Oct. 31, 1933. M. TIBBETTS 1,933,286

INTERNAL COMBUSTION ENGINE

Filed Nov. 6, 1930

Fig. 1.

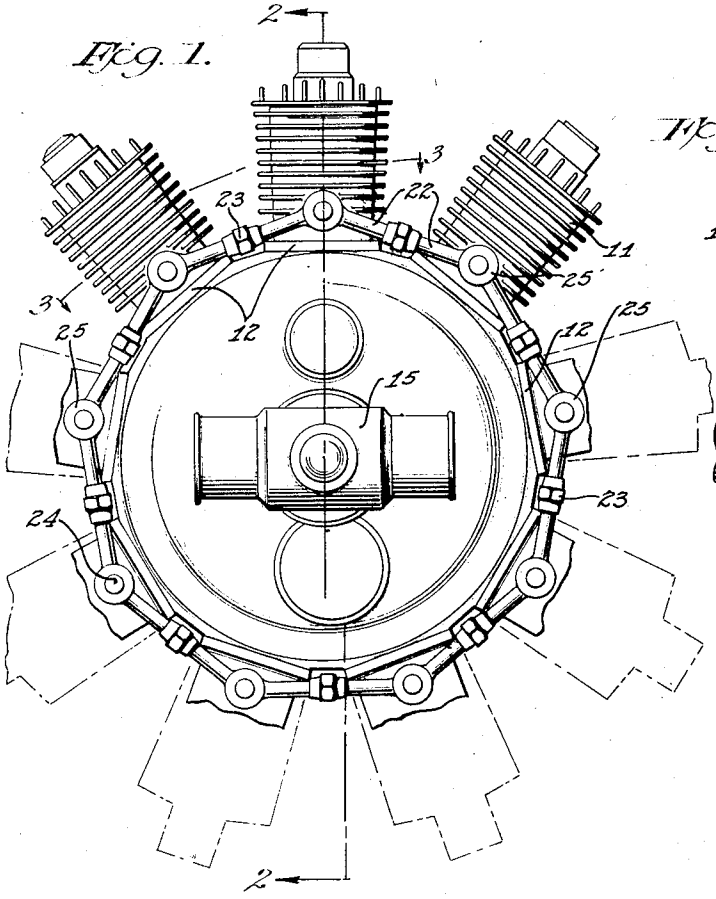


Fig. 2.

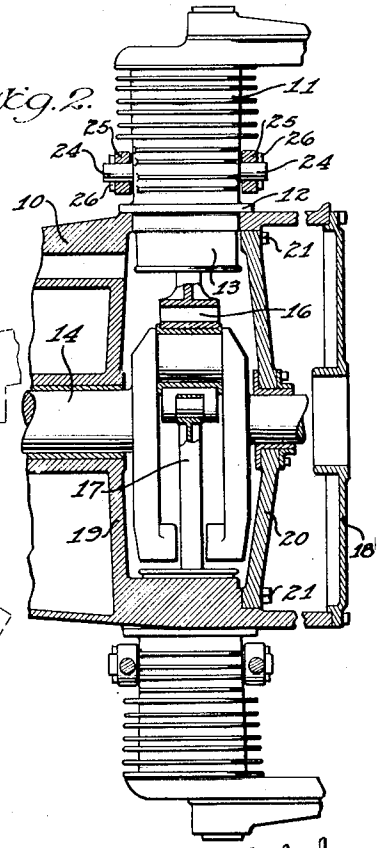


Fig. 3.

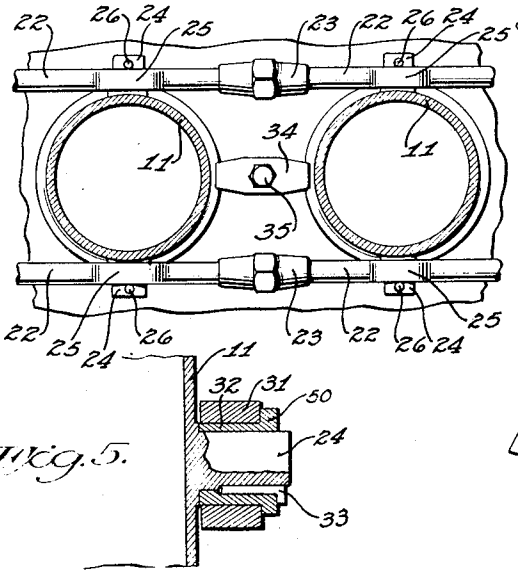


Fig. 4.

