Feb. 11, 1936. A. T. COLWELL 2,030,500

METHOD OF MAKING HOLLOW HEAD VALVES

Original Filed Feb. 19, 1931

Fig. 1

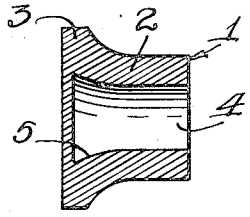


Fig. 2

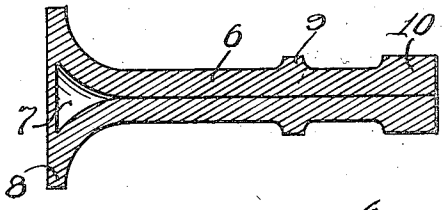


Fig. 3

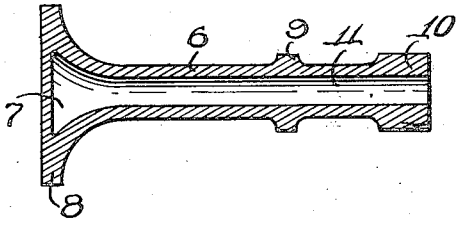


Fig. 4

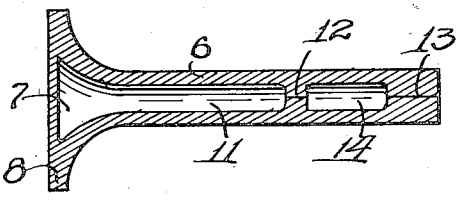


Fig. 5

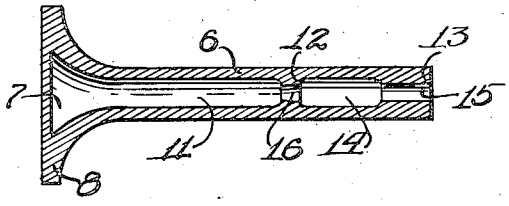
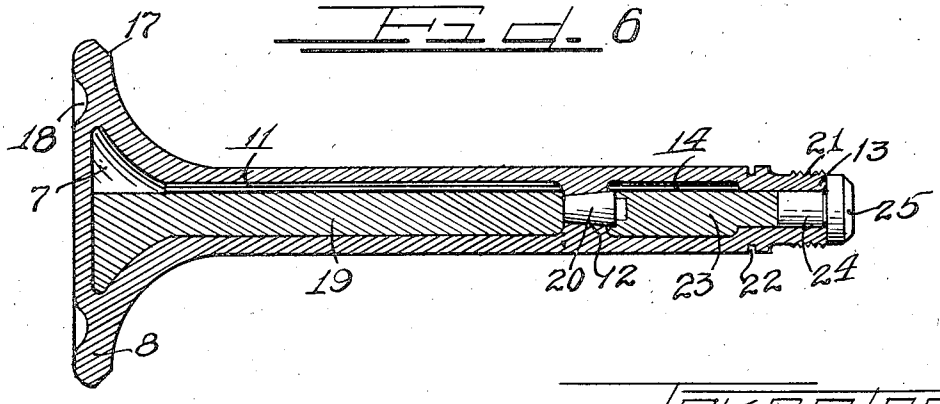


Fig. 6



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2,030,500

METHOD OF MAKING HOLLOW HEAD VALVES

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Original application February 19, 1931, Serial No. 516,882, now Patent No. 1,984,728, dated December 18, 1934. Divided and this application November 19, 1934, Serial No. 753,595

7 Claims. (Cl. 29—156.7)

This invention relates to improvements in the manufacture of hollow valves. More specifically, this invention is concerned with the production of hollow headed valves to be used in internal combustion engines, especially as exhaust valves.

This application is a division of my copending application, Serial No. 516,882, entitled "Method of making hollow head valves", filed February 19, 1931, issued as Patent No. 1,984,728 on Dec. 18, 1934.

Great difficulty has been encountered in the manufacture of valves for internal combustion engines that are capable of withstanding the high temperatures to which such a member is subjected, and at the same time maintaining the manufacturing cost on an economical basis. Many valves have been made of a special alloy capable of resisting heat, but the cost of this alloy is excessive. Valves having cooling mediums therein, such as sodium or salt, have also been produced, and have been found to be advantageous in conducting heat from those parts of the valve which contact the hot exhaust gases of the internal combustion engine to the cooler parts of the valve. Universal use of sodium or salt cooled valves has been prevented by manufacturing costs and also by a lack of uniformity and foolproofness in their manufacture.

