J. E. DIAMOND.

INTERNAL COMBUSTION ENGINE.

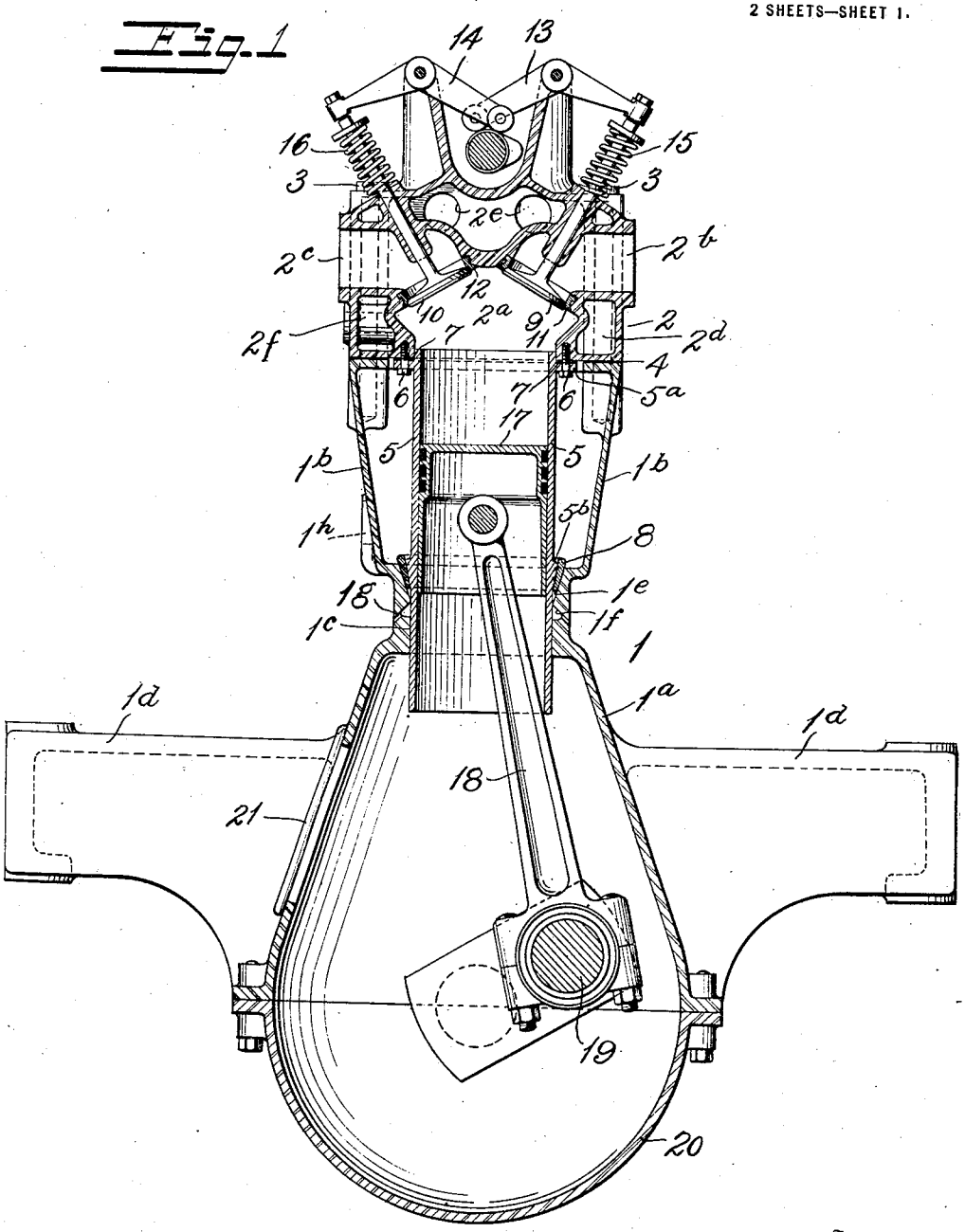
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1,331,420.

Patented Feb. 17, 1920.

2 SHEETS—SHEET 1.

Fig. 1



Witness:

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2 SHEETS—SHEET 2.

