

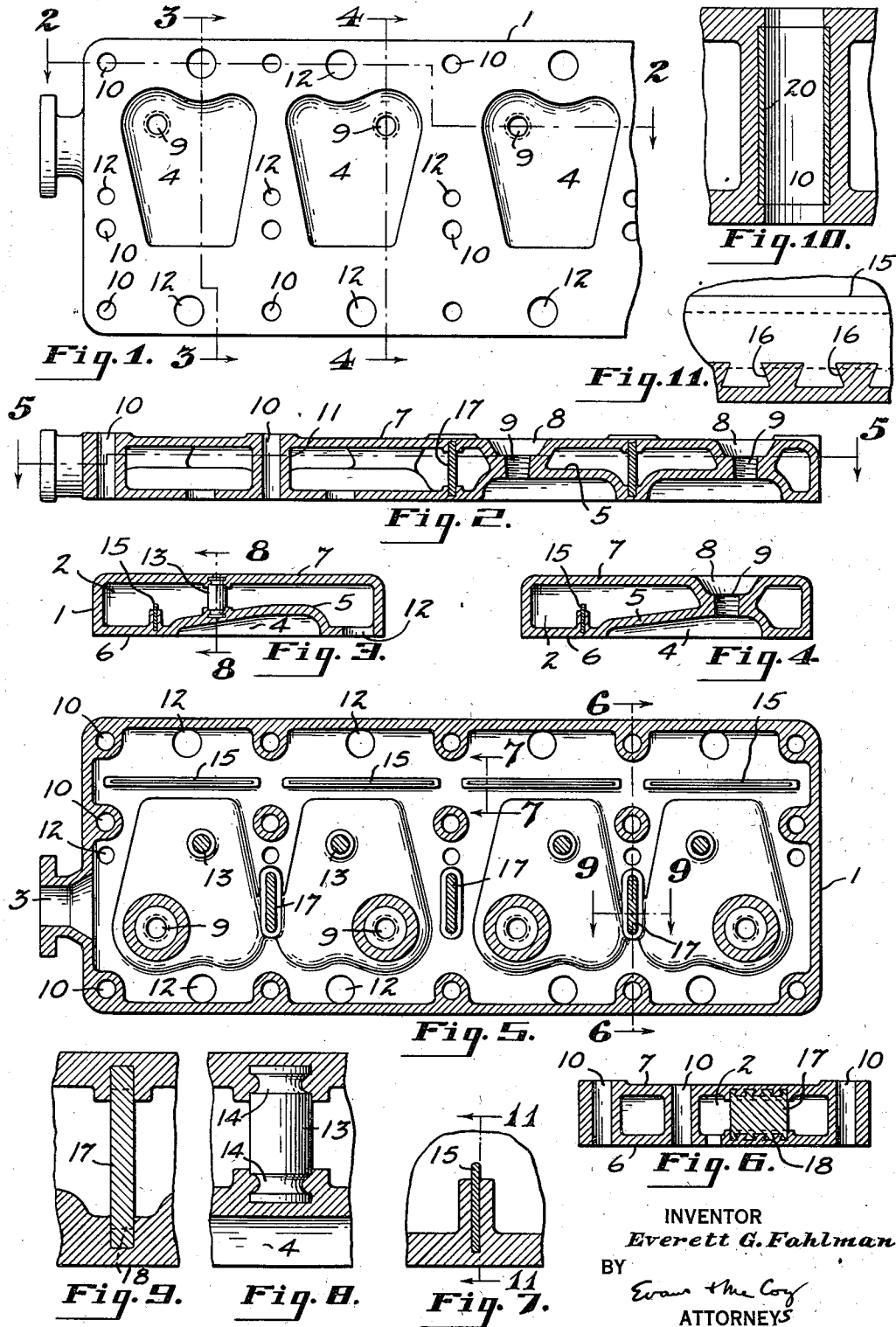
Sept. 3, 1935.

E. G. FAHLMAN

2,013,627

CYLINDER HEAD

Filed Feb. 14, 1933



INVENTOR
Everett G. Fahlman
BY
Evan & Mc Coy
ATTORNEYS

UNITED STATES PATENT OFFICE

2,013,627

CYLINDER HEAD

Everett G. Fahlman, Cleveland, Ohio, assignor to
The Permold Company, Cleveland, Ohio, a corporation of Ohio

Application February 14, 1933, Serial No. 656,695

4 Claims. (Cl. 123—173)

This invention relates to cylinder heads cast from aluminum, aluminum alloys, or other metals or alloys having high crystalline shrinkage and low melting point as compared to cast iron.

