

**Nov. 10, 1936.**

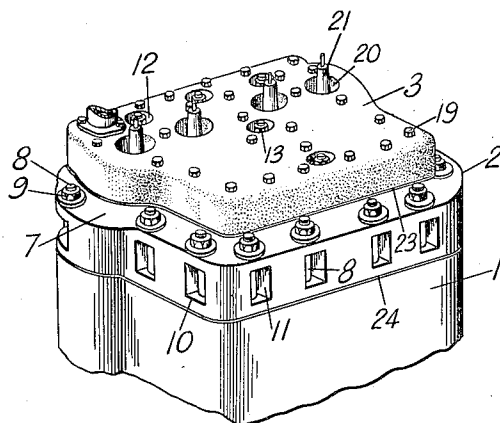
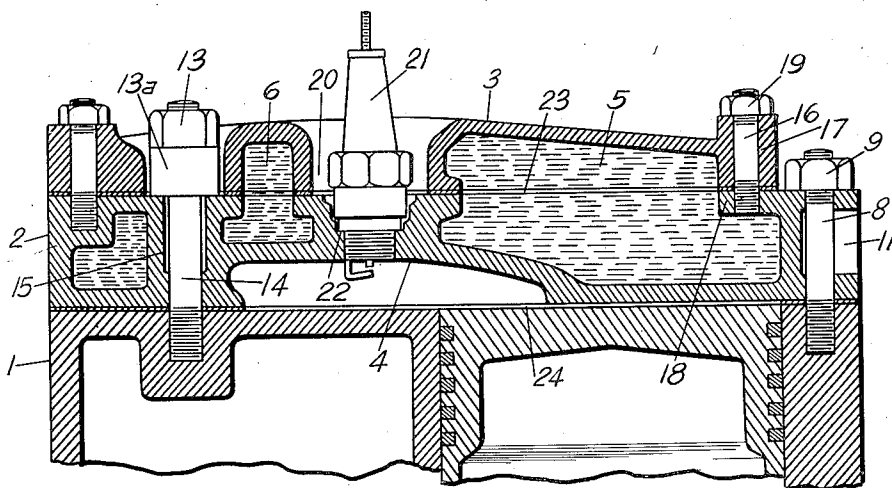
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**2,060,407**