Fig. 2

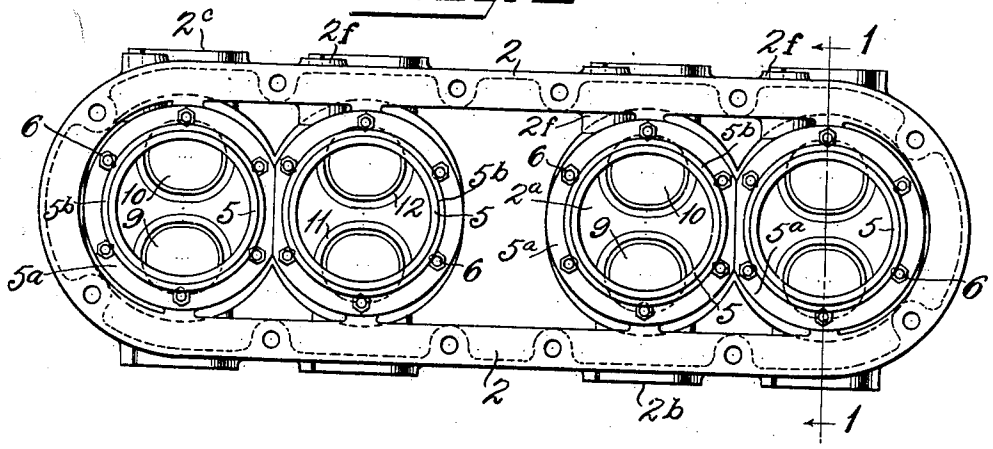
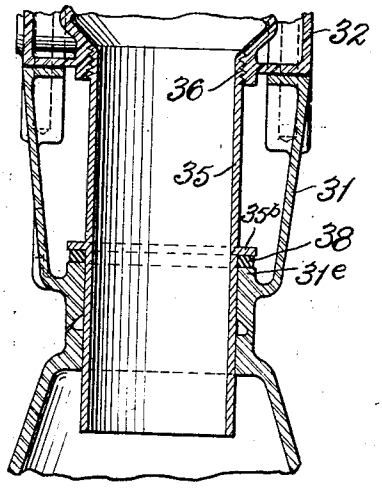


Fig. 3



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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

1,331,420. Specification of Letters Patent. Patented Feb. 17, 1920.

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To all whom it may concern:

Be it known that I, JAMES E. DIAMOND, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to an improved frame and cylinder construction for internal combustion engines.

One object of the invention is to provide an internal combustion engine having a light weight in relation to its power capacity.

Another object of the invention is to provide an internal combustion engine having high thermodynamic and mechanical efficiency, and a construction that is simple and easily produced.

Another object of the invention is to provide a construction for multiple cylinder internal combustion engines in which the joints between the combustion chamber and the water space are readily formed and maintained tight.

Another object of the invention is to produce an internal combustion engine in which the cylinder wall is in the form of a removable sleeve exposed, on its outer side, directly to the water of the jacket formed by the main frame casting and which is provided with an improved water tight joint between the cylinder sleeve and the wall of the water jacket casting.

A further object of the invention is the provision of an improved construction of multiple cylinder internal combustion engines making it possible to readily expose the coacting bearing surfaces of the pistons and cylinders.

Other objects which I have sought to attain will appear in the following description in which I set forth in connection with the accompanying drawings a preferred embodiment of the invention.

In the drawings

Figure 1 is a transverse vertical section through one of the cylinders of an engine embodying my improvements, the section being taken on line 1—1 of Fig. 2.

Fig. 2 is a bottom view of a cylinder head casting of a four cylinder engine with the cylinder sleeves attached thereto.

Fig. 3 is a fragmentary transverse vertical section through the frame and cylinder of an engine, showing a modified form of construction.

In the drawings, 1 indicates as an entirety the main frame casting of the engine which is preferably formed of metal of low specific gravity, such as a suitable aluminum alloy. This casting 1 comprises the upper part 1^a of a closed crank case and the walls of a water jacket 1^b, the crank case and jacket parts of the casting being joined by a section formed with a cylindrical passage 1^c. This frame casting is also preferably formed with suspension arms 1^d, 1^d.

