June 4, 1935. D. E. ANDERSON 2,003,571

CYLINDER HEAD FOR INTERNAL COMBUSTION ENGINES

Filed Aug. 15, 1932 2 Sheets-Sheet 1

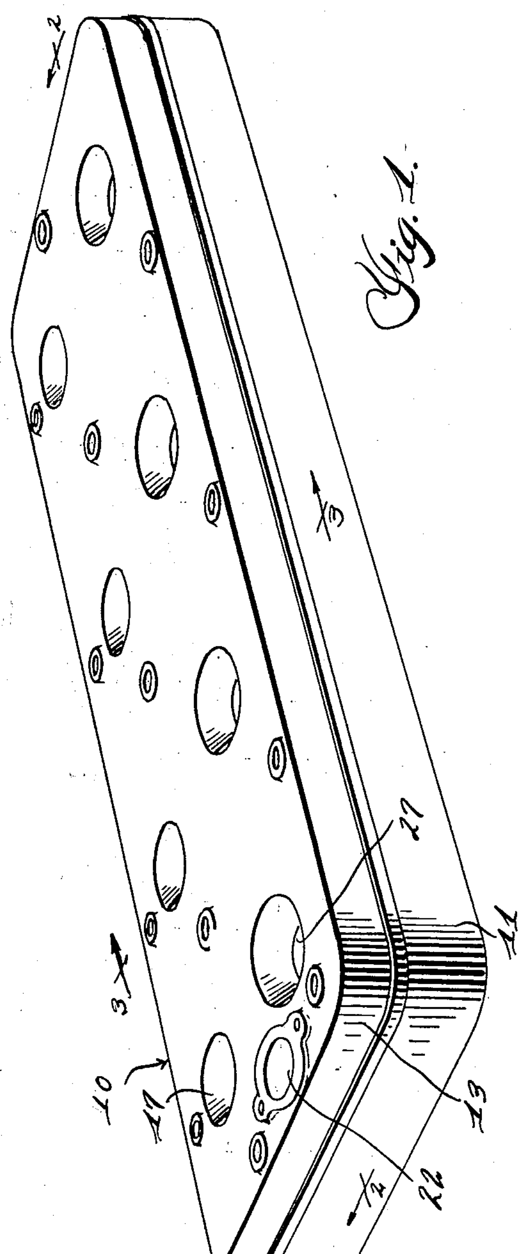

Fig. 1.

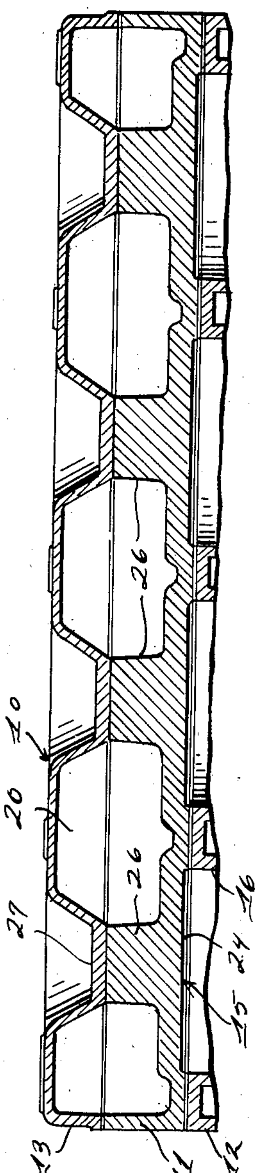

Fig. 2.

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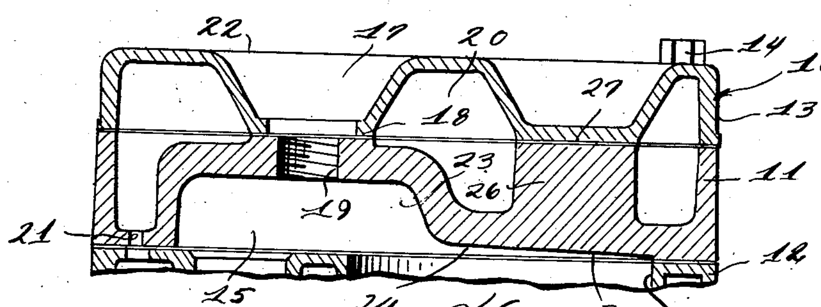

Fig. 3.

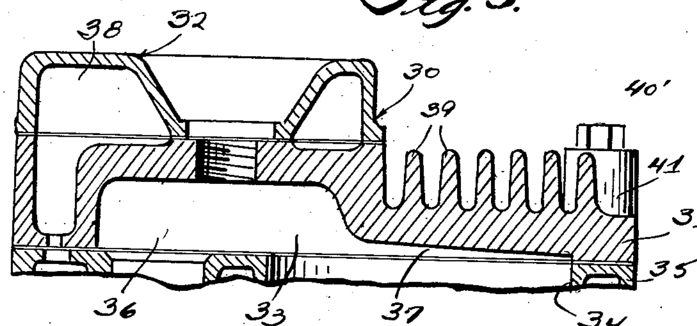

Fig. 5.

