G. FORNACA.

COMBUSTION ENGINE.

APPLICATION FILED MAY 6, 1916.

1,245,451.

Patented Nov. 6, 1917.

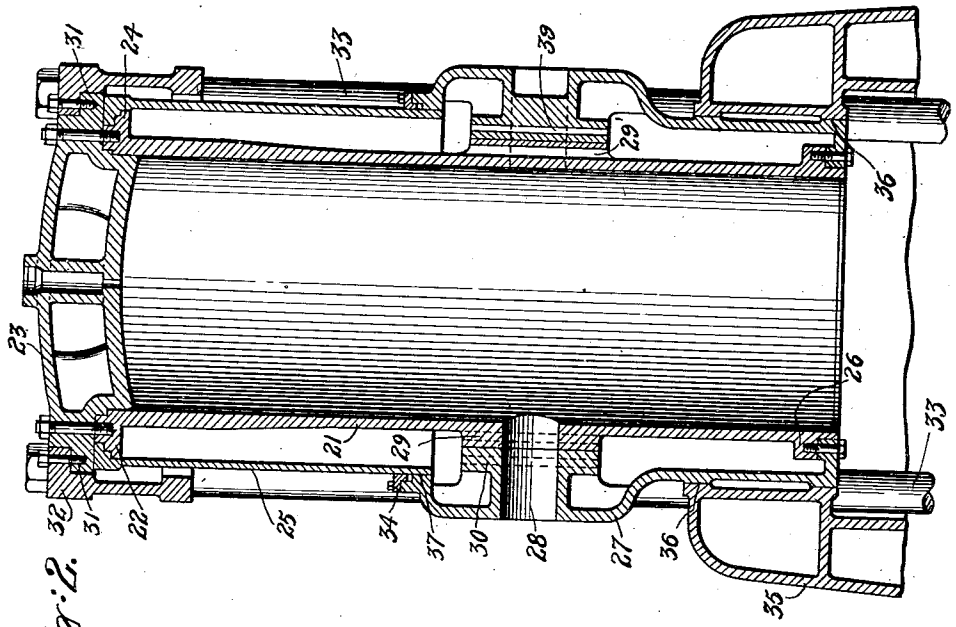


Fig. 2.

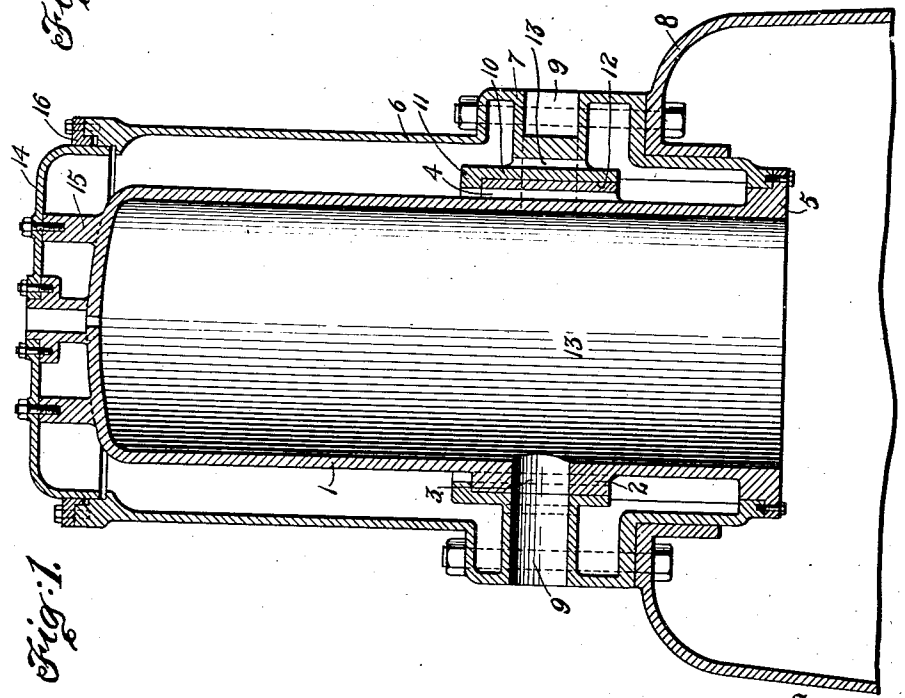


Fig. 1.

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# UNITED STATES PATENT OFFICE.

GUIDO FORNACA, OF TURIN, ITALY.

## COMBUSTION-ENGINE.

1,245,451. Specification of Letters Patent. Patented Nov. 6, 1917.

Application filed May 6, 1916. Serial No. 95,777.

*To all whom it may concern:*

Be it known that I, GUIDO FORNACA, a subject of the King of Italy, residing at Turin, in the Province of Piedmont, Italy, have invented certain new and useful Improvements in Combustion-Engines, of which the following is a full, clear, and exact specification.