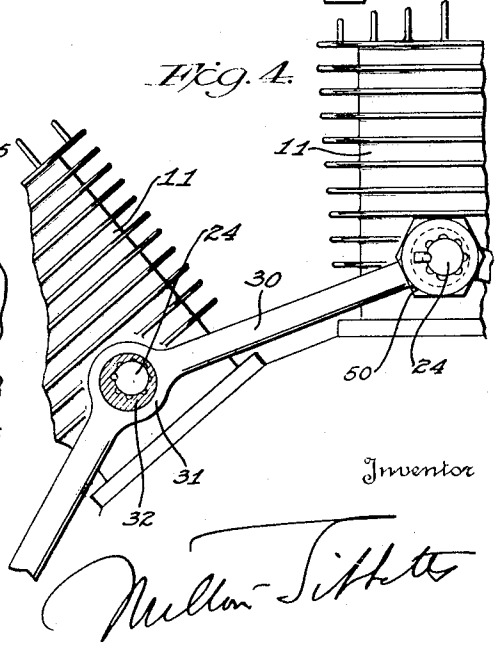


Fig. 5.

Inventor

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UNITED STATES PATENT OFFICE

1,933,286

INTERNAL COMBUSTION ENGINE

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9 Claims. (Cl. 121—194)

This invention relates to internal combustion engines and more particularly to crank case and cylinder structures.

It is a general object of the invention to provide a novel and improved form of internal combustion engine.

More particularly it is an object of the invention to provide in an internal combustion engine a novel mechanism for securing cylinders with the crank case.

Another object of my invention is to provide mechanism for securing cylinders with the crank case of an internal combustion engine in a manner such that there will be no localized stresses developed in the crank case due to forces resulting from engine operation.

A further object of my invention is to provide an internal combustion engine of the radial type in which endless band means closely encircle the crank case and are mounted upon trunnions on the cylinders.

These and other objects of the invention will appear from the following description taken in connection with the drawing, which form a part of this specification, and in which:

Fig. 1 is a front elevational view of a radial aeroplane engine with the propeller blades removed;

Fig. 2 is a vertical sectional view of the same taken on line 2—2 of Fig. 1;

Fig. 3 is a sectional view through two of the cylinders taken on line 3—3 of Fig. 1;

Fig. 4 is a fragmentary elevational view illustrating a modified form of cylinder securing means;

Fig. 5 is a fragmentary sectional view of the modified form of connecting means and its mounting.

Referring now to the drawing by characters of reference, 10 represents a barrel-type of crank case from which a plurality of cylinders 11 extend radially. The cylinders are each formed with a circular flange 12 which bears against a flattened portion of the outer face of the crank case, and the skirt portions 13 of the cylinders extend through openings formed through the flattened portions of the crank case.

A crank shaft 14 extends axially through the crank case and is provided upon its forward end with a propeller hub 15, and mounted upon the crank shaft throw is a master rod 16 to the hub of which a plurality of connecting rods 17 are pivotally connected in the customary manner. The rear end of the crank case is closed by a cover 18 while a pair of spaced reinforcing walls 19 and 20 extend across the interior of the crank case on each side of the crank throw and in a plane with the flanges 12 of the cylinders. The reinforcing wall 20 is removable and is secured within the crank case by bolts 21 while the reinforcing wall 19 is preferably cast as an integral part of the crank case.

It will be seen that the cylinders 11 are provided with flanges 12 which provide the sole axial contact for the cylinders with the crank case and thus any forces developed in the cylinders when the engine is in operation will be transferred to the crank case through the contacting area of the flanges therewith. As a means of securing the cylinders against the crank case so that there will be no localized stresses, I provide a pair of endless band means which in the preferred form consist of a plurality of angular links 22, the adjacent ends of which are joined by turnbuckles 23. Each of the cylinders is formed with a pair of oppositely disposed trunnions 24 which are preferably arranged at the front and rear of each cylinder and in a similar manner throughout the structure and each of the angular links is provided with an eye portion 25 which is pivotally mounted upon a trunnion and is secured against axial displacement therefrom by suitable means such as pins 26. The trunnions are spaced outwardly of the cylinder flanges 12 but relatively close thereto.

After the pair of endless band means have been assembled upon the trunnions on each end of the cylinders, the turnbuckles are adjusted to place each band means under a tension which is greater than that developed therein by forces to which it is subjected when the engine is in operation in order to hold the cylinder flanges 12 against their seats on the crank case under all operating conditions and with the desired factor of safety. In this manner the crank case is entirely relieved of any tensile stress resulting from the expansion of the explosive mixture in the engine cylinders during operation, as the tendency of the explosive forces to move the cylinders radially outwardly is not transmitted to the crank case as would be the condition if bolts were employed to secure the cylinders to the crank case. It will be seen that with this arrangement of securing means the forces developed in one cylinder will be transferred circularly of the band means around the crank case so that all forces developed during operation of the engine in any cylinder will be transmitted in a circular direction through the band means to the trunnions and through the base of the cylinders and their

flanges to the crank case. With this arrangement of transferring stresses I am able to construct the cylinders and crank case of relatively light and thin metal so that the weight of the crank case and cylinder construction can be light and at the same time rugged enough to withstand the high compression and explosion forces developed by a Diesel type of engine. The reinforcing walls 19 and 20 are preferably arranged in a plane with the trunnions and the endless bands so that the circumferential wall of the crank case will be interiorly supported. As a result there will be no localized stresses such as are present when bolts are used to secure the cylinders to the crank case and a very rugged lightweight structure can be made which is capable of withstanding high pressures.