CYLINDER HEAD

Filed Dec. 5, 1935

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

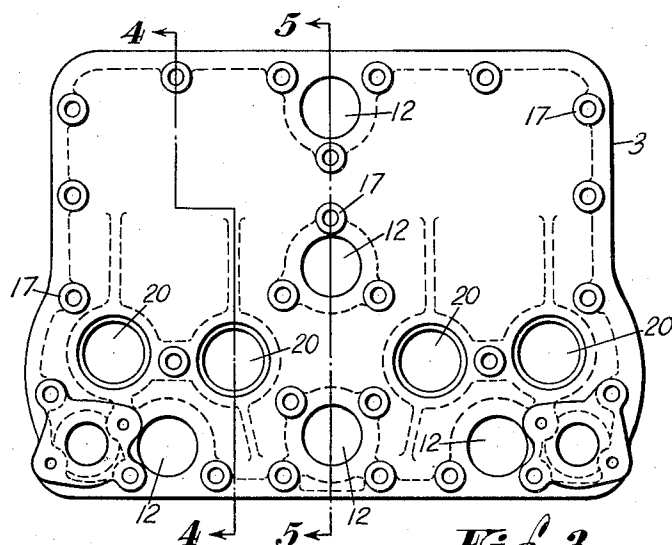


*Fig. 3*

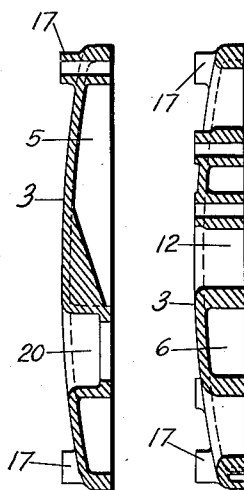


*Fig. 4 Fig. 5*

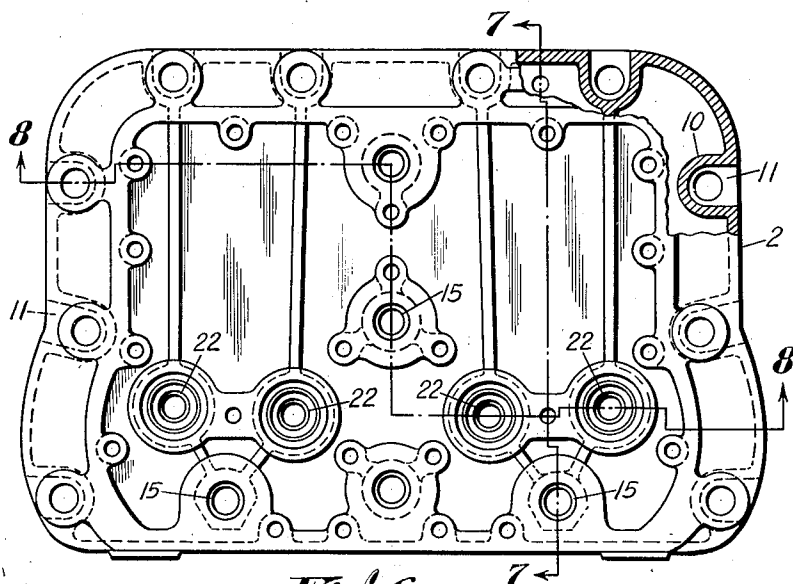


*Fig. 6*

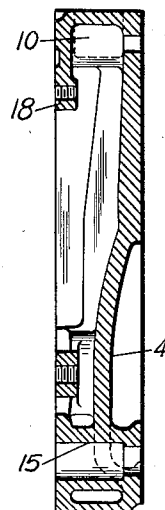


*Fig. 7*

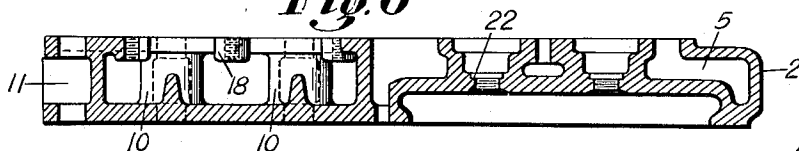


*Fig. 8*

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## UNITED STATES PATENT OFFICE

2,060,407

## CYLINDER HEAD

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6 Claims. (Cl. 123—173)

My invention relates to cylinder heads. It has to do, more particularly, with a cylinder head for use on an internal combustion engine and which is made in two or more parts, one part preferably being composed of copper or copper alloy, although certain features of my invention are not necessarily limited thereto.

Copper or copper alloys have been used recently in making cylinder heads because of certain desirable physical properties of the copper or copper alloys which bring about many advantages not possessed by cylinder heads of cast iron, aluminum or other materials. Recently, it has been proposed to cast cylinder heads from a copper or copper alloy as this is an economical way of producing such cylinder heads. However, there are certain difficulties which are encountered in casting a cylinder head from copper or copper alloys, which are known to any one familiar with foundry or metallurgical practice. It is difficult or almost impossible to cast a satisfactory cylinder head in one piece from copper or copper alloys when it is necessary to form a water space for the water jacket completely within the copper casting. These difficulties are overcome by making the cylinder head in two or more parts or sections so that the water space of the water jacket is not formed wholly within one of the parts or sections.

Although the casting difficulties are overcome by making cylinder heads in two or more parts or sections, certain other difficulties are brought about by constructing the cylinder heads in this manner. Cylinder heads have been made in two pieces, embodying a lower main portion and an upper cap portion, but these heads have not been satisfactory due to leakage which occurs during operation at the joint between the cap and the main portion of the head and between the main portion of the head and the engine block. In this type of cylinder head, both the head itself and the cap are retained on the block or held by the same set of hold-down studs or bolts. It is necessary to provide a gasket between the head and the cap and between the head and the block. The cap gasket is subjected to extremely high explosion loads and is the weak link in the design. It must be sufficiently soft and conformable to seal in the circulating engine cooling water and it must be hard and strong enough to resist the high pressure and pounding of the explosion loads.

If a cap gasket is used which is sufficiently hard and resistant to withstand the explosion pressure without compression, it is more than likely that it will be unable to seal in the cooling water par-

ticularly adjacent to the spark plug wells and bosses, as generally there are no closely adjacent hold-down studs. If this gasket is made softer and more conformable so as to seal in the water in the jacket, it will undoubtedly be subject to compression under the explosion loads. Just as soon as this compression of the cap gasket occurs, the head will be loose on the block and since the gasket between the head and the block will no longer be under the proper compression, leakage past this gasket will occur, allowing the cooling water to seep or flow into the cylinder bores and the fire of the explosion to blow over the gasket itself, thus quickly burning it out. Explosions in one chamber then blow through into the adjoining one and water leaks into cylinder bores down through into the crank case and total ruination of the engine almost immediately follows. Attempts have been made to overcome these difficulties by designing special types of cap gaskets but these attempts have not brought about the desired results.

