groups and, for instance, it is well adapted to the construction of X arranged groups in which two cylinders and the extensions belong to a common piece provided with suitable surfaces, with a view to assembling it with a similar piece including the two other cylinders and their prolonged parts.

Finally, it should be well understood that the cylinders thus grouped may be cylinders of explosion engines, of combustion engines, of compressed fluid engines, such as steam engines, and so on.

The invention further includes an embodiment of this multicylinder engine in which the axes of twin cylinders are at 180°, that is to say the cylinders are coaxial and opposed by the bases or end surfaces of their extensions. The features above set forth are applicable to this type of engine.

Other features of the present invention will result from the following detailed description of some specific embodiments thereof.

Preferred embodiments of the present invention will be hereinafter described with reference to the accompanying drawings, given merely by way of example and in which:

Fig. 1 is a diagrammatical view of a group of two V arranged cylinders, in sectional view on a line passing through their axes;

Fig. 2 diagrammatically shows, in external view, a group of X arranged four cylinders;

Fig. 3 is a view analogous to Fig. 1, corresponding to the case of a group of cylinders the axes of which are at 180° from one another.

Fig. 4 is a diagrammatic perspective view of the end portion of a cylinder adapted for assembly into a V-cylinder block with another like cylinder.

Fig. 5 is a similar view of a modification.

Fig. 6 is a diagrammatic perspective view showing assembled end portions of cylinders in a V-cylinder block.

Fig. 7 is a similar view showing a modification.

Fig. 8 diagrammatically shows in perspective view, with parts broken away, two groups of cylinders and a yoke adapted to be assembled into a V-cylinder block.

Fig. 9 diagrammatically shows in perspective view a group of cylinders adapted to be assembled into a flat cylinder block with a similar block.

Fig. 10 is a detail view of a modification of Fig. 9.

Each of the cylinders 1 of the group shown in Fig. 1 is preferably made of steel and includes, beyond the useful part, in which piston 2 is mov-

able, an extension 3, initially of cylindrical shape but which has been eventually given a different shape by hot-dieing, machining, etc. In the embodiment shown by the drawings, openings have been provided for the passage of the crank arms 4 of the crankshaft. The end edges of the cylinder extensions 3 are arranged in contacting relation in a plane 6 which is at right angles to the plane of axes *xx* and *yy*, said plane 6 preferably being the bisector plane of the angle made by axes *xx* and *yy*. It should be understood that a broad construction should be given to the term "plane" as I do not strictly confine the arrangement to the provision of absolutely planar (in the geometrical sense) end edges for cylinder extensions 3; for instance, the end edges may include complementary formed interengaging portions or the like, provided the general shape of said edges is planar. Housings are provided in the extensions 3 of these cylinders for receiving bearings 5 for the crankshaft, that is to say the shaft carrying crank arms 4.

For the assembly of the cylinders, I may provide in the mass thereof, or fix thereto, fixation lugs, preferably on the outside, and connect said lugs together through transverse bolts 7, 8, which may extend through the cylinders proper, or their extensions, or not. I may also, along the adjacent end surfaces of the cylinder extensions, form in any suitable manner, or fix, fixation lugs 20 which are directly bolted (Fig. 4). It is still possible to apply the adjacent end surfaces of the cylinder extensions no longer directly against each other but against an intermediate ring 25 (Fig. 5) which may, for instance, be provided with studs 26 for attaching thereto flanges formed along the end surfaces of the cylinder extensions. Finally, I may make use of straps or collars 27 (Fig. 6) intended to surround the extensions of the cylinders and maintained against suitable stops or abutments 28.

Another system of assembly which may be combined with one or several of the means above mentioned consists, as diagrammatically shown by Fig. 1, in applying, for instance by means of bolts 9, the bodies of the extended cylinders 1 against an intermediate piece or yoke 10, located close to the point of the V formed by the cylinders, bolts 9 being at right angles or substantially at right angles to the respective axes XX, YY. Piece 10 may be suitably shaped for being inserted between the cylinders, that is to say it may be saddle-shaped in the vicinity of the external walls of said cylinders and surround them along a certain arc as shown on Fig. 7. Bolts 9 may engage into lugs 21 carried by the outer wall of the cylinders and they may extend through said wall or not. They may also pass across the end lugs or ears 22 on a half-collar 23 surrounding a portion of the periphery of the corresponding cylinder.