It is an object of this invention to provide a process for producing hollow valves adapted to receive a cooling medium therein, which process is economical and foolproof.

It is a further object of this invention to provide improvements in methods of making hollow head valves whereby the valves may be formed from a cup-shaped blank which is produced in any manner by working the blank to collapse the shank portion thereof into a stem form, and drilling out the stem to provide a chamber in communication with the chamber in the head portion.

It is a specific object of this invention to provide a valve adapted to receive a cooling medium therein by a method which comprises forming a cup-shaped blank which has been produced in any manner to provide an article having a head and stem portion, then drilling the stem portion to provide an aperture therethrough which is adapted to receive a cooling medium therein, and finally reworking the end of the stem to seal the cooling medium in the valve.

Other and further objects of this invention will be apparent from the following description and the appended claims.

This invention (in a preferred form, is illustrated in the following specification and the accompanying drawing which form a part of this specification.

On the drawing:

Figure 1 is a central cross-sectional view of a blank used in making a valve according to the process of this invention.

Figure 2 is a central cross-sectional view showing the blank of Figure 1 worked to form a head and stem thereon.

Figure 3 is a central cross-sectional view of the worked blank shown in Figure 2, with a bore extending through the stem portion thereof.

Figure 4 is a central cross-sectional view showing the partly finished valve with a bridge formed in the stem portion thereof.

Figure 5 is a central cross-sectional view similar to Figure 4, showing the incompleted valve after the end has been reworked and apertures have been bored in the end and bridge members.

Figure 6 is a central cross-sectional view showing a completed valve prepared according to the process of this invention.

As shown on the drawing:

In Figure 1, the blank 1 having a cylindrical shank portion 2 and an enlarged end 3 thereon is provided with a bore 4 extending therethrough in close proximity to the head end 3. The bore is preferably enlarged at the head end as shown at 5. The blank 1 may be formed by any suitable method, as by forging or casting.

The shank portion 2 of the blank 1 is next worked to form an elongated stem portion 6. During the working operation, the walls of the shank 2 are collapsed together as shown in Figure 2 so that the stem portion 6 formed thereby is a solid wall. The stem forming operation is preferably accomplished by heating and forging the valve blank 1. The enlarged bore 5 of the blank 1 provides a hollow chamber 7 while the enlarged end 3 of the blank 1 forms the valve and 8. During the stem forming operation, thickened portions 9 and 10 are preferably formed on the stem in-

termediate the end of the stem and at the end of the stem as shown in Figure 2. The so formed blank is then bored with a suitable drill so as to form a passage 11 through the stem, which passage communicates with the chamber 7 in the head end of the blank.

The thickened portions 9 and 10 are next reheated and worked to form a bridge 12 from the thickened portion 9 and a closed end portion 13 from the thickened portion 10. That portion of the bore 11 between the bridge 12 and the end 13 provides a separate chamber 14 as shown in Figure 4.

As shown in Figure 5, the end 13 is drilled to provide an aperture 15 extending therethrough while the bridge 12 is drilled to provide a tapered bore 16 therethrough.

The head 8 of the valve blank is next provided with a seating surface 17 as shown in Figure 6, and an annular groove 18 extending around the top surface of the head. The finished valve head, however, can be formed without the groove 18 and with other forms of seating surfaces.

The chamber 11 of the valve stem and the chamber 7 of the valve head cooperating therewith are then partially filled with a cooling medium 19, and a plug 20 is inserted in the aperture of the bridge 12. The plug 20 is preferably force fitted into the bridge aperture to seal the compartments 7 and 11. The cooling medium may be any substance which has a heat conductivity greater than the heat conductivity of the metal of the valve. The cooling medium 19 is preferably in a liquid state at temperatures above about 200° F. It is desirable that the cooling medium wet the inside of the valve when heated to the liquefying temperature, so that a good thermal contact is obtained. Metallic sodium and metal salts, such as lithium nitrate and potassium nitrate have been used with great success.