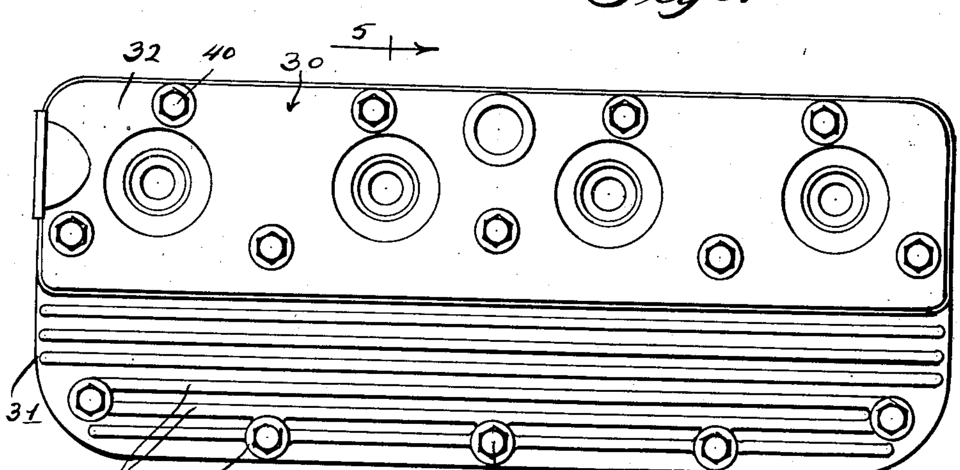

Fig. 4.

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CYLINDER HEAD FOR INTERNAL COMBUSTION ENGINES

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Application August 15, 1932, Serial No. 628,919

3 Claims. (Cl. 123—173)

This invention relates generally to internal combustion engines and refers more particularly to improvements in cylinder head constructions therefor.

The present invention contemplates increasing the efficiency of internal combustion engines as well as improving the performance thereof by providing a cylinder head construction embodying features which permit obtaining compression ratios considerably higher than has heretofore been considered possible without correspondingly increasing the tendency of the cylinder head to detonate.

Another feature of this invention which contributes materially to the elimination of detonation in the cylinder head resides in inclining the inner surfaces of the portions of the combustion chambers containing the last fuel mixture to burn in a direction to insure sweeping of the latter surfaces by the relatively cool charge as it passes from the major portion of the chamber to the cylinder. This sweeping action of the fuel not only tends to cool the inner surfaces of the quenched areas, but, due to the velocity thereof, also tends to maintain these surfaces clean.

A further advantageous feature of this invention resides in the provision of a cylinder head formed of a plurality of relatively simple castings capable of being readily fashioned from a permanent mold with the result that the manufacture thereof is rendered both expedient and inexpensive. This construction as well as other objects will be made more apparent as this description proceeds, especially when considered in connection with the accompanying drawings, wherein:

Figure 1 is a perspective view of a cylinder head constructed in accordance with this invention;

Figure 2 is a longitudinal sectional view taken substantially on the line 2—2 of Figure 1;

Figure 3 is a cross sectional view taken on the line 3—3 of Figure 1;

Figure 4 is a plan view of a slightly modified form of cylinder head construction;

Figure 5 is a cross sectional view taken on the line 5—5 of Figure 4.

For the purpose of illustration, the several features of the present invention are shown in association with two different types of cylinder head constructions. The two embodiments of the invention are broadly similar in that both illustrate a composite cylinder head construction wherein the lower section containing the combustion chambers is formed of a metal of high thermal conductivity and wherein the upper or cap section is preferably formed from a metal of relatively high tensile strength so as to effectively reinforce the lower section. By forming the walls of the combustion chamber from a metal of high thermal conductivity, the compression ratio may be appreciably increased due to the fact that the rate of pressure or temperature rise in the combustion chamber proper is materially reduced, and the effect of the latter pressure in building up the temperature of the last fuel to burn in the portion of relatively small area of the combustion chamber is minimized. However, the formation of the walls of the portions of the combustion chambers containing the last fuel mixture to burn of a metal of high thermal conductivity is objectionable since rapid heat transfer through the walls of this relatively small area is highly inducive to the accumulation of carbon upon the inner surfaces thereof. Inasmuch as carbon is a poor conductor of heat, the accumulation of the same upon the walls of the portions of the combustion chambers containing the last fuel to burn reduces the rate of heat transfer through these walls to a minimum irrespective of the metal from which the latter are formed, and, as a consequence, increases the rate of pressure rise in these areas to such an extent as to cause detonation. Accordingly, both embodiments of the invention are provided with means for minimizing the tendency for carbon to accumulate upon the inner surfaces of the portions of the combustion chambers containing the last fuel mixture to burn by restricting the rate of heat transfer through these walls. In addition to the foregoing, the inner surfaces of the aforesaid portions of the combustion chamber in both modifications are inclined in a direction to insure sweeping of the same by the incoming fuel during its passage from the major portions of the combustion chambers into the cylinder bores. As previously stated, this latter feature is desirable since the temperature of the incoming fuel is considerably less than the temperature of the walls of the portions of the chambers containing the last fuel mixture to burn, and, as a consequence, serves to cool these walls or prevent any carbon accumulation on the latter from reaching a temperature sufficiently high to cause detonation.

