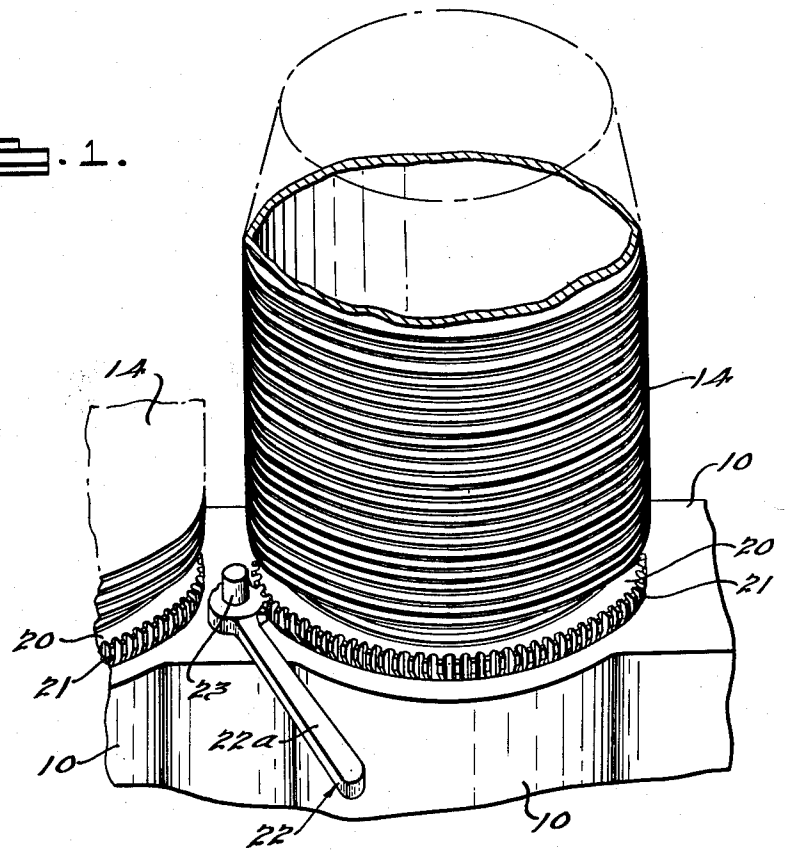
May 2, 1944. J. TJAARDA ET AL 2,347,721

ENGINE

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Fig. 1.



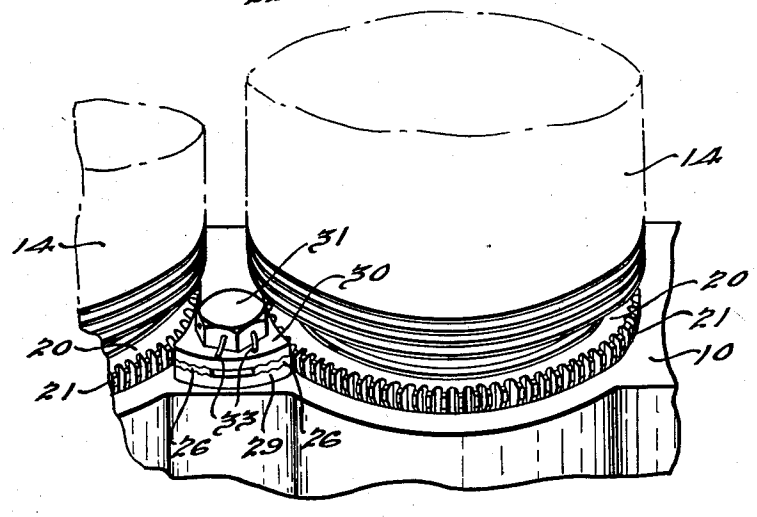


Fig. 2.

