Dec. 11, 1934. J. F. WHITE 1,984,101

CYLINDER HEAD CONSTRUCTION

Filed Aug. 15, 1932

Fig. 1.

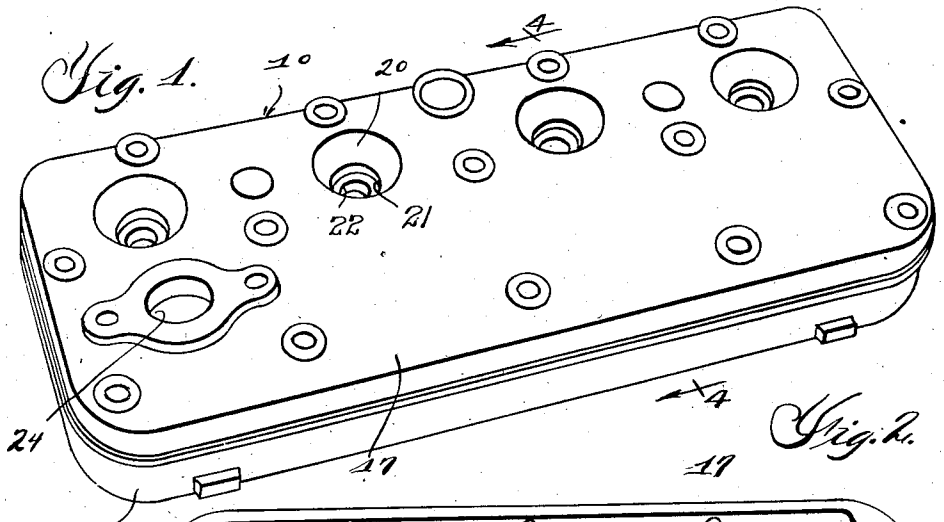
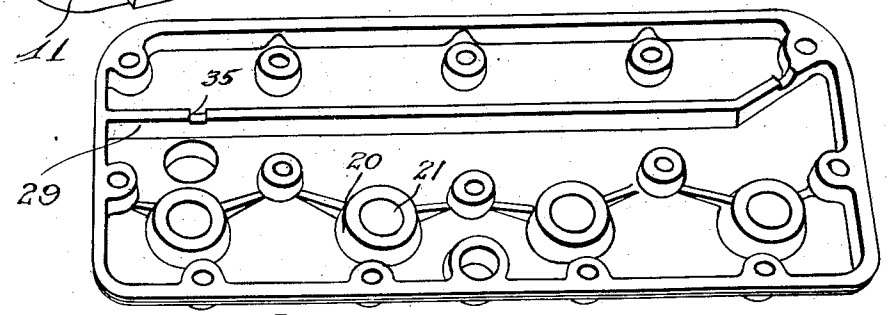


Fig. 2.



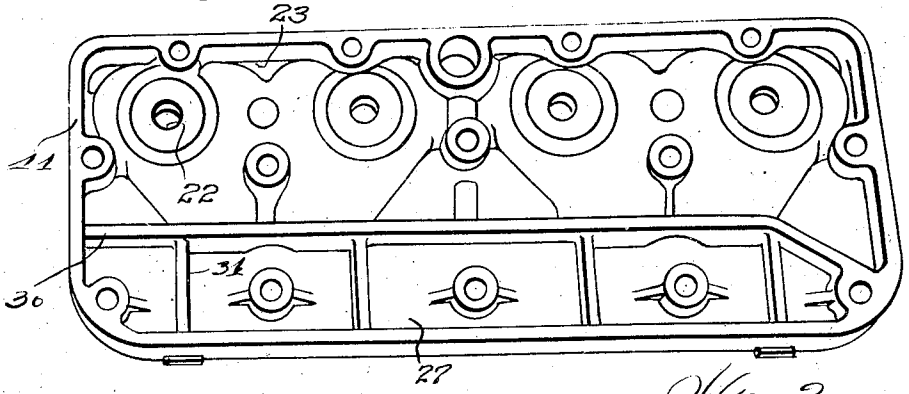


Fig. 3.

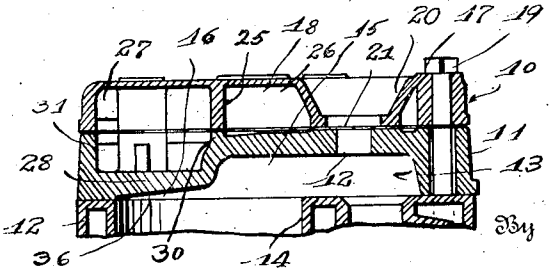


Fig. 4.

Inventor
James F. White

By Williamson, Walker & Williamson
Attorneys

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CYLINDER HEAD CONSTRUCTION

James F. White, Detroit, Mich.

