

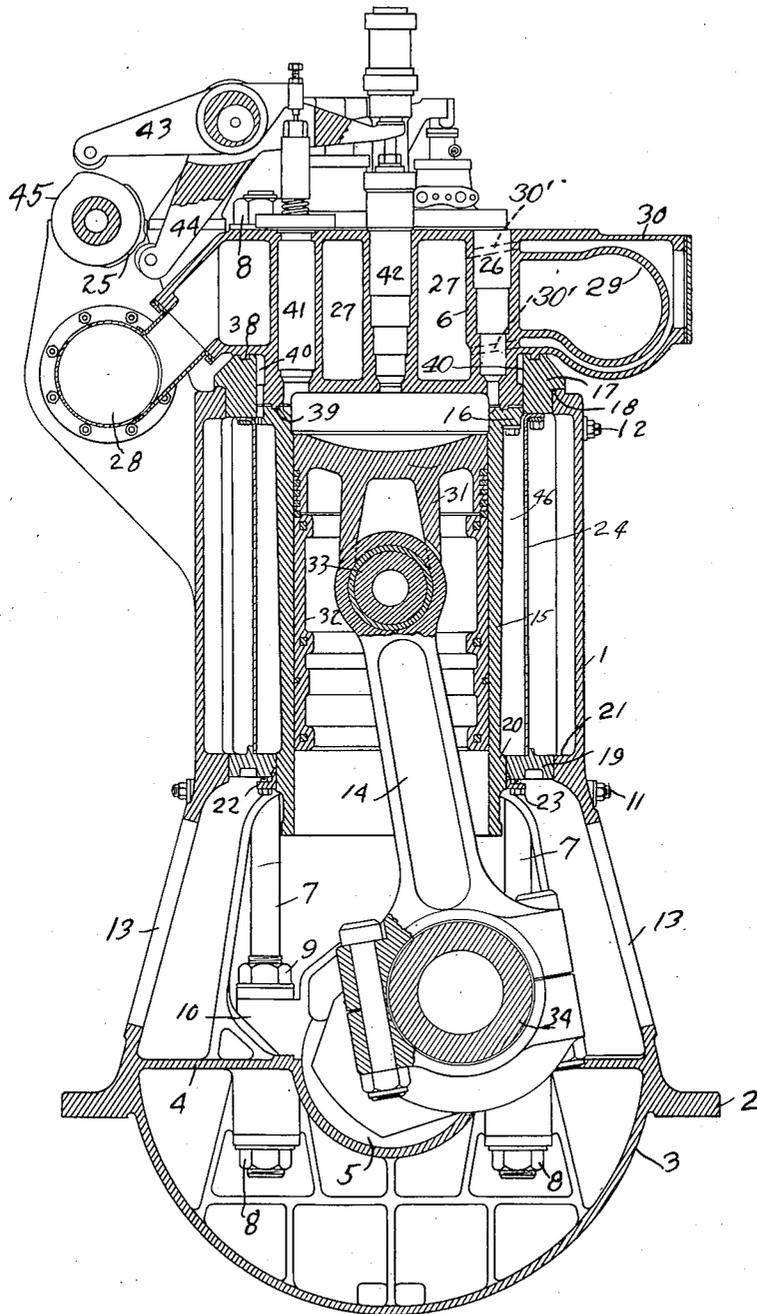
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INTERNAL COMBUSTION ENGINE

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# UNITED STATES PATENT OFFICE

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## INTERNAL COMBUSTION ENGINE

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This invention relates to an internal combustion engine, and more particularly to the construction of the frame and cylinder head thereof.

Our invention has among its various objects to provide a mechanism of the kind mentioned that is simple in its structure and makes for small cost of manufacture, low specific weight, high rigidity, freedom from torsional vibration of the crankshaft, improved cooling of the joint between the cylinder head and the cylinder liner, and elimination of an external exhaust manifold.

With the above and other objects in view, the invention consists in the construction, combination and arrangement of parts as will be described more fully hereinafter.

The drawing shows a vertical section through one cylinder of an embodiment of our invention.

The drawing shows our invention adapted to a Diesel engine, though it is to be understood that its usefulness is not limited thereto as it is applicable to any internal combustion motor.

Frame 1 may be made of cast, welded or wrought metal and if cast it may be in one piece for smaller sizes, though more than one part will probably be found to be more satisfactory in large engines. Where lightness is a desideratum the frame may be of suitable alloys of aluminum or other light weight material. Foot pieces 2 are provided for mounting the engine upon a suitable bed.