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ENGINE

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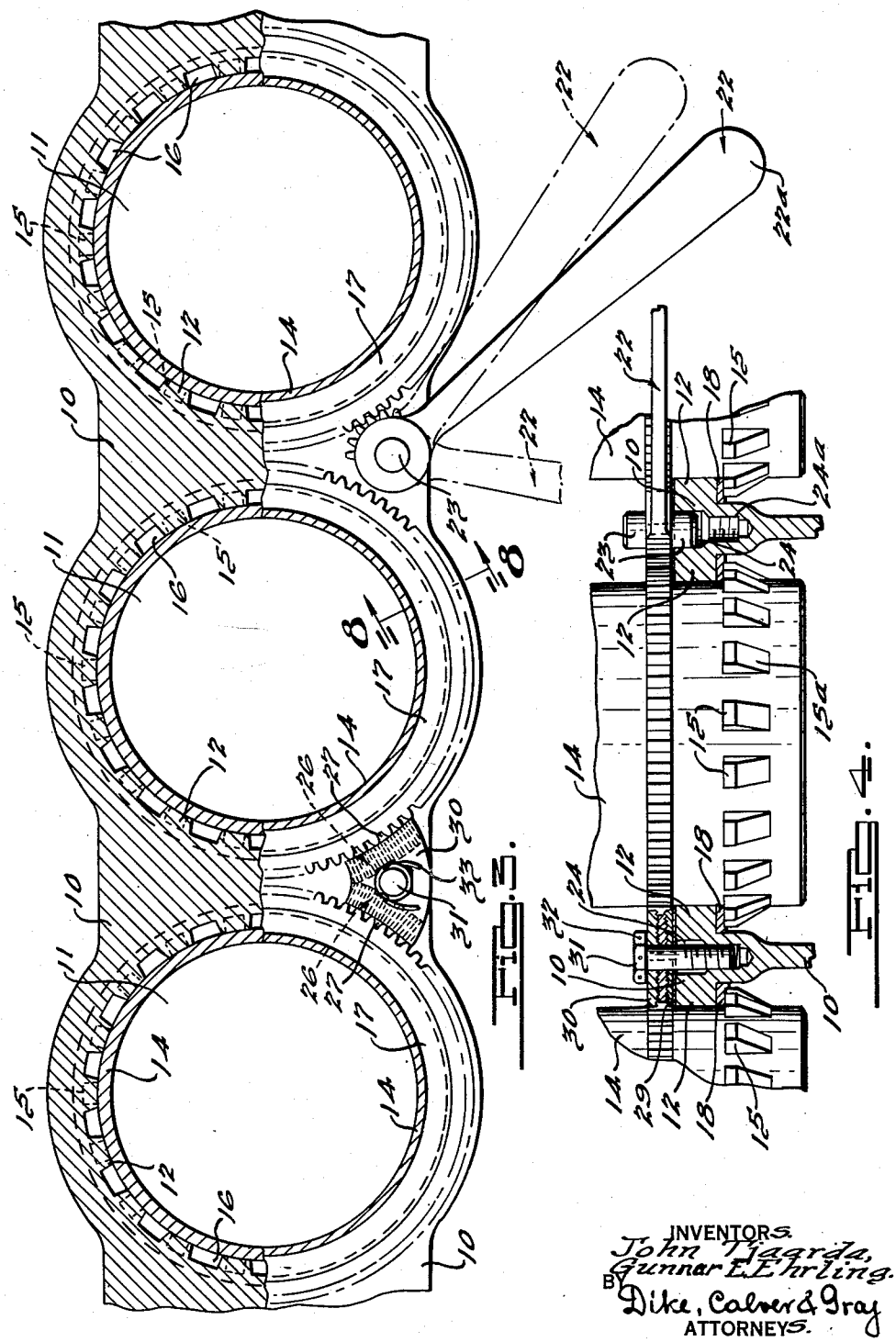


Fig. 3.

Fig. 4.

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ENGINE

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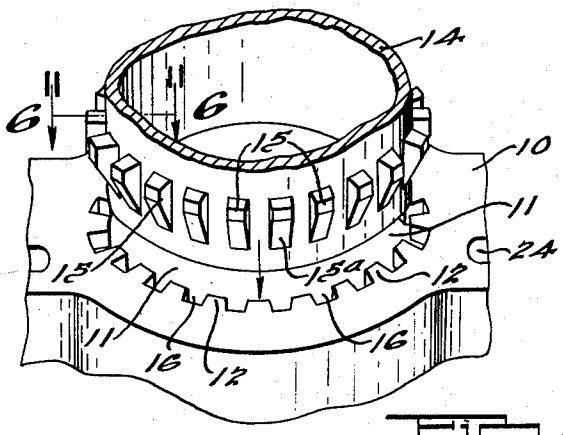


Fig. 5.