In Figs. 4 and 5 I have illustrated a second form of cylinder securing means wherein the endless band means 30 is formed as an integral structure instead of being made in sections. This endless structure includes eye portions 31 which correspond to the eye portions 25 of the preferred form of connecting means and such eyes are mounted upon eccentric bearings 32 which are adjustably carried by the trunnions 24. The eccentric bushings are provided with a hexagonal head 50 which can be engaged by suitable means and rotated to place the eccentric bushings in desired adjusted position. In this embodiment I have illustrated keys 33 which can be inserted in registering grooves formed in the adjacent surfaces of the trunnions and the eccentric bushings. It will be seen that rotation of the eccentric bushings 32 will increase or decrease the tension of the endless band means 30 so that by regulating the eccentric bushings the endless band means can be placed in any desired tension.

In order to retain the cylinder against the crank case when the endless band means is removed, I provide a clamp 34 arranged intermediate adjacent cylinders which can be positioned to engage the flanges 12 when the bolt 35 is loosened, the bolt 35 being screwed into the crank case. This clamp of course is not required when the endless securing means are in position and under tension.

While I have herein described in some detail a specific embodiment of my invention, which I deem to be new and advantageous and may specifically claim, I do not desire it to be understood that my invention is limited to the exact details of the construction, as it will be apparent that changes may be made therein without departing from the spirit or scope of my invention.

What I claim is:

1. In an internal combustion engine, a crank case, cylinders having a portion bearing against the crank case, trunnions on the cylinders, and tension band means extendings around the crank case and anchored upon the trunnions, said means including adjustable tension elements.

2. In an internal combustion engine, a crank case, cylinders having a portion bearing against the crank case, trunnions on the cylinders beyond the bearing portion, and a pair of sectional, contractible and expansible band structures surrounding the crank case, each section of the band structures being anchored on a trunnion and the ends being joined by adjustable connectors for placing the structures in tension greater than that developed therein by the forces present during operation of the engine.

3. In an internal combustion engine, a crank case, cylinders having a portion bearing against the crank case, band means extending around the crank case and composed of sections joined by adjustable tension connectors, and trunnions extending from the walls of the cylinders, said sections of the band means being pivotally anchored on the trunnions.

4. In an internal combustion engine, a crank case, a plurality of cylinders extending radially from the crank case, flanges integral with the cylinders and bearing against the crank case, trunnions projecting from opposite sides of the cylinders adjacent the flanges, and a pair of band means closely surrounding the crank case on opposite sides of the cylinders and in high initial tension, each pair of band means comprising a plurality of sections pivotally anchored on the cylinder trunnions and adjustable means joining the adjacent sections together in high tension.

5. In an internal combustion engine, a crank case, a plurality of radial cylinders bearing against the crank case, oppositely disposed trunnions projecting from the cylinders in a similar manner, endless band means surrounding the crank case and pivotally mounted on the trunnions, and means associated with the band means for establishing a tension therein greater than that developed therein by engine forces.

6. In an internal combustion engine, a crank case, a plurality of radial cylinders bearing against the crank case, oppositely disposed trunnions projecting from the cylinders adjacent the bearing portion thereof, and endless band means for securing the cylinders to the crank case, said band means comprising links each pivotally mounted on a trunnion, and turnbuckles connecting the adjacent ends of the links.

7. In an internal combustion engine, a crank case, a plurality of radial cylinders bearing against the crank case, oppositely disposed trunnions projecting from the cylinders adjacent the bearing portion thereof, an adjustable eccentric bushing on each of the trunnions, and endless band means encircling the crank case and mounted on the bushings, the rotation of the bushings varying the tension of the band means.

8. In an internal combustion engine, a crank case, radial cylinders bearing against the crank case, oppositely disposed trunnions extending from the cylinders in a similar manner, adjustable eccentric bushings on the trunnions, endless band means encircling the crank case and mounted on the bushings, and means for securing the bushings in desired position of adjustment, the position of the bushings determining the tension of the endless band means.

9. In an internal combustion engine, the combination of a crank case, cylinders having a portion thereof bearing against the crank case, oppositely disposed trunnions projecting from the cylinders, a pair of endless band means disposed on opposite sides of the cylinders and anchored on the trunnions, and means associated with each of said band means adjustable to establish tension in the band means greater than that developed therein by engine explosion forces.

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