Application August 15, 1932, Serial No. 628,952

6 Claims. (Cl. 123—173)

This invention relates generally to internal combustion engines and refers more particularly to cylinder head constructions for use in connection with engines of this character.

The present invention contemplates increasing the efficiency of cylinder heads by insuring maximum cooling of the combustion chambers proper and by restricting the rate of cooling of the portions of the chambers containing the last fuel mixture to burn. Diminishing the amount of cooling of the portions of the combustion chambers containing the last fuel mixture to burn materially reduces the tendency for carbon to accumulate upon the inner surfaces of these portions, and, as a consequence, eliminates one of the chief causes of detonation. Maximum cooling of the remaining portions of the combustion chambers of relatively large area also has the effect of minimizing detonation since it reduces the rate of pressure rise in the latter portions, and, as a consequence, correspondingly reduces the effect of the rise in pressure in these portions on building up the pressure or raising the temperature of the last fuel mixture to burn. Thus, it will be seen that the above arrangement provides for reducing the pressure rise in the combustion chambers to a minimum, and since volumetric efficiency increases as the pressure rise decreases, it necessarily follows that this invention permits raising compression ratios of cylinder heads appreciably without instituting roughness in the performance of the engine.

Another feature of this invention which contributes materially to maintaining the inner surfaces of the portions of the combustion containing the last fuel mixture to burn cool and free from particles of carbon resides in the provision of means for insuring sweeping of the aforesaid inner surfaces by the fuel flowing from the major portions of the chambers into the cylinder bores.

A further feature of the present invention which contributes materially to the commercial manufacture of a cylinder head possessing the foregoing features resides in forming the latter in two sections arranged in superposed relation in the assembled position of the head.

A still further feature of this invention which cooperates with the foregoing features to form a highly efficient cylinder head resides in the provision of a composite cylinder head wherein the section containing the combustion chambers is formed of a metal of high thermal conductivity capable of being fashioned from permanent molding apparatus.

In addition to the foregoing, the present invention contemplates the provision of a composite cylinder head of the type specified above wherein the upper section is formed of a metal of high tensile strength so as to reinforce the lower section and effectively clamp the same to the cylinder block.

The above as well as other objects will be made more apparent as this description proceeds, especially when considered in connection with the accompanying drawing, wherein:

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

Figure 2 is a perspective view of the underside of the upper section of the head;

Figure 3 is a perspective view of the lower section of the head;

Figure 4 is a cross sectional view taken substantially on the line 4—4 of Figure 1.

In accordance with the present invention, differential cooling of the cylinder head is accomplished by providing a column or partition in the cooling chamber of the head in such a position as to separate the space above the major portions of the combustion chambers from the space above the portions of the latter containing the last fuel mixture to burn. Cooling medium is introduced into the space above the combustion chambers proper from a suitable heat exchange unit (not shown) and a limited amount of the cooling medium may be by-passed through the partition for circulation over the quenched areas if desired.

Although the several features of the present invention which provide for efficiently controlling combustion in the combustion chambers of a cylinder head may be advantageously employed in heads of numerous different designs, nevertheless, I have shown the same as incorporated in a sectional cylinder head since the latter lends itself more readily to the inclusion of the construction provided herein for obtaining these features. The cylinder head shown herein for the purpose of illustration is designated generally in Figure 1 by the reference character 10 and comprises a lower section 11 fashioned to extend for substantially the full length of the cylinder block 12. The lower section is formed with a plurality of combustion chambers 13 in the bottom surface thereof corresponding in number to the number of cylinders 14 in the block and is preferably, although not necessarily, formed from a metal of high thermal conductivity such as aluminum

or an aluminum alloy. By forming the lower section from a metal having high thermal conductivity as one of its characteristics, a more rapid dissipation of heat from the combustion chambers is effected, with the result that the rate of pressure or temperature rise in the latter correspondingly decreases. Controlling the rate of pressure rise in a combustion chamber is important to the operation of an internal combustion engine since it permits obtaining greater volumetric efficiency, and, accordingly, higher compression ratios.

The lower section 11 is open at the upper side thereof and is designed to permit forming the same from a mold having permanent mold forming portions. The construction of the section 11 which permits the same to be fashioned from a permanent mold is desirable not only because it provides for more expediently and economically manufacturing this section in production, but also because it permits fashioning the combustion chambers to within extremely close limits without the necessity of machining the same. Accuracy in forming the combustion chambers is important in the performance of an internal combustion engine since it permits securing uniform volumetric efficiency in each of the engine cylinders. The shape of the combustion chambers in the present instance contributes materially to the success of the present type of head in controlling combustion and forms the subject matter of my copending application, Serial Number 628,951, filed August 15, 1932. In general, the combustion chambers are of the high compression type having major portions 15 for receiving the charge of fuel and having other portions 16 extending from the major portions over the cylinders 14. The portions 16 have large surface to volume ratios as compared to the portions 15 and contain the last fuel mixture to burn in the combustion chambers.