From the foregoing brief description of the present invention, it will be apparent that provision is made in both of the illustrated constructions for obtaining maximum cooling of the portions of the combustion chambers where such action is most desirable and for restricting the rate of cooling of other portions of the combustion chambers to eliminate one of the chief causes of detonation.

In other words, the present invention provides for obtaining efficient operation of a high compression cylinder head, and this operation is accomplished herein by a relatively simple construction about to be described.

Referring now more in detail to the specific embodiment of the invention illustrated in Figures 1 to 3, inclusive, it will be noted that this modification features a composite cylinder head 10 comprising a lower section 11 adapted to seat upon a cylinder block 12 and an upper or cap section 13 for clamping the lower section to the block. The clamping action is accomplished herein by a plurality of stud bolts 14 having head portions engaging the upper section and having threaded shank portions extending through aligned stud bosses in the aforesaid sections for threaded engagement with the cylinder block. The lower section 11 is formed with a plurality of combustion chambers 15 in the bottom surface thereof corresponding in number to the number of cylinders 16 in the block and is preferably, although not necessarily, formed from a metal of high thermal conductivity such as aluminum or an aluminum alloy.

In the event the lower section 11 is formed from aluminum or some metal having similar characteristics, the cap section 13 is preferably formed from a metal having relatively high tensile strength so as to reinforce the aluminum section in the assembled relation of the head. The upper walls of the combustion chambers are effectively reinforced by forming depression 17 in the cap section in such a manner that the lower wall portions 18 thereof abut the top surfaces of the combustion chambers. In this connection, it is to be noted that the lower walls of the depressions are apertured in alignment with suitable threaded openings 19 in the upper walls of the combustion chambers for receiving suitable spark plugs or other fuel igniting devices (not shown). As will be observed from Figure 3, the cap section 13 cooperates with the lower section 11 to form a space 20 for the circulation of a cooling medium over the combustion chambers. The cooling medium is introduced into the space 20 from the cylinder block through suitable openings 21 formed in the lower section and is permitted to flow back into the heat exchange unit (not shown) through a suitable opening 22 in the cap section.

The particular shape of the combustion chambers 15 forms no part of the present invention except for the fact that they are of the high compression type having major portions 23 for receiving the charge of incoming fuel and having other portions 24 extending over the cylinders of the engine. The latter portions of the combustion chambers have a large surface to volume ratio as compared to the portions 23, and the inner surfaces 25 thereof are inclined in a direction to insure sweeping of the same by the fuel passing from the major portions 23 of the combustion chambers into the cylinders 16. The above feature not only provides for cooling the inner surfaces 25 of the portions 24 to prevent any carbon accumulation on the latter from reaching a sufficient temperature to cause detonation, but in addition tends to dislodge any small particles of carbon adhering to these surfaces due to the extremely high velocity of the fuel.

While the sweeping of the surfaces 25 of the portions 24 by the incoming fuel reduces the effect of carbon accumulation to cause detonation, nevertheless, the present invention contemplates minimizing the tendency for carbon to adhere to the surfaces 25. As explained above, rapid transfer of heat through the walls of the combustion chambers is highly inducive to carbon accumulation upon the inner surfaces of these walls. Inasmuch as the surface to volume ratio of the portions 24 of the combustion chambers is considerably greater than the portions 23 of the latter, the accumulation of carbon upon the former appreciably reduces the volume thereof, and, as a consequence, increases the pressure or temperature rise to such an extent as to cause detonation. The rate of transfer of heat through the walls of the portions 24 of the combustion chambers is restricted in the embodiment shown in Figure 3 by preventing the circulation of the cooling medium in the space 20 over portions of the walls of the portions 24. This is accomplished in the present instance by forming projections 26 upon the upper walls of the portions 24 in the manner illustrated in Figure 3. As shown in this latter figure, the projections extend upwardly from the upper walls of the portions 24 and engage depressed wall portions 27 on the cap or upper section 13 of the cylinder head. The above construction not only provides for obtaining the desired restriction in heat transfer through the upper walls of the quenched areas, but in addition serves as a reinforcement for the portions of the combustion chambers where the compression pressures are the greatest.