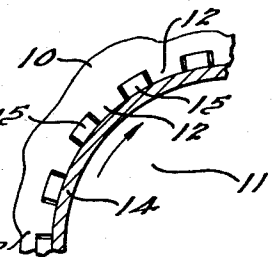


Fig. 6.

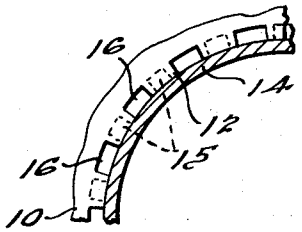


Fig. 7.

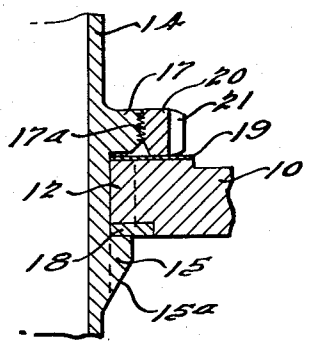


Fig. 8.

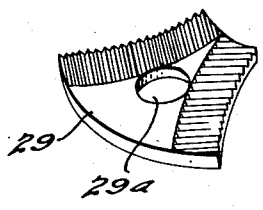


Fig. 9.

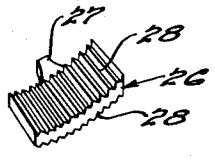


Fig. 10.

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Patented May 2, 1944 2,347,721

UNITED STATES PATENT OFFICE

2,347,721

ENGINE

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Application March 12, 1941, Serial No. 382,924

11 Claims. (Cl. 121—194)

This invention relates to engines, such for instance as engines of the internal combustion type, and more particularly to engines used in various types of aircraft.

One of the objects of the present invention is to provide an improved engine having a detachable cylinder, means being provided whereby said cylinder may be detachably secured to the engine structure in an improved manner.

Another object of the invention is to provide an improved aircraft engine having a crankcase and a detachable cylinder, means being provided whereby said cylinder may be secured to said crankcase as well as disconnected therefrom in a speedier, safer and more dependable manner.

A further object of the invention is to provide an improved engine having a crankcase and a cylinder detachably connected thereto, means being provided for locking said cylinder in its operative position, thereby preventing undesirable movements or displacements of the cylinder with respect to the crankcase.

A still further object of the invention is to provide an improved engine having a cylinder, means detachably securing said cylinder to the engine structure, and means locking said cylinder in its operative position, said locking means being adapted to be set in place and removed easily and quickly.

A still further object of the present invention is to provide an improved engine having a crankcase and a plurality of cylinders detachably secured to said crankcase, means being provided whereby securing and disconnecting of individual cylinders is done easily and quickly, as well as independently of other cylinders, and in which engine the number of small parts, such as bolts and nuts effecting such a connection, is greatly reduced.

It is an added object of the present invention to provide an improved structure of the foregoing character, which is simple in construction, safe and dependable in operation, and is relatively inexpensive to manufacture and service.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Fig. 1 is a perspective view of a portion of an engine embodying the present invention, one of the detachable cylinders of said engine being shown engaged by a toothed wrench.

Fig. 2 is a view similar in part to Fig. 1, the structure being shown with the wrench removed and cylinder locking means inserted in place for locking the adjacent cylinders.

Fig. 3 is a plan view, partly in section, of an engine embodying the present invention, the cylinder on the right hand side of the drawings being shown engaged by a wrench, while the two cylinders on the left hand side of the drawings are shown locked by means of a locking piece.

Fig. 4 is a side view, partly in section, showing the lower portions of the cylinders and their connection to the crankcase.

Fig. 5 is a fragmentary perspective view showing the lower portion of one engine cylinder about to be inserted into the crankcase cylinder opening.

Fig. 6 is a horizontal sectional view taken just above the cylinder lugs, said lugs being shown inserted into recesses between the crankcase teeth, but before the cylinder is turned in the opening for locking.