This invention relates to internal combustion engines, and the object of the invention is to construct the engine so that the heated part of the cylinder is free to expand without imposing strains on the cylinder walls or the cooling jacket usually placed around the cylinder.

The elongation of the cylinder owing to the expansion of the parts subjected to the highest temperature causes dangerous strains in the walls of the cylinder and jacket often producing fractures. To allow for this elongation of the cylinder, this invention provides for relative movement between the cylinder and the walls of the jacket. The water jacket is constructed in two parts fastened to separated portions of the cylinder and inter-connected by a fluid tight joint allowing for relative movement between the parts of the jacket so that the whole of the jacket may readily expand according to the elongation of the cylinder without giving rise to strains within the parts. To further accommodate the expansion of the cylinder it is fixed by one of its ends only so that the other free end may move without resistance.

A further object of the invention is also to relieve the walls of the cylinder of the axial tension produced by the pressure of the gas on the head of the cylinder. This is accomplished by the use of auxiliary means which transmit these efforts directly from the head of the cylinder to the base of the engine.

In the accompanying drawings:

Figure 1 is a sectional view of a cylinder embodying the invention, and

Fig. 2 is a similar view of a cylinder showing a different embodiment of the invention.

In Fig. 1 is shown a two cycle cylinder for small sizes. The cylinder 1 is closed at its upper end so as to form the combustion chamber and is formed toward its lower part with the circular boss 2 provided with the distributing ports 3 and having axial passages 4 for the circulation of the cooling fluid. At the lower end of the cylinder 1 a flange 5 is provided for securing thereto the water jacket 6. The main portion of the jacket is formed by a cylinder having a greater diameter than the cylinder 1; the jacket is formed toward its lower end with a flange structure 7 which rests on the frame 8 to which it is secured by means of bolts. The flange 7 is provided with ports 9 registering with ports 3 of cylinder 1 and providing communication with the exterior. The flange structure 7 is provided with axial passages 13 for the circulation of the water and carries internally a circular portion 10 having a flange 11 and an inner surface 12 which fits perfectly and tightly on the boss 2.

The flanges 11 and 5 are sufficiently near to each other to secure the two parts rigidly together. The zone between them and particularly below the exhaust ports may be regarded as the cold zone and the cylinder and the jacket are almost at the same constant temperature owing to the great number of ribs and ducts in contact with the water. Consequently the difference of expansion and the relative sliding movements within this zone may be regarded as negligible, thereby permitting of the rigid securing of the parts together at these points in a fluid tight manner. The said two joints form in effect a single point of connection between the cylinder 1 and the frame 8 so that the upper end, that is to say, the hotter part of the cylinder is perfectly free to expand in all directions. The jacket serves to house and support the cylinder, receiving the thrust of boss 2 and flange 5. The cylinder and jacket can be easily removed from the casing as a unit and the cylinder taken out of the jacket without disassembling the parts of the jacket.

The second portion of the jacket is formed by a cover 14 secured by means of bolts to short pillars 15 integral with the cylinder head and leaving between the two parts a free space for the circulation of water. The cover 12 forms the end of the jacket and has fluid tight sliding contact with the cylindrical portion of the jacket 6. The fluid tightness between the parts sliding on each other is insured by the provision of stuffing box 16. As the cover 14 is not rigidly connected with the jacket 6 it can follow the cylinder head in its axial displacement of expansion without meeting any resistance.

Referring to Fig. 2, which shows a cylin-

der for large sizes, the cylinder 21 formed with tapering walls is open at both ends and is provided at the top with a flange 22 for securing the head 23 thereto; this flange is formed with an external rib 24 on which the upper cooling jacket 25 bears and is bolted. Flange 26 at the other end of the cylinder serves to connect the cylinder with the lower jacket 27 and insure fluid tightness. Registering with the ports 28 for the admission of the scavenging air and the exhaust of the burnt gases, an external circular boss 29 is formed on the cylinder through which open the ducts leading to the ports. This boss is formed with axial passages 29′ for the circulation of the jacket water.

The head 23 of the cylinder is independent and has a double wall with a space for the circulation of the cooling water. This head is peripherally formed with a flange 31, the lower surface of which serves to secure the cylinder while the upper one carries the plate 32 which the rods 33 connect to the base of the engine.

The cooling water jacket is composed of two parts; the upper part 25 is a simple tube which a flange connects at the top to the cylinder; the lower part 27 secured to the bottom of the cylinder through the medium of the flange 26 comprises the internal sleeve 30 tightly fitting the cylindrical boss 29 and provided with passages 39 for the circulation of the jacket water; and it is formed externally with the bearing surfaces 36 for connection to the frame 35 with which it has a tight sliding fit so that it can move relatively thereto. The two parts of the water jacket are in sliding contact with each other at 37, a stuffing box 34 insuring fluid tightness of the joint.