One of the objects of the present invention is to provide a new and improved means whereby articles of manufacture having internal webs, struts and the like may be efficiently cast from metals having high crystalline shrinkage and low melting point, as compared to cast iron.

Another object is to provide a chambered article of cast metal having high crystalline shrinkage or low melting point with internal reinforcing parts of metal having anchoring portions that are embedded in the metal of the article.

Another object is to provide a cylinder head of cast metal having high crystalline shrinkage and low melting point as compared to cast iron, with internal reinforcing portions positioned within the water chamber and having parts embedded during the casting operation within the metal of the head.

A further object is to provide a cast metal article of manufacture which requires the use of sand cores during the casting operation, in order to provide reinforcing flanges, webs, struts or the like, with means which, particularly in the case where metal having a high crystalline shrinkage is employed, insures the production of efficient and relatively strong reinforcing parts.

With the above and other objects in view, which will be apparent from the following detailed description, the present invention consists in certain features of construction and combinations of parts that will be readily apparent to those skilled in the art to which the invention appertains.

As an illustration of the application of the present invention to cast articles, I have selected for description a cylinder head for internal combustion engines, and in the drawing,

Figure 1 is a partial bottom plan view of a cylinder head casting showing the recessed portions which form the combustion chamber thereof, bolt openings and the ports for the cooling fluid;

Fig. 2 is a full longitudinal section taken approximately on the line 2—2 of Fig. 1, showing the internal structure of different portions of the cylinder head;

Fig. 3 is a section taken approximately on the line 3—3 of Fig. 1, showing a reinforcing strut extending between opposite walls of the chambered portion of the cylinder head;

Fig. 4 is a transverse section taken approximately on the line 4—4 of Fig. 1 to show the spark plug openings and to show a longitudinally extending reinforcing web embedded in one of the walls of the chambered portion of the cylinder head;

Fig. 5 is a section taken approximately on the line 5—5 of Fig. 2, showing the internal construction of the cylinder head in substantially a plan view;

Fig. 6 is an enlarged section taken approximately on the line 6—6 of Fig. 2, showing the relatively short reinforcing web extending transversely of the head and being embedded in opposed walls thereof;

Fig. 7 is an enlarged section taken approximately on the line 7—7 of Fig. 5 showing in greater detail one of the longitudinally extending reinforcing webs;

Fig. 8 is an enlarged section taken approximately on the line 8—8 of Fig. 3 showing in greater detail one of the reinforcing struts;

Fig. 9 is an enlarged section taken approximately on the line 9—9 of Fig. 5 showing an enlarged section of one of the transversely extending reinforcing webs.

Fig. 10 is an enlarged section taken through a cylinder head showing the application of the present invention to a cored bolt opening; and

Fig. 11 is a fragmentary section taken approximately on the line 11—11 of Fig. 7.

Referring to the accompanying drawing, in which like numerals refer to like parts throughout the several views, the cylinder head 1 which has been selected to illustrate the application of the present invention, is of the type having a chamber 2 for the reception and passage of a cooling fluid therethrough which is discharged through an outlet passage 3 located at any suitable point. The transverse wall 6 which engages with the engine cylinder block (not shown) is preferably provided with spaced recesses 4 which cooperate with the engine cylinder to provide the combustion chamber, although this wall may be of a flat plane surface, in which case the head merely closes in the cylinder and the combustion chambers are then provided solely within the ends of the cylinders. However, in the head here shown the portions 5 of the wall 6 which form the recesses 4 are illustrated as extending into the cooling chamber 2 beyond the transverse wall 6 in order to more clearly show the useful application of the present invention to an article of this character. The upper transverse wall 7, as shown in Figs. 2, 3, 4 and 6, is spaced from the

lower transverse wall 6 and at certain regions of the head is formed with depressions 8, the walls of which are joined integral with the portions 5 of the transverse wall 6 in order that threaded openings 9 extending into the recesses 4 may be provided for the reception of the spark plugs (not shown). A suitable number of bolt openings 10 are provided to extend completely through the head for the reception of the bolts which secure the head to the cylinder block, and the annular walls 11 which define the openings 10 are integral with the transverse lower and upper walls 6 and 7 respectively of the cylinder head, as shown in Fig. 2.

A suitable number of ports 12 are arranged through the lower transverse wall 6 at suitable locations to permit the flow of cooling fluid from the cylinder block into the cooling fluid chamber 3 of the cylinder head.