Fig. 7 is a view similar in part to Fig. 6, the cylinder being shown turned and the lugs disposed under the crankcase teeth for locking the cylinder in place.

Fig. 8 is a fragmentary sectional view taken in the direction of the arrows on the section plane passing through the line 8—8 of Fig. 3.

Fig. 9 is a perspective view showing the bottom piece of the ring locking means.

Fig. 10 is a perspective view showing the toothed piece of the ring locking means.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

In the drawings there is shown by way of example an internal combustion engine embodying the present invention. The invention is herein illustrated and described as embodied in a multiple cylinder engine having a crankcase. It will be understood, however, that the invention is not limited to any particular kind of engine or to any definite number of cylinders thereof. The invention may be successfully used in various kinds of engines such for instance as in multiple cylinder internal combustion engines for various types of aircraft, as well as in engines of other types whether single cylinder or multiple cylinder. In describing the engine, the end of the cylinder connected to the crankcase will be referred to as the "lower" end. However, such a term is one of description and not of limitation and it will be understood that an engine cylinder while presumed to be disposed vertically, may be arranged in any desired position. The details of the engine such as its pistons, connecting rods, crankshaft, ignition means and the like, are not illustrated or described, since they do not form parts of the present invention, and their descrip-

tion, not being necessary to the proper understanding of the invention, would greatly overburden the specification.

Referring to the drawings, the engine illustrated therein includes a crankcase 10 having a plurality of cylinder openings 11, said openings being of a circular shape. On the crankcase 10 at the edges of and around said openings there are provided evenly spaced inwardly projecting teeth 12. There is also provided a corresponding plurality of engine cylinders 14, each of said cylinders having a lower end provided with a plurality of outwardly projecting evenly spaced lugs 15, said lugs being adapted to enter the recesses 16 between the crankcase teeth 12 when a cylinder 14 is inserted into an opening 11. The lugs 15 are slanted at their lower portions as indicated at 15a in order to facilitate the insertion of the cylinder into the opening 11.

On the lower end of each cylinder 14 above the lugs 15 there is provided an annular shoulder 17, (see Fig. 8), the distance between the lugs 15 and the shoulder 17 being substantially equal to the thickness of the crankcase wall at the opening 11. Thus, when the cylinder 14 is inserted into the opening 11 and the shoulder 17 contacts and rests on the teeth 12, the lugs 15 just clear said teeth, and when the cylinder 14 is turned in the opening 11 around its longitudinal or vertical axis, the lugs 15 go under and underlie the teeth 12.

It will now be understood in view of the foregoing that when the cylinder 14 is inserted in said opening 11 and turned therein around its vertical axis for a predetermined angle, the lugs 15 go under the teeth 12 and thus upward movement of the cylinder is prevented by said teeth. At the same time further inward movement of the cylinder into the crankcase 10 is prevented by the shoulder 17. A thrust washer 18 is provided in the crankcase under the teeth 12 and it is embedded into the material of the crankcase for such a depth as to be flush with the inner surface of the crankcase wall, as is best shown in Fig. 8. An upper thrust washer 19 is inserted between the crankcase 10 and the shoulder 17 of the cylinder 14 as shown in Fig. 8.

In order to tighten the cylinder 14 in place and prevent undesirable movements thereof, there is provided on the shoulder 17 an external thread 17a, which thread is engaged by the internal thread of a ring 20. The ring 20 represents, in effect, a portion of the shoulder and forms a nut member, and when rotated in proper direction it acts like a nut and upon reaching the crankcase it pulls the cylinder 14 upwardly and presses the lugs 15 against the thrust washer 18 and the teeth 12. By rotating the ring 20 in the opposite direction the same may be untightened, whereupon the cylinder may be turned in the opening until the lugs 15 register with the recesses 16. Thereupon the cylinder 14 may be easily removed from the opening for inspection repairs, and the like.