The crankcase 3 has in it bridge members 4 on which the crankshaft main bearings 5 are carried. Passing through the bridge members 4 and on through the cylinder head 6 are vertical tie rods 7 that have nuts 8 on the ends thereof whereby the tie rods are tensioned, the engine assembly is placed under an initial vertical compression and stresses are transmitted directly from the cylinder head to the main bearings. Intermediate nuts 9 on the tie rods secure the main bearing caps 10 in place; this, however, sets up indeterminate stress distributions in the tie rods and therefore large factors of safety in the rods are required. Horizontal tie rods 11 and 12 may be employed to apply transverse stresses to the frame and so increase its rigidity. Crankcase 3 has in it openings 13 to permit inspection of and work upon the bearings, crankshaft, etc.

Cylinder liner 15 has at its upper end a laterally turned portion 16 by which it is bolted to the under flange of cylinder head 6. Cylinder liner 15 and cylinder head 6 are carried in frame top cover 17 that has on its outer face an undercut forming a step 18 that rests upon the upper end

of frame 1 and supports the liner. A filler ring 19 is disposed between a circumferential rib 20 on the liner adjacent its lower end and an inwardly extending flange 21 on the frame, thus forming an enclosed space between the liner and the frame. The lower inner edge of the filler ring is cut away and suitable packing is compressed in the space so formed between the liner and the filler ring by a packing gland 22 that is forced against the packing by studs 23. An intermediate water jacket 24 that has watertight contact with the portion 17 and with filler ring 19 is disposed between liner 15 and frame 1, both to reduce the weight of the contained water and to protect the frame from attack by the cooling water in case the frame is made of readily corrosible material. Cylinder head 6 is seated upon the top cover 17 of the frame 1 with a tongue and groove joint 38 between them. The gasket in the tongue and groove joint is of compressible material that permits the cylinder head to be drawn into metal to metal contact with frame top cover 17 after the gasket in the tongue and groove joint 38 is compressed. Were it not for this feature, the advantage obtained by placing the engine frame 1 in initial compression would be lost. Cylinder liner 15 has a flange 16 through which it is bolted to the cylinder head 6. Tongue and groove joint 39 has a soft copper gasket to make a gas-tight joint between cylinder head and liner. An uncooled joint between the liner and the cylinder head is eliminated by circulating water through space 40 around the joint in addition to the cooling effected by the water in space 46 around the liner.

In cylinder head 6 are air start valve 41 and spray valve 42 operated by rocker arms 43 and 44, respectively, that are actuated by cams 45 and 25, respectively, and relief valve 26. Water passages 27 make provision for cooling the valves. The air intake is shown at 28 and the exhaust header at 29, the latter being enclosed in a water jacket 30 whereof the interior is connected to passages 27 by openings 30'. The exhaust header is preferably formed integrally with the cylinder head.

This construction relieves the cylinder liner 15 of all longitudinal tensile stress due to gas pressure in the combustion space. Dismounting is accomplished by removing the upper tie rod nuts 8, cylinder liner gland 22, and connecting rod bearing bolts, the piston being locked in the liner, as by a split ring or other suitable device expanded in the cylinder 15 below the piston and withdrawing cylinder head 6, liner 15, piston 32, and connecting rod 14 as a unit. Disassembly of

these individual parts is completed outside the engine.

The construction shown does not necessitate the removal of the connecting rod through the cylinder and consequently permits the use of a crankshaft 34 sufficiently large and rigid practically to eliminate torsional vibration in the crankshaft without the use of any other vibration damping device.

Placing the exhaust header 29 within a water jacket that is in free communication with the cooling system for the cylinder head reduces weight and cost, insures adequate water cooling of the header and limits the corrosion of the header to substantially that of the cylinder head.

The construction shown makes the cylinder liner readily removable and leaves it free to expand longitudinally with the consequent elimination of all longitudinal tensile strains in the liner due to gas pressure and to inertia.

It will be understood that the above description and accompanying drawing comprehend only the general and preferred embodiment of our invention, and that various changes in construction, proportion and arrangement of parts may be made within the scope of the appended claims without sacrificing any of the advantages of this invention.

We claim:

1. In an internal combustion engine, a one-piece frame including a crankcase, a cylinder head, a cylinder liner in said frame having at its upper end a laterally extending portion secured to said cylinder head, a frame top cover, said cylinder head having a laterally extending portion supported on and engaging said frame top cover, said frame top cover being in turn supported by and engaging said frame, an intermediate water jacket member disposed between said liner and said frame and secured to said frame top cover, a filler ring disposed between said liner and said frame adjacent the lower end of said liner and connected to said intermediate member, said cylinder head having formed integrally therewith an exhaust header and a water jacket enclosing said header, said cylinder head having in it passages for the circulation of water there-through in communication with the jacket around said exhaust header and a passage adjacent said laterally extending portion, all of said passages being in communication with the space between said intermediate member and said liner, a piston in said liner, a crankshaft connected thereto, transverse bridging members across said crankcase, crankshaft main bearings carried by said bridging members, tie rods extending from said bridging members through said cylinder head, and other tie rods extending transversely of said frame, all of said tie rods placing the cylinder head and frame assembly under initial compressive stress.