In the modification illustrated in Figures 4 and 5, I have shown a combined water and air-cooled cylinder head 30. In general, maximum cooling of the major portions of the combustion chambers in the head 30 is effected by passing water over the same and restriction of the rate of heat transfer through the relatively small area portions is accomplished by air cooling the same. In detail, the head 30 is similar in general construction to the head 10 in that it is of the composite type having a lower section 31 and a cap section 32. The lower section is formed with a plurality of combustion chambers 33 in the bottom surface thereof corresponding in number to the number of cylinders 34 in the block 35 and is preferably, although not necessarily, formed from a metal of high thermal conductivity such as aluminum or an aluminum alloy. The combustion chambers 33 are of the high compression type having major portions 36 for receiving the charge of fuel and having portions 37 extending over the cylinders 34 in the block.

The upper or cap section 32 corresponds in width to the length of the major portions 36 of the combustion chambers and cooperates with the top walls thereof to form a chamber 38 for a cooling medium. The cooling medium is circulated over the top walls of the major portions of the combustion chambers 33 from a heat exchange unit (not shown) in the same manner as hereinbefore set forth in connection with the first described form of the invention. As in the first described modification, the cap 32 is preferably formed from a metal of high tensile strength for reinforcing the lower section and serves to clamp the latter to the cylinder block by means of the stud bolts 40.

The upper walls of the portions 37 of the combustion chambers extend laterally from the corresponding walls of the major portions of the chambers beyond the cap 32 so as to be exposed to the atmosphere and are formed with a plurality of laterally spaced upwardly extending ribs 39. The ribs 39 not only provide for obtaining the desired rate of cooling of the portions 37 of the combustion chambers, but also serve to rein-

force the upper walls of the latter areas. The side of the lower section projecting beyond the cap 32 is clamped directly to the cylinder block by means of a plurality of stud bolts 40' extending through stud bosses 41 formed on the lower section and threaded for engagement with the cylinder block 35.

By virtue of the foregoing construction, maximum cooling of the major portions of the combustion chambers 36 is not only secured, but the desired restricted cooling of the portions 37 of the combustion chambers is obtained. In connection with the embodiment of the invention illustrated in Figure 5, it will be noted that by reason of the specific construction thereof set forth above, the effective area of the passage 38 for the cooling medium is appreciably less than in cylinder heads now commercially produced, with the result that the cooling medium will flow over the major portions of the combustion chambers at a considerably higher velocity, and the efficiency of cooling will be correspondingly increased.

While in the description of the foregoing modifications particular stress has been placed upon the association of this invention with a composite cylinder head, nevertheless, it is to be understood that the same may be advantageously employed in connection with different types of cylinder heads formed of various kinds of metals, and, accordingly, reservation is made herein to make such changes as may come within the purview of the accompanying claims.

What I claim as my invention is:

1. An internal combustion engine cylinder head formed with a combustion chamber therein and having a wall spaced above the top wall of the combustion chamber to form with said top wall a space for a cooling medium, said combustion chamber having a portion for receiving a charge of fuel and having another portion of relatively large surface to volume ratio adapted to register with a cylinder of an engine, and cooperating registering projections extending into the space aforesaid from the top wall of the second named portion of the combustion chamber and the above mentioned wall of the head to prevent the flow of the cooling medium in said space over a portion of the top wall of the second named portion of the combustion chamber.

2. An internal combustion engine cylinder head having a lower section formed from a metal of relatively high thermal conductivity and having a combustion chamber therein, an upper section removably secured to the top surface of the lower section and cooperating therewith to form a space for a cooling medium above the combustion chamber, said combustion chamber having a fuel receiver portion and having a communicating portion of relatively large surface to volume ratio adapted to register with a cylinder of an engine, and cooperating means extending into the space from both of said sections and forming a column above the top wall of the second named portion of the chamber for preventing the flow of cooling medium over a portion of said wall.

3. An internal combustion engine cylinder head having a lower section formed with a combustion chamber therein and having an upper section removably clamped to the lower section forming with the latter a space above the combustion chamber for a cooling medium, said combustion chamber having a fuel receiving portion and having a communicating portion adapted to register with a cylinder of an engine, and a projection of predetermined cross sectional area extending into the space aforesaid from the top surface of the second named portion of the chamber and engaging the upper section to prevent the flow of cooling medium over a portion of the upper wall of said second named portion of the chamber.

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