An envelope 11 forms a casing and it is fixed to the cylinder unit for instance in the manner shown by the drawings. Since the envelope 11 is not considerably strained in operation as it is just an oil reservoir, it is preferably made of thin metal.

If it is desired to increase the number of groups of twin cylinders, the intermediate piece may be prolonged as shown by reference character 10' on Fig. 8 in such manner as to be common to all these groups or to several of them; on the other hand a connection from one group to the next one may be provided through any suitable means as illustrated on the left hand side of Fig. 8 where a line of assembly is shown at 24.

Fig. 2 diagrammatically shows how it is possible to form an X-shaped group of four cylinders. Two cylinders located above each other, for instance cylinders 12 and 13, belong to a common piece, and in their extensions there are provided surfaces intended to be applied against the corresponding surfaces of the symmetrical piece 16. The assembly is, for instance, ensured through bolts 14. If desired, the parts designated by 15 and on which bolts 14 are bearing may be distinct from the extensions of the cylinders.

In Fig. 3, the reference numerals above indicated designate the same, or corresponding, parts. The extensions 3 of the two cylinders 1 are provided with apertures for the working of the connecting rods driving the shaft a crank arm of which is shown at 4. These extensions are provided at their ends with fixation lugs 17, connected together either directly or with the interposition of an intermediate piece, by means of bolts. The space in which the connecting rods are moving is closed by a casing. If the cylinders are horizontally disposed, this casing may include a cup-shaped part forming an oil reservoir and a lid 19. These two elements of the casing are for instance made of sheet iron. Of course, the engine may include several pairs of associated cylinders, or again it may include two groups of cylinders arranged in line, each provided with an apertured extension similar to part 17 and common to all the cylinders of the group. By way of illustration Fig. 9 shows one of two companion groups of two cylinders, having an apertured extension 29 common to both cylinders while Fig. 10 shows a portion of a like group, wherein the two cylinders are associated along a line of assembly 30. In a general manner, the engine according to the embodiment of Fig. 3 may include all the modifications above mentioned with reference to Figs. 1 and 2, as far as they are applicable.

While I have, in the above description, disclosed what I deem to be practical and efficient embodiments of the present invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the accompanying claims.

What I claim is:

1. In a piston engine, the combination of a cylinder cut-through at an angle with its axis so as to have an end edge, the cylinder having a bore which is cylindrical throughout from its piston working zone to said end edge both inclusive; a second cylinder cut through at the same angle with its axis, so as to have an end edge corresponding to that of the first cylinder, the second cylinder also having a bore which is cylindrical throughout from its piston working zone to said end edge both inclusive, the cylinders being twinned with their end edges in contacting relation and further having corresponding cut-away portions to form housings straddling the meeting edge surface, on either side of the plane including the cylinder axis, the center line of said housings being at right angle to said plane; bearing members fitted in said housings; and means, including tension members at right angles to said meeting edge surface, for bracing the cylinders together.

2. In a piston engine having a crankshaft, the

combination of a cylinder cut-through at an angle less than 90° to its axis, so as to have an end edge; a second cylinder cut through at the same angle to its axis so as to have an end edge corresponding to that of the first cylinder, the cylinders being arranged in V formation with their end edges in contacting relation and further having corresponding cut-away portions adapted to form, on either side of the plane of the cylinder axis, housings straddling the meeting edges, the center line of the housings being at right angles to said plane; bearing members for the crankshaft in said housings; and means for attaching the cylinders together, including a saddle shaped member inserted in the cylinder-V, and means for attaching each cylinder to said saddle shaped member.