2. In an internal combustion engine, a one-piece frame including a crankcase, said crankcase having in it openings through which running parts may be adjusted, a cylinder head, a cylinder liner in said frame having at its upper end a laterally extending portion secured to said cylinder head, a frame top cover, said cylinder head having a laterally extending portion supported on and engaging said frame top cover, said frame top cover being in turn supported by and engaging said frame, an intermediate water jacket member disposed between said liner and said frame and secured to said frame top cover, a filler ring disposed between said liner and said

frame adjacent the lower end of said liner and connected to said intermediate member, said cylinder head having formed integrally therewith an exhaust header and a water jacket enclosing said header, said cylinder head having in it passages for the circulation of water there-through in communication with the jacket around said exhaust header and passages between said frame top cover and said laterally extending portion of said liner, all of said passages being in communication with the space between said intermediate member and said liner, transverse bridging members across said crankcase, tie rods extending through said bridging members and through said cylinder head, and other tie rods extending transversely through said frame, all of said tie rods placing the cylinder head and frame assembly under initial compressive stress.

3. In an internal combustion engine, a one-piece frame including a crankcase, said crankcase having in it openings through which running parts may be adjusted, a cylinder liner in said frame having at its upper end a laterally extending portion secured to a cylinder head, said cylinder head having a laterally extending portion supported on and engaging said frame top cover, said frame top cover being in turn supported by and engaging said frame, an intermediate water jacket member disposed between said liner and said frame and secured to said frame top cover, a filler ring disposed between said liner and said frame adjacent the lower end of said liner and connected to said intermediate member, said cylinder head having formed integrally therewith an exhaust header and a water jacket enclosing said header, said cylinder head having in it passages for the circulation of water there-through in communication with the jacket around said exhaust header and passages between said frame top cover and said laterally extending portion of said liner, all of said passages being in communication with the space between said intermediate member and said liner, and tie rods whereby the cylinder head and frame assembly may be placed under initial compressive stress.

4. In an internal combustion engine, a frame, a cylinder liner mounted therein, a cylinder head mounted thereon, said cylinder head having formed integrally therewith an exhaust header and a water jacket therefor, there being passages provided to circulate water through said head and said jacket and around the joint between said head and said liner, and tie rods whereby said frame and cylinder head assembly may be placed under compressive stress.

5. In an internal combustion engine, a frame including a crank case, a frame top cover mounted thereon, a cylinder head mounted on said top cover, a cylinder liner secured to and suspended from said head, a filler ring adjacent the lower end of said liner disposed between said liner and said frame, a separate water jacket member extending from said cover to said filler ring, said member being secured to said cover and serving to define a space around said liner, and packing means to prevent leakage of fluid between said liner and said filler ring.

6. In an internal combustion engine, a frame including a crank case, a frame top cover mounted thereon, a cylinder head mounted on said top cover, a cylinder liner operatively related to said head, a filler ring adjacent the lower end of said liner disposed between said liner and said frame, a separate water jacket member extending from said cover to said filler ring, said mem-

ber being secured to said cover and serving to define a space around said liner, and packing means to prevent leakage of fluid between said liner and said filler ring.

5 7. In an internal combustion engine, a frame including a crank case, a frame top cover mounted thereon, a cylinder head mounted on said top cover, a cylinder liner secured to and suspended from said head, a filler ring adjacent the lower end of said liner disposed between said liner and said frame, and packing means to prevent leakage of fluid between said liner and said filler ring.

10 8. In an internal combustion engine, a frame including a crank case, a frame top cover mounted thereon, a cylinder head mounted on said top cover, a cylinder liner secured to and suspended from said head, and a filler ring adjacent the lower end of said liner disposed between said liner and said frame.

15 9. In an internal combustion engine, a frame including a crank case, a frame top cover mounted thereon, a cylinder head mounted on said top cover, a cylinder liner operatively related to said head, a filler ring adjacent the lower end of said liner disposed between said liner and said frame, packing means to prevent leakage of fluid between the said liner and said filler ring, and

means for placing the assembly of the aforesaid elements under initial vertical compression.

10. In an internal combustion engine, a frame including a crank case, a frame top cover mounted thereon, a cylinder head mounted on said top cover, a cylinder liner operatively related to said head, a filler ring adjacent the lower end of said liner disposed between said liner and said frame, packing means to prevent leakage of fluid between the said liner and said filler ring, and means for placing the assembly of the aforesaid elements under initial transverse compression.

11. In an internal combustion engine, a frame including a crank case, a frame top cover mounted thereon, a cylinder head mounted on said top cover, a cylinder liner operatively related to said head, a filler ring adjacent the lower end of said liner disposed between said liner and said frame, packing means to prevent leakage of fluid between the said liner and said filler ring, and means for placing the assembly of the aforesaid elements under initial vertical and transverse compression.

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