On the upper end of the main frame casting is a head casting 2 which is also preferably formed of metal of low specific gravity similar to that employed for the main casting 1. The head casting is removably secured to the main casting by screw bolts 3, 3, a gasket 4 being interposed between the two castings to insure a water tight joint. The head casting is formed with a series of combustion chambers 2^a, one for each cylinder of the engine. In register with the bottom opening of each combustion chamber is a cylinder sleeve 5 formed of suitable wear-resisting metal such as steel, iron or bronze. These cylinder sleeves are detachably secured to the head casting. In the construction shown in Fig. 1 the sleeve is formed near its upper end with an outwardly turned flange 5^a which is drilled to receive screw bolts 6 by which the sleeve is securely bolted to the head casting, a gasket 7 being preferably interposed to insure a gas and water tight joint, and the upper end of the sleeve being preferably formed to fit the cylindrical opening of the combustion chamber.

Each of the cylinder sleeves 5 in its lower part has a sliding fit in the cylindrical opening 1^c of the main frame casting. Above this point each of the cylindrical sleeves is formed with a tapering shoulder 5^b which is disposed opposite a correspondingly formed conical wall 1^e of the main casting, the parts being formed and proportioned to provide an annular space for a compressible packing ring or gasket 8 which is compressed between the cylinder sleeve and the main frame casting to form a substantially water tight joint between said parts. To obviate the possibility of any slight seepage of water

passing the gasket 8 and finding its way downward into the crank case, I form in the wall of the casting 1 an annular chamber 1^f which communicates through one or more passages 1^g with the exterior of the casting. Any water that seeps past the gasket 8 finds its way in the chamber 1^f and thence drains through the passages 1^g to the outside of the frame casting, so that the danger of jacket water leaking into the crank case and contaminating the lubricating oil is obviated.

The head casting 2 is provided with inlet and exhaust passages 2^b and 2^c for each of the combustion chambers. The said passages are controlled by puppet valves 9 and 10 which coöperate with seats 11, 12. These seats are preferably formed of suitable wear-resisting metal such as bronze or alloy steel and may be secured to the head casting in any suitable manner as by casting in when the head casting is formed. The valves may be actuated in any suitable manner as by the cam operated rocker arms 13, 14, and springs 15, 16.

The head casting is chambered out to form a water jacket space 2^d which surrounds the combustion chamber and the inlet and exhaust passages 2^b and 2^c. The water jacket space 2^d of the head casting, as will be seen from an inspection of Fig. 2, is freely open to the water jacket space surrounding the cylinders 5. At a suitable point in the jacket wall 1^b I form a water inlet opening 1^h and at one end of the head casting 2 I form water outlet openings 2^e. These inlet and outlet openings may be connected in any suitable manner with a cooling apparatus such as a radiator.

The head casting 2 is provided in connection with each combustion chamber with a cylindrical conduit 2^f each of which opens into one of the combustion chambers and is adapted to receive a spark plug.

In each of the cylinder sleeves 5 is arranged a piston 17 preferably formed of an aluminum alloy or other light weight metal. Each piston is operatively connected by connecting rod 18 with the crank shaft 19, said shaft being suitably mounted in bearings carried by the main frame casting 1. 20 is the bottom or pan member of the crank case. It is bolted in the usual manner to the upper part of the crank case and serves in connection therewith to entirely inclose the crank shaft, connecting rods, etc.

If desired, the upper part 1^a of the crank case can be formed with a series of hand holds closed by suitable detachable covers 21.

In assembling the parts of an engine constructed as set forth the cylinder sleeves are securely bolted to the head casting as shown and then, the gaskets 8 having been placed in position in the frame casting, the head, together with the cylinder sleeves is lowered into position. In doing this the gaskets 8 are compressed between the shoulders 5^b of the cylinder sleeves and the opposite inclined walls 1^e of the frame casting and tight joints are thereby formed, the parts being secured, of course, by the bolts 3 which connect the head casting to the main casting 1. In originally assembling the parts of the engine the piston, connecting rods and crank shaft may be introduced after the cylinder sleeves and head have been assembled, or the crank shaft with assembled connecting rods and pistons may be placed in position and the cylinder sleeves, carried by the head casting, later lowered into position over the pistons. But when the engine is in use, if it becomes desirable to inspect the coacting bearing surfaces of the piston and cylinders, these surfaces may be readily exposed by simply unbolting and lifting the head casting and the attached cylinder sleeves.