Means are provided for engaging the ring positively for rotation. In the present embodiment of the invention said means are represented by gear teeth 21 cut on the outside periphery of the ring, which teeth are adapted to be engaged by a toothed wrench 22 having a two-end pivot 23 adapted to enter with either of its ends a hole 24 provided in the crankcase 10. For tightening or untightening the ring 20 the pivot 23 of the wrench is inserted into the hole 24, and the teeth of the wrench are arranged to register with the recesses between the teeth of the ring, whereupon the pivot is pushed all the way into the hole. The handle 22a of the wrench is thereupon rotated in the proper direction for a definite angle and after the teeth of the wrench gradually lose contact with the teeth of the ring 20 because of rotation, the pivot is removed from the hole 24 and the wrench is reset for another turn. The same wrench is used for adjacent cylinders and for engaging the ring of the opposite cylinder the wrench is turned over and the other end or portion of the pivot 23 is inserted into the hole 24, whereupon the tightening or untightening of the ring 20 of the adjacent cylinder is effected in a manner similar to the one described above.

Means are provided whereby rings 20 are positively locked in place, and self-rotation thereof is prevented. In the present embodiment of the invention said means are represented by a toothed piece 26 having a tooth 27 and ribbed portions 28. The piece 26 is adapted to be held by its ribbed portions between the similar ribbed portions of the lower piece 29 and the upper piece 30, with the tooth 27 of the piece 26 being arranged in a recess between two adjacent teeth 21 of the ring 20. There are provided two pieces 26 between the pieces 30 and 29, one for each of the adjacent cylinders. The pieces 30, 26 and 29 are firmly held together with the aid of a screw 31 engaging an internally threaded hole 24a forming a continuation of the pivot hole 24, the screw passing through holes 29a in the superposed clamping pieces 29 and 30. The head of the locking screw 31 may be provided with a plurality of holes 32 for inserting a cotter pin or a wire 33, the ends of which may be connected or anchored in the crankcase. By virtue of such a construction there are provided locking means which prevent rotation of the rings 20 in consequence whereof the cylinders 14 remain firmly locked in their places and self-rotation or any other undesirable movements thereof are prevented. For detaching any of the cyliners 14 the locking screw 31 is removed after which the corresponding toothed piece 26 and clamping members 29 and 30 may be taken out, the wrench 22 inserted in place and the ring 20 loosened. Thereupon the cylinder is rotated around its axis to bring the lugs 15 in registration with the recesses 16 and the cylinder is taken out of the opening 11.

There are thus provided an engine having a crankcase, a plurality of openings therein and a corresponding plurality of cylinders detachably secured to said crankcase in said openings, the connecting and disconnecting of said cylinders to and from said crankcase being effected in an easy and quick manner. The cylinders may be secured and removed independently of each other, and yet when in operative position, be held in the crankcase in a safe and dependable manner with no possibility of self-rotation or undesirable loosening.

We claim:

1. In an engine, a crankcase having an opening, a cylinder having an end insertable into said opening for connection to said crankcase, means detachably securing said cylinder end to said crankcase, said means including a rotatable member tightening said cylinder in its secured position, gear teeth on said member adapted to be engaged by a toothed wrench for rotation, said teeth lying in a plane transverse to the cylinder axis, a toothed piece disposed on said crankcase

externally of the cylinder and mainly within the confines of lines which are projections of radii of the adjacent cylinder and forming an included angle of less than forty-five degrees, said toothed piece adapted to engage the the toothed portion of said rotatable member, and means detachably securing said piece to said crankcase to lock positively said rotatable member to said crankcase.

2. In an engine, a crankcase having an opening, a cylinder having an end adapted to enter said opening, means detachably securing said end to said crankcase, said means including a ring nut engaging said cylinder for tightening the same in its secured position, gear teeth on said ring nut around the periphery thereof, said teeth being adapted to be engaged by a pivot gear wrench for rotation, said crankcase having a pivot hole adapted to receive the wrench pivot, a toothed piece adapted to engage the gear teeth on said ring nut, and a threaded member adapted to enter said pivot hole and to secure said toothed piece to said crankcase.

3. In an engine, a crankcase having an opening, a cylinder having an end adapted to enter said opening, means detachably securing said end to said crankcase, said means including a ring nut engaging said cylinder for tightening the same in its secured position, gear teeth on said ring nut around the periphery thereof, said teeth being adapted to be engaged by a pivot gear wrench for rotation, said crankcase having a pivot hole adapted to receive the wrench pivot, a toothed piece adapted to engage the gear teeth on said ring nut, a screw adapted to engage said crankcase at said pivot hole and to hold said toothed piece down.