One of the objects of my invention is to provide a cylinder head which is made of a plurality of parts, one part preferably being composed of copper or copper alloy, so as to facilitate casting thereof and so that part of the head may be made of metal other than copper or of thinner wall sections of copper.

Another object of my invention is to provide a cylinder head made of two or more parts which is so designed that there will be no danger of leakage between the parts of the cylinder head and between the head and the engine block and wherein this result may be accomplished without the use of special types of gaskets.

In its preferred form my invention contemplates the provision of a cylinder head composed of two sections, a lower section which rests on the engine block and may be termed the head and an upper section which is mounted on the lower section and may be termed the cap. The head is preferably made of copper or copper alloy and has the dome or upper end of the combustion chamber formed therewithin. It is desirable to have the dome or upper end of the combustion chamber formed of copper or copper alloy because of its high physical properties and high conductivity, which bring about a number of advantages, such as an increased compression ratio without detonation, a saving of fuel with increased power, etc. Part of the water space of the water jacket will be formed in the head and part in the cap and this will greatly simplify casting of the head. The cap member may be composed of

thinner wall sections of copper than the head proper or it may be composed of some other metal such as aluminum which is lighter in weight and less expensive.

5 In order to prevent leakage between the cap and the head and between the head and the engine block, the cap and the head have a special design and I have devised special means for holding the cap and the head in position on the engine.  
10 The head proper is held on the engine block by a set of hold-down studs or bolts and the cap member is attached to the head proper by an additional set of bolts which are entirely independent of the cylinder head hold-down studs or bolts.  
15 This entirely eliminates any danger of leakage without the use of special types of gaskets. The cap gasket will not be subject to compression and explosion loads and, therefore, the disadvantages pointed out in the discussion of prior art two-piece heads will not be present in the head which I have devised.

The preferred embodiment of my invention is illustrated in the accompanying drawings wherein similar characters of reference designate corresponding parts and wherein:

25 Figure 1 is a perspective view of a two-piece engine head made in accordance with the principles of my invention and showing how the head is mounted on the engine.

30 Figure 2 is a transverse section taken through the structure illustrated in Figure 1.

Figure 3 is a plan view of the cap member of the cylinder head.

35 Figure 4 is a transverse section taken substantially on line 4—4 of Figure 3.

Figure 5 is a transverse section taken substantially on line 5—5 of Figure 3.

Figure 6 is a plan view of the lower part or head proper of the cylinder head.

40 Figure 7 is a transverse section taken substantially on line 7—7 of Figure 6.

Figure 8 is a longitudinal section taken substantially along line 8—8 of Figure 6.

45 With reference to the drawings, I have illustrated an engine block 1 upon which a cylinder head made according to my invention is mounted. This cylinder head preferably comprises a lower part or section 2 which forms the head proper and an upper part or section 3 which may be termed a cap member. The head proper 2 is preferably cast from copper or copper alloy. However, it may be formed in other ways from copper or copper alloy or may even be made from material other than copper or copper alloy.

55 It will be noted from Figure 2 that the dome or upper portion 4 of the combustion chamber of the engine is formed wholly within the head 2 which, as stated, is preferably formed of copper or copper alloy. As previously stated, it is desirable to have the dome or the upper portion of the walls of the combustion chamber formed of copper or copper alloy because of its high physical properties and high conductivity, which bring about a number of advantages, such as an increased compression ratio without detonation, a saving of fuel with increased power, etc. The cap 3 is preferably made of aluminum although it may be made of other metal. Because of this two-piece construction, it is possible to make the lower section or head 2 of copper and make the cap 3 of other material which is less expensive. However, the cap 3 could be made of copper or copper alloy and thinner wall sections than those of the head 2 could be employed because the cap

3 is not subjected to compression and explosion loads.

It will be noted from Figure 2 that the large water space 5 and the water space 6 of the water jacket of the engine are formed partly within the copper or copper alloy portion or head 2 and partly within the cap 3. This greatly facilitates casting of both parts of the head and especially of the copper or copper alloy portion 2. Because of this structure it is possible to obtain a sound copper or copper alloy casting for the portion 2 of the head.