The end 13 of the valve is next threaded as shown at 21 and a groove 22 is formed above the threaded portion 21. The groove 22 is adapted to receive a valve spring retainer lock. If desired, a cooling medium 23 may be inserted to partially fill the chamber 14. It should be understood, however, that this chamber may be left as a dead air space, or may be filled with some medium for carrying off heat, such as water. A plug 24 having a head 25 is inserted into the aperture 15 of the end 13 and is preferably welded therein so as to permanently close the chamber 14. The head 25 of the plug 24 is preferably formed of a hard steel alloy capable of resisting wear.

From the above description, it is evident that I have provided a method of producing valves having hollow head and stem portions, from a blank formed by any suitable method, such as casting or forging. The blank walls are collapsed by a working operation to form a solid stem portion which is subsequently drilled to provide a chamber extending through the stem and in communication with the chamber in the head. The method of this invention is simple, expedient, and economical. It is also adapted for mass production with standard equipment.

I am aware that numerous details of the process may be varied through a wide range without departing from the principles of this invention, and I, therefore, do not purpose limiting the patent granted hereon otherwise than necessitated by the prior art.

I claim as my invention:

1. The method of making a valve which comprises forming a cup-shaped blank with an enlarged bottom, the recess in the cup-shaped blank being also enlarged at the bottom, forging said cup-shaped blank so as to form a head with a cavity therein and a solid stem portion extending therefrom and so as to leave a thickened portion adjacent the end and intermediate the head and end of the stem, drilling out said stem, reworking the stem so as to form partitions from the thickened portions at the end and intermediate the end and head of the valve, boring apertures through said partitions, introducing a fusible cooling medium into the valve, and plugging up the apertures in said partitions.

2. The method of making a valve which comprises forming a cup-shaped blank, working the blank to form a head with a cavity therein and a solid stem portion extending therefrom, drilling out said stem portion to provide a chamber therein in communication with the cavity in the head, and closing the end of the stem.

3. The method of making a valve which comprises forming a cup-shaped blank having shank walls defining a cylindrical chamber and an enlarged bottom defining an enlarged recess in communication with said chamber, collapsing the shank walls to confine a cavity in the bottom of the blank and elongating said walls to provide a solid stem portion, drilling out said stem portion to provide a chamber therein in communication with the cavity in the head, and sealing the end of the stem.

4. The process of making a hollow head valve which comprises forming a cup-shaped blank with an enlarged bottom and having an enlarged recess in the bottom, working the blank to form a head with a cavity therein and a solid stem portion extending therefrom, drilling out said stem portion to provide a chamber therein in communication with the cavity in the head, and closing the end of the stem to form a compartment adapted to receive a cooling medium therein.

5. The process of making a hollow head and stem valve which comprises forming a metal blank with cylindrical shank walls defining a cylindrical aperture, an enlarged end on said blank having an enlarged recess therein, collapsing the shank walls together to confine a cavity in the enlarged head portion, working the blank to provide an elongated stem thereon, drilling out said stem to provide a chamber therein in communication with the cavity in the end portion thereof, and closing the end of the stem to provide a compartment adapted to receive a cooling medium therein.

6. The process of making a valve which comprises forming a cup-shaped blank with an enlarged bottom, the recess in the cup-shaped blank being also enlarged at the bottom, working the walls of the blank to form a solid stem portion thereon with thickened metallic portions adjacent the end and intermediate the head and end of the stem, drilling out the stem, reworking the stem so as to form partitions from the thickened metallic portions at the end and intermediate the end and head of the valve, boring apertures through said partitions, introducing a fusible cooling medium into the chamber formed between the head and partition intermediate the ends of the valve stem, plugging the aperture in said partition, and sealing the end of the valve stem.

7. The process of making a filled valve which

comprises forming a cup-shaped blank having an enlarged end and an enlarged recess in said end, collapsing the walls of said blank and working said collapsed walls to provide an elongated solid stem portion with thickened metal portions intermediate the ends of the stem and adjacent the end of the stem, boring out said stem to provide an aperture extending therethrough, heating said thickened portions of the stem and working the heated portions to provide partitions in the stem, providing apertures in said partitions, introducing a fusible cooling medium into the compartment formed in the valve stem, and plugging the partitions to seal the cooling medium therein.

ARCHIE T. COLWELL.