The open upper side of the lower section 11 is normally closed by an upper or cap section 17 cooperating with the top wall of the section 11 to form a chamber 18 for a cooling medium. In addition, the cap section serves to clamp the lower section to the block and for accomplishing this result a plurality of stud bolts 19 are provided. The bolts 19 are of conventional design having head portions engageable with the upper section 17 and having shank portions extending through aligned stud bosses in the sections for threaded engagement with the block. In the event the lower section 11 is fashioned from aluminum or an aluminum alloy, the upper section 17 is formed from a metal having relatively higher tensile strength so as to reinforce the lower section 11 throughout the length thereof and thereby prevent any tendency for compression pressures developed in the combustion chambers to deform the head. The top section 17 is further provided with depressions 20 opposite the combustion chambers having openings 21 therethrough in alignment with threaded openings 22 formed in the top walls of the combustion chambers for receiving the spark plugs (not shown). The portions of the depression 20 surrounding the openings are arranged to embrace the top walls of the combustion chambers in the assembled relationship of the sections so as to provide for reinforcing the latter.

The cooling medium employed for cooling the cylinder head is supplied to the space 18 from the cylinder block 12 through openings 23 in the lower section 11 and is returned to the heat exchange unit through a suitable opening 24 in the top section 17 of the head. As previously stated, one of the features of the present invention which contributes materially to controlling combustion in the chambers 13 resides in the provision of means associated with the head for differentially cooling the portions 15 and 16 of the latter. In the present instance, differential cooling of the aforesaid portions is secured by providing a column or partition 25 arranged to divide the space 18 into virtually two passages designated herein by the reference characters 26 and 27. The construction is such that the passage 26 extends above the portion 15 of the chamber and communicates with both the inlet and outlet openings 23 and 24, while the passage 27 extends above the upper wall 28 of the portion 16 of the combustion chamber free from direct communication with either of the aforesaid openings. The partition 25 comprises a wall 29 depending from the upper wall of the section 17 and engageable with a corresponding wall portion 30 extending upwardly from the lower section 11. Both of the walls 29 and 30 are formed integral with their respective sections and extend from one end wall of the same to the opposite end wall thereof. It will be apparent from Figure 4 that in the assembled relationship of the head sections, the partition 25 forms in effect a continuation of the connecting wall portion between the portion 16 and major portion 15 of the combustion chamber, with the result that this partition has the additional function of materially reinforcing the cylinder head. The partition 25 is assisted in reinforcing the lower section 11 by means of a plurality of ribs 31 extending transversely of the passage 27 and integrally connected at the inner ends to the wall 30 and at the outer ends to the adjacent side wall of the section 11.

The provision of a partition in a cylinder head in the manner specified above restricts the rate of cooling of the portions 16 of the combustion chambers and correspondingly increases the rate of cooling of the major portions 15 of the chambers. As previously stated, the above features are extremely important in internal combustion engine design since they permit securing considerably higher compression ratios without detonation, and, as a consequence, provide for obtaining increased efficiency in the performance of internal combustion engines. In detail, the partition 25 reduces the effective area of the chamber 18 for the cooling medium to substantially the area 26 over the major portions 15 of the combustion chambers, with the result that a greater volume of cooling medium will flow over these portions per unit of time. The desirability of providing maximum cooling of the major portions of the combustion chambers will be apparent when considering that detonation is caused to a large extent upon the rapidity of the pressure rise of the portion of the fuel first ignited and its effect in building up the temperature of the unburned portion of the fuel in the quenched areas of the chambers. Consequently, efficient cooling of the portions 15 of the combustion chambers materially reduces the pressure rise and the tendency for the charge to detonate irrespective of the compression ratio. The foregoing object is realized to a greater degree when the section 11 is formed from metal of high thermal conductivity since this metal is

able to transfer the heat from the combustion chamber to the cooling medium with considerably greater rapidity than other metals commonly employed in the manufacture of cylinder heads.

It will be apparent from the preceding description that increased cooling efficiency of the major portions 15 of the combustion chambers is effected by restricting the flow of cooling medium over the walls 28 of the portions 16 of the combustion chambers, and while this may appear on its face to be objectionable in view of the above remarks, nevertheless, it is desirable since overcooling of the walls 28 of the portions 16 or rapid transfer of heat therethrough into the surrounding medium is highly inducive to carbon accumulation on the inner surfaces of these walls, and it is well established that carbon is an extremely poor conductor of heat. Owing to the relatively large surface to volume ratio of the portions 16 of the combustion chambers, a very small amount of carbon accumulation upon the inner surfaces of the walls 28 is sufficient to cause a relatively great increase in the rate of pressure or temperature rise, and since the heat is prevented from being transferred through the walls 28 by the carbon, detonation results. The tendency for carbon to accumulate upon the inner surfaces of the walls 28 of the portions 16 in the present instance is materially reduced by the partition 25 which restricts the rate of cooling of the walls 28. In this connection, it is to be noted that in the event it is found desirable to slightly cool the walls 28, suitable apertures 35 may be formed in the wall 29 of the partition so as to permit cooling medium to flow into the passage 27 from the passage 26. The rate of cooling of the portions 16 may, of course, be controlled by varying the number or dimensions of the openings 35.