15 In order to mount the cap member 3 and the head proper 2 on the engine in such a manner as to prevent leakage between the cap and the head proper and the head proper and the engine block, I provide the structure now to be described. The head proper 2, as shown best in Figure 1, is of substantially greater area than the cap 3. Consequently, the edges of the cap will be spaced within the edges of the head proper for the greater portion of the distance around the head. This forms a ledge or shelf 7 on top of the head 2 which is not covered by the cap 3. A plurality of hold-down studs or bolts 8 are disposed at spaced intervals around the periphery of the member 2. These studs 8 are threaded into the engine block 1 and have nuts 9 threaded on their upper ends which contact with the ledge or shelf 7. The studs 8 are disposed in bosses 10, formed on member 2, which are cored out as at 11 to reduced the volume of metal in them which makes it possible to obtain castings which are more sound, especially if the member 2 is cast from copper or copper alloy.

35 At one side of the head the cap 3 has its edge substantially in alignment with the member 2. Consequently, at this side it is necessary to form wells 12 in the cap member 3 for receiving the stud nuts 13 which are disposed on the upper ends of studs 14 which are used for aiding in holding down the member 2. One of the wells 12 and studs 14 are also disposed substantially at the center of the cap member 3 and another is disposed substantially in alignment therewith adjacent the opposite edge of the cap. The arrangement of the wells 12 is best illustrated in Figure 3 from which it will be apparent that the wells are arranged in one longitudinal row adjacent one edge of the cap 3 and also in a transverse row located substantially midway between the ends of the cap. The studs 14 pass downwardly through bosses 15 formed in the member 2 and have their lower ends threaded into the engine block. The bosses 15 are also cored out. The member 2 is cored out at a number of points, as indicated in the drawings, to reduce the volume of metal therein and, thus, facilitate casting. The wells 12 formed in the cap member are of such a diameter as to permit spacer washers 13a to be disposed therein without contact with the walls thereof. These spacer washers 13a will contact only with the top surface of the member 2. It will be seen that the hold-down studs 8 and 14 merely act to hold the member 2 down in position on the engine block and do not function to hold the cap member in position.

70 I provide an entirely separate and independent set of hold-down studs or bolts for holding the cap member 3 in position on the member 2. Thus, as shown in Figure 2, I provide a plurality of hold-down studs or bolts 16. These studs 16 pass through bosses 17 formed on the cap member 3 and have their lower ends threaded into bosses 18 formed on the member 2. The upper

end of each stud has a nut 19 threaded thereon. I also provide well members 20 in the cap member 3 for receiving the spark plugs 21 so that they may be threaded into the member 2 as indicated at 22. The hold-down studs 16 for the cap are disposed in spaced relation all along the edge of the cap member, and are disposed at positions spaced inwardly from the edges of the cap and towards the middle thereof. These studs 16 are so disposed that at least three and in some cases four studs are provided adjacent each well 12 and three or these studs are provided adjacent each of the spark plug wells 20. It is desirable to arrange the studs in this manner so as to effectively prevent leakage of water from the water jacket into these wells and especially into the spark plug wells. To prevent leakage between the cap and head proper a gasket 23 is provided. However, this gasket may be an ordinary treated paper gasket since it will not be subjected to the explosive forces. A cylinder head gasket 24 is also provided between the member 2 and the engine block.

It will be apparent that the head proper is held down on the engine block by the studs 8 and 14 which are entirely separate and independent from the studs 16 which hold the cap on the head proper. No heavy explosion loads whatever affect the cap gasket 23 and, consequently, there is no danger of leakage developing at this point as it did in prior art two-piece heads. Consequently, it is not necessary to use a special type of gasket at this joint. Also, with this structure there is no danger of leakage developing at the joint between the head proper and the engine block where the gasket 24 is disposed. Where both the cap and the head proper were held down by the same set of studs, leakage developed at this point at the time the cap gasket was subjected to compression, due to the explosive forces, which brought about loosening of the head on the engine block.

It will be apparent from the above description that I have provided a cylinder head having many desirable features. Because the cylinder head is made in two pieces, casting is facilitated and it is possible to obtain a sound casting for the head proper of copper or copper alloys. Since the upper end of the combustion chamber is formed wholly within the copper or copper alloy section of the cylinder head, the advantages of a one-piece copper or copper alloy cylinder head will be obtained. Furthermore, with my cylinder head, although I do employ two sections, there is no danger of leakage developing between the two sections of the head or between the head and the engine block.

Although I have specified that the cylinder head is made of two sections, viz., the head proper and the cap, it will be apparent that the cap might be made in several sections and the head proper might be made in several sections. One of the most important features of my invention is to have the cap member and the head proper held in position by independent means. Although I have described this feature as being applicable to a head composed of a cap member of aluminum and a lower section of copper, it will be apparent that it is not limited in its application to a head made of these particular materials.

In the following claims where I specify "copper" or "aluminum", I intend to cover also copper alloys and aluminum alloys.