It has been found desirable to construct cylinder head castings of a metal such as aluminum or aluminum alloys or other metals having a high thermal conductivity in order to more rapidly conduct the heat away from the combustion chamber, but the commercial production of such castings has been difficult and uneconomical because of the difficulty in preventing shrinkage or sinks in the internal portions of the casting surrounded by sand cores used in sand or semi-permanent molds.

Because of the lower strength of many of the metals having a high thermal conductivity as compared to cast iron, it is necessary that when these metals are used in cylinder heads that the conventional cylinder head embodying the parts just described, be substantially reinforced at different regions in order that the head will withstand the compression and explosion forces. These reinforcements need to be in the form of ribs, webs or struts or other reinforcements arranged within the cooling fluid chamber in such a manner as not to block off the chamber from the flow of fluid therethrough, and these internal portions may extend from one or the other of the opposed walls of the head and may also extend between opposed walls. It has been found, however, that when such ribs, webs or struts comprise integral portions of the head and are cast in molds using sand cores, shrinkage draws and cracks frequently occur which detract from the strength of these portions. These disadvantageous results which have made it commercially impractical because of the high cost of casting, to produce cylinder heads and other chambered articles of metals having high thermal conductivity result largely from the fact that because of the high crystalline shrinkage and low melting point characteristics, as compared to cast iron, and because of the isolation of these internal portions from the main portions of the casting, the outer walls and main portions of the castings that in the case of semi-permanent molds are surrounded by metal, solidify much more rapidly than the metal of the interior strut and web portions surrounded by the sand cores, with the result that the metal forming such internal portions will, therefore, remain hot, and, upon solidification, shrink or crack.

In order to overcome these difficulties, it is proposed by the present invention to cast the cylinder head of aluminum or aluminum alloys or other suitable metals having a high thermal conductivity with separate ribs, webs or struts connecting the top and bottom portions of the casting or projecting from one of them toward

the other within the cooling fluid chamber. These webs, struts or ribs are in the form of inserts of aluminum, aluminum alloy, iron or other suitable metal, which are preferably provided with portions to anchor the same within the metal of the cylinder head casting. These internal reinforcing portions may be arranged in any desired manner so as to give the necessary strength to the cylinder head construction, and may also be utilized for directing the flow of cooling fluid in any desired direction.

I have shown in Figs. 3, 5 and 8, one embodiment of the invention in the form of a strut 13 which may be circular in cross section or any other suitable cross sectional shape and which extends between the recess portion 5 of the lower transverse wall 6, and the upper transverse wall 7, in order to reinforce the portion 5 which takes the majority of the explosion and compression forces, and in order to prevent excessive deflection of the same. The strut 13 is anchored in the metal of the cylinder head in any suitable manner and this may be provided for as shown in Fig. 8 by forming the strut 13 with any suitable means such as the annular grooves 14 at its opposite ends, into which the metal of the portions 5 and 7 may flow during the casting operation.

In Figs. 5, 7 and 11 I have shown another form of the application of the present invention, wherein a series of metal ribs 15 are arranged within the cooling fluid chamber 2 to extend upwardly from the lower transverse wall 6 of the cylinder head. These ribs 15, in order to permit a free flow of the cooling fluid within the cooling chamber 2, are preferably spaced an appreciable distance from each other. However, if desired they may be in the form of a single rib extending from end to end of the cooling fluid chamber. These ribs 15 may be of any suitable metal and any desired height according to the strength that is required in the lower transverse wall 6 of the head and are preferably formed with anchoring recesses such as the dovetailed recesses 16 so that when the metal of the lower transverse wall 6 is cast, it will securely anchor the ribs 15 in place. The metal of the wall 6 may extend a substantial distance up the sides of the rib 15 in order to further reinforce the head. Ribs of this character may, however, also be provided to extend downwardly from the upper transverse wall 7 and they may also be provided to extend transversely of the cooling fluid chamber or at an angle for directing the cooling fluid in any desired direction.

As a further application of the present invention, I have illustrated in Figs. 6 and 9 relatively short webs 17 that extend between the transverse walls 6 and 7 to additionally reinforce the head. These short webs 17, like the ribs 15, are provided with anchoring recesses, such as the dovetail recesses 16, which anchor the webs in place when the metal of the transverse walls 7 and 6 is cast about the same during the operation of forming the cylinder head. These webs, it will be noticed, are disposed between the wall portions 5 which provide the combustion chamber recesses 4 and also positioned substantially midway between pairs of bolt openings in order to reinforce the portions of the head where a considerable amount of force is exerted. These webs may also be arranged in any desired manner and in any desired direction, and the struts 13, previously described, may also be provided at any location within the cooling fluid chamber to extend be-

tween the upper and lower transverse walls 7 and 6 respectively.