Another feature of the present invention which contributes materially to minimizing the accumulation of carbon upon the inner surfaces 36 of the walls 28 consists in tapering the inner surfaces from a common center inwardly and upwardly so as to provide for locating the surfaces 36 in the path of the fuel entering the portions 16. It has been found that by inclining the surfaces 36 in the manner specified above, the fuel flowing from the major portions of the combustion chambers into the cylinder bores 14 sweeps across these surfaces instead of by-passing the same as is the case in conventional cylinder head constructions wherein the surfaces 36 are arranged in a plane parallel to the top wall of the cylinder block. The sweeping effect of the incoming charge on the surfaces 36 is important since it not only serves to cool these surfaces, but tends to dislodge therefrom any small particles of carbon which may be adhering thereto. The foregoing is especially true in the present instance wherein the combustion chamber proper is designed and cooled to such an extent as to afford maximum velocity of the incoming charge.

Thus, from the foregoing, it will be apparent that I have increased the efficiency of internal combustion engines as well as improved the performance thereof by providing a cylinder head construction possessing a number of features capable of being readily incorporated without complicating the construction thereof or appreciably affecting the cost of manufacture of the same. Much of the commercial value and acceptability of the cylinder head previously described resides in the fact that the same is formed essentially of two relatively simple castings which renders the provision of the partition or column 25 practical and inexpensive. In addition to the above, it is to be noted that by forming the head in two sections, the combustion chambers may be formed from a material of high thermal conductivity without sacrificing strength since the upper section forms an effective reinforcement for the lower section throughout the length of the latter.

What I claim as my invention is:

1. A cylinder head formed with a combustion chamber therein having a portion for receiving a charge of fuel and having another portion of relatively large surface to volume ratio arranged to extend over a cylinder of an engine, said head further having a chamber for a cooling medium disposed above the combustion chamber, a partition in the cooling medium chamber extending from one end of the latter to the opposite end of the same in a position to separate the space above the first named portion of the chamber from the space above the second named portion of the latter and having restricted openings therethrough, and means providing for the circulation of a cooling medium through the space above the first named portion aforesaid of the chamber.

2. A cylinder head comprising, a lower section having a combustion chamber therein, a cap section seated upon the lower section and cooperating therewith to form a space above the chamber for a cooling medium, means providing for the circulation of cooling medium through the space, and means for restricting the flow of cooling medium over a predetermined portion of the chamber including a wall projecting from one of the sections into the space aforesaid and extending from one end of the latter section to the opposite end of the same.

3. A cylinder head formed with a combustion chamber therein having a portion for receiving a charge of fuel and having another portion adapted to extend over a cylinder of an engine, said head further having a compartment for a cooling medium extending over the combustion chamber, means dividing the space in the compartment extending over the first named portion of the combustion chamber from the space in the compartment extending over the second named portion of the combustion chamber, means providing for the circulation of a cooling medium through the space over the first named portion of the combustion chamber and means associated with said first named means permitting a restricted circulation of the cooling medium through the space extending over the second mentioned portion of the combustion chamber.

4. A cylinder head formed with a combustion chamber therein and having a compartment extending over the combustion chamber, means in the compartment dividing the space above one portion of the combustion chamber from the space above another portion of said chamber including a partition, means providing for the circulation of a cooling medium through one of the aforesaid spaces and restricted openings through the partition permitting limited circulation of said cooling medium through the other of said spaces.

5. A cylinder head formed with a combustion chamber therein and having a compartment for

a cooling medium extending over the chamber, and means providing for the circulation of cooling medium over a portion of the chamber and for by-passing a limited quantity of the cooling medium over the remaining portions of the chamber including a partition predeterminedly located in the compartment and having a restricted aperture therethrough.

6. In an internal combustion engine having a cylinder and a valve gallery adjacent the cylinder, a cylinder head formed with a combustion chamber therein having a portion located above the valve gallery and having another portion located above the cylinder of the engine, a compartment in the head extending over both said portions and fashioned to receive a cooling medium, means for separating the space in the compartment above the first named portion of the combustion chamber from the space above the second mentioned portion thereof including a partition in the compartment having a restricted opening therethrough, and means for discharging cooling medium into the space above the portion of the combustion chamber extending over the valve gallery.

JAMES F. WHITE.