Having thus described my invention, what I claim is:

1. In combination, an engine block, a cylinder head comprising a lower section and a cap member, a set of hold-down studs for securing the lower section on the engine block, and a set of independent hold-down studs for securing the cap member on the lower section, said cap member having a plurality of wells formed therein and said lower section having openings formed therein directly beneath the wells, certain of said first-named hold-down studs projecting through certain of said wells into the corresponding openings and spark plugs projecting through certain other of said wells into the corresponding openings, said hold-down studs for the cap being so arranged that a plurality thereof are disposed around each well, said first-named set of hold-down studs functioning to secure the lower section only on the engine block.

2. In combination, an engine block, a cylinder head comprising a lower section and a separate cap member, said cap member and said lower section cooperating with each other to form a space for receiving cooling fluid, means for securing the cap member only to the lower section, said means comprising adjustable hold-down studs, a gasket disposed between said cap member and said lower section, said cap member having a plurality of wells formed therein and extending therethrough so as to expose portions of the lower section therebeneath and said lower section having a plurality of openings formed therein which are in alignment with said wells, means for securing the lower section only to the engine block, said means comprising independent adjustable hold-down studs, a gasket disposed between said lower section and said engine block, said last-named hold-down studs projecting into the openings in the lower section disposed in alignment with certain of said wells and bearing against the lower section only, and spark plugs projecting into the openings in the lower section disposed in alignment with certain other of said wells and bearing against the lower section only, said hold-down studs for the cap being so arranged that a plurality thereof are disposed around each well, said lower section having the dome of a combustion chamber formed therein, said cylinder head being so designed that the forces produced by the firing pressure in the combustion chamber will be precluded from compressing the gasket between said cap member and said lower section thereby causing leakage of the cooling fluid at said gasket.

3. In combination an engine block, a cylinder head comprising a lower section and a separate cap member, said cap member and said lower section cooperating with each other to form a space for receiving cooling fluid, means for securing the cap member only to the lower section, said means comprising hold-down studs, said cap member having a plurality of wells formed therein and extending therethrough so as to expose portions of the lower section therebeneath and said lower section having a plurality of openings formed therein which are in alignment with said wells, means for securing the lower section only to the engine block, said means comprising independent hold-down studs, said last-named hold-down studs projecting into the openings in the lower section disposed in alignment with certain of said wells and bearing against the lower section only, and spark plugs projecting into the openings in the lower section disposed in alignment with certain other of said wells, said hold-down studs for

the cap being so arranged that a plurality thereof are disposed around each well, said lower section having the dome of a combustion chamber formed therein, said cylinder head being so designed that the forces produced by the firing pressure in the combustion chamber will be precluded from affecting the joint between said upper section and said lower section and thereby causing leakage.

4. In combination an engine block, a cylinder head comprising a lower section and a separate cap member, said upper section and said lower section cooperating with each other to form a space for receiving cooling fluid, means for securing the cap member only to the lower section, said means comprising hold-down studs, said cap member having a plurality of wells formed therein and extending therethrough so as to expose portions of the lower section therebeneath and said lower section having a plurality of openings formed therein which are in alignment with said wells, means for securing the lower section only to the engine block, said means comprising independent hold-down studs, said openings in the lower section which are in alignment with said wells having members projecting thereinto, said hold-down studs for the cap being so arranged that a plurality thereof are disposed around each well, said lower section having the dome of the combustion chamber formed therein, said cylinder head being so designed that the forces produced by the firing pressure in the combustion chamber will be precluded from af-

fecting the joint between said upper section and said lower section and thereby causing leakage.

5. In combination an engine block, a cylinder head comprising a lower section and a separate cap member, means for securing the cap member only to the lower section, said means comprising hold-down studs, said cap member having a plurality of wells formed therein and extending therethrough so as to expose portions of the lower section therebeneath and said lower section having a plurality of openings formed therein which are in alignment with said wells, means for securing the lower section only to the engine block, said means comprising independent hold-down studs, said last-named hold-down studs projecting into the openings of the lower section disposed in alignment with said wells and contacting with the lower section only.

6. In combination, an engine block, a cylinder head comprising a lower section and a separate cap member, means for securing the cap member only to the lower section, said cap member having a plurality of wells formed therein and extending therethrough so as to expose portions of the lower section therebeneath and said lower section having a plurality of openings formed therein which are in alignment with said wells, and independent means for securing the lower section only to the engine block, said openings in the lower section which are in alignment with said wells having members projecting thereinto which bear against the lower section only of the head.

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