All or any desired number of the ribs, webs or struts, as the case may be, may be in the form of a single insert in which portions are provided to extend between the opposed portions of the cylinder head or from one of the wall portions.

In the case of the cored bolt openings 10, it may be desirable to reinforce the surrounding wall 11 and in this connection, there is shown in Fig. 10 a tubular insert 20, about which the metal of the wall 11 is cast and which may be supported by the core during the casting operation.

It is, therefore, seen that the internal portions of the cylinder head, with the exception of the annular walls 11, which define the bolt openings 10, and the integral portions which define the spark plug openings 9, are substantially isolated from the outer wall portions and that these portions, including the webs, ribs, struts, and the like, are in the form of metal inserts which, if desired, may be the same kind of metal as the head, and do not depend upon the flow of metal during the casting operation for their formation and it is therefore obvious that they will provide suitable reinforcing elements.

This materially assists the formation of such castings in semi-permanent molds, as the external portions of each wall can be arranged to have contact with the metal of the mold, and also the bolt openings 10 and spark plug openings 9 may be formed by the use of suitable cores which preferably are of metal and which may also have reinforcing portions such as 20 illustrated in Fig. 10. Inasmuch as the necessary webs and struts, such as those indicated by numerals 13, 15 and 17, are inserts, and the metal of the head is actually cast around the same, the difficulties in obtaining suitable reinforcements within the head will not be encountered.

It is thus seen that by the use of the present invention that an article having internal portions such as reinforcing webs, struts and the like, which were heretofore formed during the casting operation by the metal of the article itself, can be efficiently produced of a metal having high thermal conductivity such as aluminum, and alloys, without liability of such internal parts being improperly formed inasmuch as such internal parts may in the use of the present invention be in the form of inserts which are anchored in place by the metal of the article during the casting operation, so that danger of shrinkage draws and cracks is eliminated. The metal inserts of course may be suitably positioned in the casting cavity of the mold by forming the sand cores about the same in such manner as to leave projecting portions about which the metal comprising the casting is cast.

While the present invention has been confined to a cylinder head application, it is to be understood that the cylinder head casting was merely selected for the purpose of illustration and that

the present invention is equally as applicable to any article in which heretofore the formation of the particular internal portion in question was obtained through the use of sand cores.

Although several embodiments of the invention have been herein shown and described it will be understood that numerous details of the construction shown may be altered or omitted without departing from the spirit of this invention as defined in the following claims.

What I claim is:

1. An engine cylinder head cast of a metal or alloy having high thermal conductivity as compared to cast iron, comprising spaced walls defining a cooling fluid chamber and internal reinforcing means within said chamber consisting of one or more ribs of a different metal, said ribs being of greater strength than the metal comprising said head, the metal of one of said walls being cast about portions of said ribs to securely anchor the same, said portions being completely surrounded by said metal so that no part of the ribs extends through the cast metal.

2. An engine cylinder head cast of a metal or alloy having high thermal conductivity as compared to cast iron, comprising spaced walls defining a cooling fluid chamber and internal reinforcing means within said chamber consisting of one or more struts of a different metal extending between opposed walls defining said chamber, said struts being of greater strength than the metal comprising said head, the metal of said walls being cast about the ends of said struts to securely anchor the same, said ends being completely surrounded by said metal so that no part of the struts extends through the cast metal.

3. In an aluminum cylinder head having spaced walls defining a cooling fluid chamber, internal reinforcing means of a different metal for said head positioned within said chamber and having anchoring portions, said reinforcing means being of greater strength than the metal comprising said head, the metal of at least one of said walls being intimately cast about said anchoring portions to securely anchor said metal reinforcing means, said anchoring portions being completely surrounded by said metal so that no part of the reinforcing means extends through the cast metal.

4. An article of manufacture of cast metal having high crystalline shrinkage as compared to cast iron, comprising a plurality of walls defining a substantially enclosed space, and separate reinforcing inserts of a different metal positioned within the space between said walls and having anchoring portions, said inserts being of greater strength than the metal comprising said article, the metal of at least one of said walls being intimately cast about said anchoring portions, said anchoring portions being completely surrounded by said metal so that no part of the reinforcing means extends through the cast metal.

EVERETT G. FAHLMAN.