4. In an engine, a crankcase having an opening, a cylinder having an end adapted to enter said opening, means detachably securing said end to said crankcase, said means including a ring nut engaging said cylinder for tightening the same in its secured position, gear teeth on said ring nut around the periphery thereof, said teeth being adapted to be engaged by a pivot gear wrench for rotation, said crankcase having a pivot hole adapted to receive the wrench pivot, a toothed piece adapted to engage the gear teeth on said ring nut, a screw adapted to engage said crankcase at said pivot hole and to hold said toothed piece down, and means on said piece preventing rotation thereof around said screw.

5. In an engine, a crankcase having an opening, a cylinder having an end adapted to enter said opening, means detachably securing said end to said crankcase, said means including a ring nut engaging said cylinder for tightening the same in its secured position, gear teeth on said ring nut around the periphery thereof, said teeth being adapted to be engaged by a pivot gear wrench for rotation, said crankcase having a pivot hole adapted to receive the wrench pivot, a toothed piece adapted to engage the gear teeth on said ring nut, a screw adapted to engage said crankcase at said pivot hole and to hold said toothed piece down, means associated with said toothed piece preventing rotation thereof around said screw, and means locking said screw to said crankcase to prevent loosening thereof.

6. In an engine, a crankcase having a plurality of openings, a corresponding plurality of cylinders having ends insertable in said openings, means for detachably securing said cylinders to said crankcase, means embracing each cylinder for tightening said cylinder in its secured position, and common means located between adjacent cylinders and mainly within lines which are defined by tangents common to said adjacent cylinders for positively and detachably locking together and to the crankcase the tightening means of the adjacent cylinders.

7. In an engine, a crankcase having a plurality of openings, a corresponding plurality of cylinders having ends insertable in said openings, means for detachably securing said cylinders to said crankcase, a ring nut on each cylinder engaging the same for tightening it in its secured position, gear teeth around peripheries of said nuts, two ribbed pieces adapted to be secured to said crankcase between an adjacent pair of cylinders, and two correspondingly ribbed toothed pieces adapted to be held between said first pieces and to engage said nuts at the gear tooth portions thereof to prevent their rotation.

8. In an engine, a crankcase having an opening, a cylinder having an end adapted to enter said opening and also having annularly arranged threads, an internally threaded ring cooperable with said threads and having exterior teeth engageable by a tool to effect rotation of the ring to clamp the cylinder in said opening, a locking member mounted externally of the cylinder and mainly within the confines of lines which are projections of radii of the adjacent cylinder and forming an included angle of less than forty-five degrees, said locking member having a toothed portion coacting with teeth of said ring, and means engaging said locking member for detachably securing the same in fixed position.

9. In an engine, a crankcase having an opening, a cylinder having an end adapted to enter said opening and also having annularly arranged threads, an internally threaded ring cooperable with said threads and having exterior teeth engageable by a tool to effect rotation of the ring to clamp the cylinder in said opening, a locking member having a toothed portion coacting with teeth of said ring, a clamping member engaging said locking member, and a threaded device for securing said clamping member to the cylinder.

10. In an engine, a crankcase having an opening, a cylinder having an end adapted to enter said opening and also having annularly arranged threads, an internally threaded ring cooperable with said threads and having exterior teeth engageable by a tool to effect rotation of the ring to clamp the cylinder in said opening, said exterior teeth lying in a plane substantially perpendicular to the axis of the cylinder, a locking member mounted externally of the cylinder and mainly within the confines of lines which are projections of radii of the adjacent cylinder and forming an included angle of less than forty-five degrees, said locking member having a toothed portion coacting with teeth of said ring, and means associated with said locking member for detachably securing the same in fixed position.

11. In an engine, a crankcase, a pair of adjacent cylinders each having an annularly arranged threaded portion, a ring threadedly connected to each threaded portion and adapted to be turned to clamp the cylinder to the crankcase, each of said rings having external teeth adapted to lie in a plane substantially perpendicular to the cylinder axis, locking members having toothed portions cooperable with teeth of said rings, and a common means for securing said locking members in fixed positions to the crankcase.

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