It is to be observed that the joint formed between each cylinder sleeve and the head casting is individual to said cylinder sleeve and entirely independent of the joint between the walls 1^b of the water jacket and the head casting. This is especially advantageous in a multiple cylinder engine because, in so far as the joint between the cylinder wall and head is concerned, it avoids the difficulty inherent in other forms of construction, of rendering and maintaining tight all parts of a widely extended joint.

By forming the upper part of the crank case and the water jacket walls in a single casting of light weight metal, making the head casting of similar light weight metal and making the cylinders proper in the form of relatively thin detachable sleeves, I at the same time reduce the weight of the engine to a minimum, attain high thermodynamic and mechanical efficiency and provide a main engine casting which is simple and capable of production by rapid and cheap foundry work. The gain in thermodynamic and mechanical efficiency arises from the fact that the cylinder wall can be made of selected materials especially suited to the purpose, and also from the fact that such a sleeve formed of suitable material can be made thin and of uniform thickness so that its expansion and contraction will be uniform throughout. Under these conditions mechanical friction between the piston and cylinder wall is reduced to a minimum and the working temperature of the engine may be controlled to secure a maximum thermodynamic efficiency.

In Fig. 3 of the drawing I have shown a modified form of construction comprising a main frame casting 31 and a head casting 32 in most respects similar to the castings 1 and 2 in the form of construction shown in Fig. 1. In the present form of construction, however, the cylinder sleeves 35 are detachably secured to the head casting 32 by

a direct screw-threaded connection 36, the construction being such that when the cylinder sleeve is turned home a gas and water tight joint is formed between the parts. In this form of construction I have also modified the lower water jacket joint by forming on the cylinder sleeve a rectangular collar 35^b which coöperates with the upturned flange 31^e of the casting 31 to compress an interposed packing or gasket 38.

It will be understood that after the cylinder sleeves 35 are connected to the head casting 32, the parts of the engine may be assembled and disassembled in the same manner as in the case of the construction first described.

It will be understood that the construction which I have shown and described is for the purpose of illustration and explanation and that many modifications and variations of the construction can be made without departing from my invention.

What I claim is:

1. In an internal combustion engine, the combination of a frame casting common to a plurality of cylinders and forming the walls of the water jacket therefor, a cylinder head casting common to the said cylinders and removably mounted on the top of the said jacket walls and formed with an inner combustion chamber wall and an outer water jacket wall, and cylinder sleeves each detachably secured at one end independently of the frame casting and with a gas tight joint to the head casting, the outer walls of the cylinder sleeves being directly exposed to the water jacket space and the unsecured ends of said sleeves having connections with the frame casting permitting relative longitudinal contraction and expansion of the frame and cylinder parts and the free upward withdrawal of the cylinder sleeves with the head casting when the latter is detached from the frame casting.

2. In an internal combustion engine, the combination of a unitary frame casting common to a plurality of cylinders and forming one part of a closed crank case and the walls of the cylinder water jacket, a cylinder head casting removably mounted on the top of the jacket walls and formed with an inner combustion chamber wall and an outer water jacket wall, the head casting being common to the said cylinders and said frame and head castings being formed of metal of low specific gravity, and cylinder sleeves of wear-resisting metal each detachably secured at one end independently of said frame casting and with a gas tight joint to the cylinder head casting, the outer walls of the cylinder sleeves being directly exposed to the water jacket space and the unsecured ends of the said sleeves having connections with the frame casting permitting relative longitudinal contraction and expansion of the frame and cylinder parts and the free upward withdrawal of the cylinder sleeves with the head casting when the latter is detached from the frame casting.

3. In an internal combustion engine, the combination of a frame structure comprising a closed crank case, a water jacket above the crank case and intermediate walls forming a cylindrical passage from the water jacket to the crank case, a cylinder head secured to the upper end of the water jacket, a cylinder sleeve having its upper end fixedly connected to the frame structure, its outer walls directly exposed to the water jacket space and its lower end slidably fitted in the said cylindrical passage, and an annular packing disposed between the lower part of the cylindrical sleeve and the adjacent wall of the frame structure, an annular chamber being formed below the packing and between the opposing faces of the passage wall and cylinder sleeve and said wall having a drainage duct leading from the annular chamber to the outside of the wall.

In testimony whereof I affix my signature.

JAMES E. DIAMOND.