In this construction there is also attained the advantages set forth with regard to the structure of Fig. 1. The cylinder and the cooling jacket are rigidly connected in proximity to the distributing ports where the displacement due to the expansion is a minimum because the temperature at said point is comparatively small and constant. When the cylinder 21 expands, flange 22 will bear on the head 23 which is rigidly connected to the base by means of the plate 32 and the rods 33 and cause the part 27 to slide in the frame 35 and on the upper part 25 without producing any strain in the cylinder or jacket. Moreover, the efforts due to the pressure on the end are transmitted to the base of the engine through the plate 32 and the rods 33 independently of the walls of the cylinder which are thus relieved of any axial tension.

By the telescoping of one part of the jacket within the other the walls of the cylinder and jacket are prevented from imposing any strain upon each other. Accurate register of the ports through the jacket and fluid tightness of the ports are attained by providing ample bearing surface between the jacket and cylinder and so constructing and positioning the connecting means that relative sliding is a minimum at these points. Provision is also made for relieving the cylinder walls of the axial tension due to the pressure of the gas on the cylinder head and therefore both the cylinder walls and the jacket are relieved from all transmitted strains.

Suitable supply and discharge pipes are, of course, provided for the circulation of water through the jackets. The cylinders shown are particularly adapted for very large marine engines of the Diesel type, wherein each cylinder develops many hundred horsepower. The minimizing and proper distribution of the strains in these large units are important factors in attaining the stability and reliability of operation required in such service where the greatest efforts occur at the most critical times.

While in the above disclosure my invention is shown in connection with a two cycle cylinder it is apparent that it may be applied to other forms of cylinders and that the invention is not confined to the specific embodiment above described, but includes such modifications thereof as come within the scope of the appended claims.

Having thus described my invention, I declare that what I claim as new and desire to secure by Letters Patent, is:—

1. In an internal combustion engine, the combination with a cylinder, of a water jacket therefor, and connecting means between said jacket and cylinder allowing relative movement between the head of the cylinder and the jacket so that the cylinder may expand without imposing strain on the water jacket.

2. In an internal combustion engine, the combination with a cylinder, of a water jacket formed in two relatively movable parts, one part being rigidly connected to the upper end of the cylinder and the other part to the lower end of the cylinder.

3. In an internal combustion engine, the combination with a cylinder fixed at one end only, of a water jacket therefor, and connecting means between said jacket and cylinder allowing relative movement between the head of the cylinder and the jacket, so that the cylinder may expand without imposing strain on the water jacket.

4. In an internal combustion engine, the combination with a cylinder having sides and a head, of a water jacket surrounding the sides and head of said cylinder and forming a continuous water compartment, a rigid connection binding said jacket integrally to the crank end of said cylinder, and means providing for sliding movement between said rigid connection and the head end of said

cylinder to permit said cylinder to expand without imposing strain on said water jacket.

5. In an internal combustion engine, the combination with a two cycle cylinder, of a water jacket therefor composed of telescoping parts, one of said parts being fastened to the cylinder near the ports thereof, the other section being connected to the cylinder head.

6. In an internal combustion engine, the combination with a cylinder, of a water jacket therefor formed by telescoping parts, means supporting said cylinder by its head, and means guiding the base of the cylinder in the engine frame.

7. In an internal combustion engine, the combination with a cylinder having a separable head, of rods supporting said head from the engine frame, one section of a water jacket attached to said cylinder adjacent said head, another relatively movable section of said water jacket connected to a separated part of the cylinder, and means for guiding the crank end of the cylinder in the engine frame.

8. The combination in an internal combustion engine, of a cylinder, means for supporting the head of said cylinder from the engine frame, one section of a water jacket rigid with said supporting means, and a relatively movable section of said water jacket rigidly connected to the free end of said cylinder and supported for sliding movement in the engine frame.

9. In an internal combustion engine, the combination with a cylinder, of a section of a water jacket having an outer flange for attachment to the engine frame and an inner flange for attachment to the crank end of said cylinder, and another section of said water jacket telescoping within said first mentioned section and connected to the head of said cylinder.

10. In an internal combustion engine, the combination with a two cycle cylinder having a peripheral boss thereon, of a section of a water jacket supported by the engine frame and carrying an annular seat fitted to said boss, a port through said boss and said seat, means rigidly connecting said jacket and cylinder at one end, and means providing a sliding connection between said jacket and cylinder at the other end.

11. In an internal combustion engine, the combination of a cylinder head, rods supporting said head from the engine frame, a cylinder depending from said head, and a telescopic water jacket carried by said cylinder and sliding in the engine frame.

12. In an internal combustion engine, the combination with a cylinder having a peripheral port intermediate its ends, of a water jacket surrounding said cylinder and fitting the periphery thereof at said port, means rigidly connecting said jacket to the crank end of said cylinder, and means providing a sliding connection between said jacket and the head end of said cylinder to permit free expansion of said cylinder without imposing strain on said jacket.

In testimony whereof I affix my signature, in presence of two witnesses.

GUIDO FORNACA.

Witnesses:
NORAH WHITESTONE,
MINA VEUJ.