3. In a piston engine, the combination of a first two cylinder unit including two cylinders in V-formation, the V having its apex truncated so as to provide an annular seating edge; a second two cylinder unit including two cylinders in V-formation, the V also having its apex truncated so as to provide a complementary annular seating edge; the units being grouped with their seating edges in contacting relation, and having corresponding cut-away portions along said seating edges to form openings in assembly; crankshaft bearings fitted in said openings; and means for holding the two units in assembly.

4. The combination of claim 3, further comprising a yoke member disposed between the two truncated apex V units, in operative contact therewith; and means for applying said units against said yoke member.

5. In a piston engine, the combination of a solid yoke having on either side thereof two converging cylindrical depressions with co-planar axis; a cylinder separate from the yoke, accommodated in each depression, the two cylinders merging into oppositely disposed adjacent edges; means for removably holding said cylinders in said depressions; and crankshaft bearings disposed between said adjacent edges, adapted to be operatively nipped between the same.

6. The combination of claim 5, further comprising means disposed in the vicinity of the crankshaft bearings for directly bracing said cylinders together.

7. The combination of claim 5, further comprising tensional members operatively interposed between the cylinders on that side remote from the yoke with respect to said crankshaft bearings, for further nipping said bearings between the cylinders.

8. A twin cylinder engine having a crankshaft, which comprises two cylinders having coplanar axes and meeting end edges with two groups of complementary cut away portions, each cylinder having a bore which is cylindrical throughout from its piston working zone to its end edge both inclusive, one group being located substantially in a plane at right angles to the plane of the cylinder axes so as to form, in assembly, openings for accommodating the crankshaft, while the other group is located substantially in the plane of the cylinder axis, so as to form, in assembly, openings for clearing the crankshaft in operation; crankshaft bearings fitted in the openings of the first group; and means for bracing the cylinders together.

9. In a piston engine having a crankshaft, the combination of two cylinders having complementarily formed edges at corresponding ends, and two groups of complementary indentations along said edges, the complementarily formed edges being disposed in contacting relation and the groups of complementary indentations being correspondingly located to form housings for the crankshaft and clearance openings for allowing crankshaft operation respectively, each cylinder having a bore which is cylindrical throughout from its piston working zone to its end edge both inclusive; bearing elements for the crankshaft fitted in said housings and means for holding said cylinders in assembly.

10. The combination of claim 9, further comprising corresponding projections on the cylinders in zones adjacent to the said edges, the means including tension members operatively interposed between said corresponding projections.

11. The combination of claim 9, the cylinders having aligned axes to form an opposed cylinder assembly.

12. In a piston engine having a crankshaft, the combination of two cylinder blocks each of which has a cylinder bore for a working piston, the blocks having complementarily formed end surfaces disposed in contacting relation, two groups of complementarily formed cut-away end portions, one group being in a plane including the two cylinder bore axes, and the other in a plane at right angles to the first-named plane, the said portions being adapted to define housings for the crankshaft and clearance openings for allowing crankshaft operation, respectively, each cylinder bore being cylindrical throughout from its piston working zone to said end surface of the corresponding block both inclusive; bearing elements for the crankshaft, fitted in said housing; and means for holding said blocks in assembly.

13. A piston engine having a crankshaft, which comprises two cylinders disposed with coplanar axes, each cylinder having a bore including a piston working zone which is cylindrical throughout, and being prolonged by an integral annular extension the inner surface of which integrally prolongs the said bore and is cylindrical throughout, the extensions of the cylinders converging towards one another and having corresponding cut-away portions forming two groups, the portions in one group being adapted to form in assembly, coplanar housings for crankshaft bearings, while the portions in the other group are adapted and located to form, in assembly clearance openings lying in a plane at right angles to the crankshaft bearing housing plane, for allowing crankshaft operation; and continuous means operatively engaged by each extension, for bracing said extensions together.

14. In a piston engine having two cylinders arranged in V-formation, the combination with said cylinders of a separate holding block for said cylinders, located in the bisector plane of the V, and having on either side of said plane seating surfaces shaped in conformity and adapted for contact with the respective cylinders; and means for anchoring the cylinders to the holding block.

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