

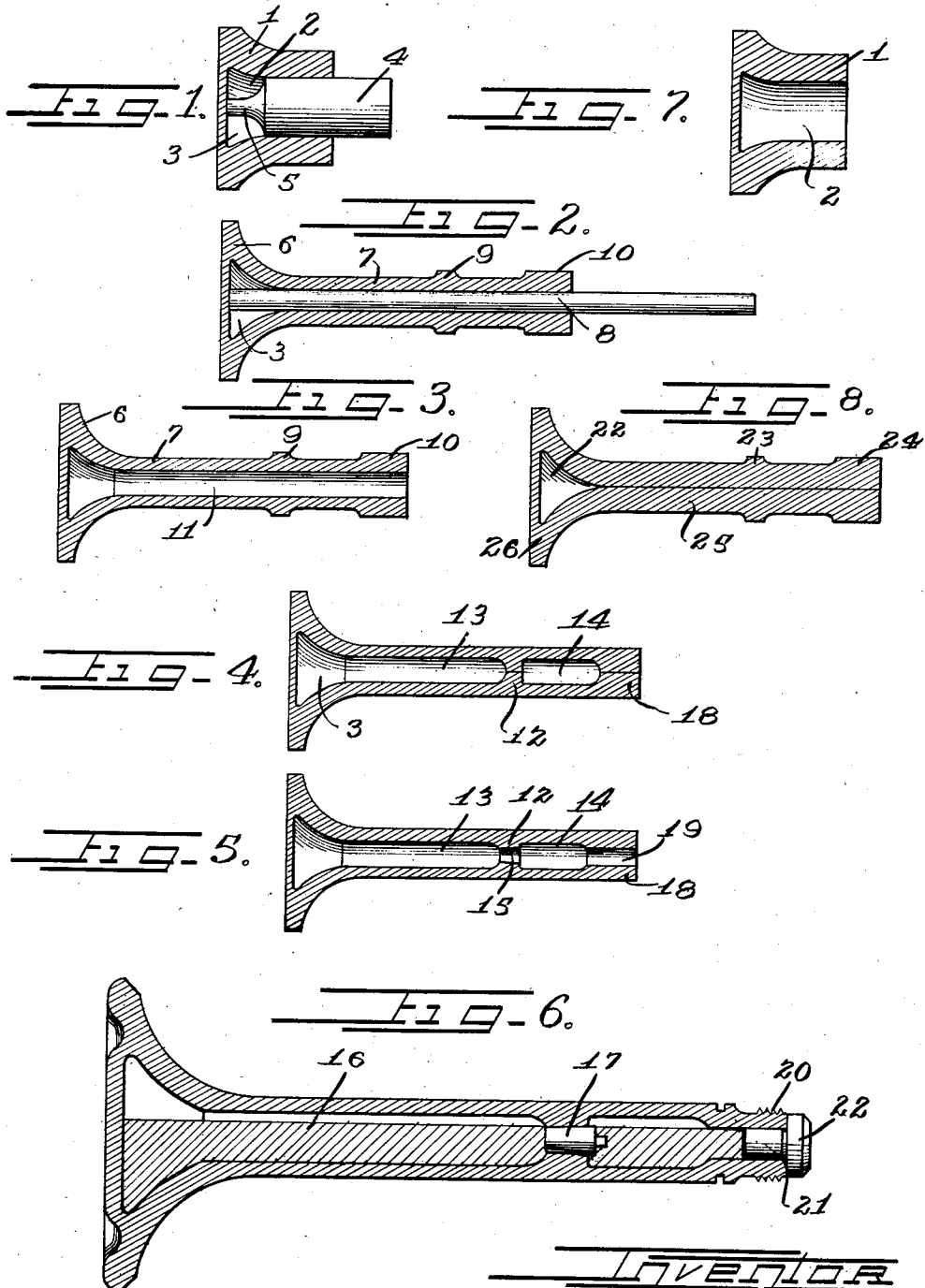
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METHOD OF MAKING HOLLOW HEAD VALVES

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METHOD OF MAKING HOLLOW HEAD VALVES

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My invention relates to improvements in valves and the method of making the same. My invention is particularly concerned with valves intended to be used in internal combustion engines and especially exhaust poppet valves for internal combustion engines.

In the design and manufacture of exhaust valves for internal combustion engines, great difficulty has been experienced in manufacturing a valve which is capable of withstanding the high temperatures to which such a member is subjected and at the same time in producing such valves at a cost commensurate with the cost of related parts in an automotive engine. Many valves have been made of a special alloy to resist heat, but the cost is excessive. Also, many valves having special cooling mediums have been produced. Sodium or salt cooled valves may be classed in this latter type. The use of sodium cooled valves has been found very advantageous in conducting the heat from the parts of the valve which come in contact with the hot exhaust gases to the cooler parts of the valve. The universal use of sodium or salt cooled valves has been prevented by manufacturing costs and also by a lack of uniformity and fool-proofness in their manufacture.

It is an object of the present invention to provide a valve of the sodium or salt cooled type which is capable of being manufactured at a reasonable cost and which will give long service under the most severe operating conditions.

It is a further object of the present invention to provide a valve having two chambers separated by a bridge in which chambers sodium or other cooling medium may be placed.

It is still further an object of the present invention to produce a valve of the type described by a method which is inexpensive, expedient and capable of mass production.

It is a particular object of this invention to provide a valve of the sodium cooled type by a method which consists essentially in forging a blank to form an article having a head and stem, then boring the same, filling it with the cooling medium and finally reworking the end of the stem to seal the medium in place.

It is still further a particular object of this invention to produce a valve of the type described by a method which consists in forging a blank which contains an insert of a soft metal so that the metal will be drawn out with the blank and later boring through the soft metal to form a cavity in the stem for the reception of the cooling medium.

Other and further objects of this invention will

be apparent from the following description and appended claims.

My invention (in a preferred form) is illustrated in this specification and the accompanying drawing which forms a part thereof.

On the drawing:

Figure 1 is a sectional view of a metal forging having a recess and an insert therein.

Figure 2 is a view of the blank of Figure 1 after it has been drawn out.

Figure 3 is a view similar to Figure 2 showing the bore therein left by drilling out the insert.

Figure 4 is a sectional view showing the partly finished valve with a bridge formed therein.

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

Figure 6 is a sectional view showing the completed valve.

Figure 7 is a sectional view of a forged blank used in making the valve by an alternate method.

Figure 8 is a view showing the blank of Figure 7 forged to form a head and stem thereon.

As shown on the drawing:

In carrying out this invention, a forging or blank of the shape shown in Figure 1 is drilled or reamed as shown at 2. In drilling the bore 2 an expanding reamer is used which produces the enlarged recess as shown at 3. While it is preferable to form the blank 1 and then drill the recess 2, it is to be understood that the blank may be cast and then drilled or reamed to the shape shown in Figure 1. In either case, a cup shaped blank having an enlarged bottom portion is formed.

An insert 4 of copper or other soft metal having a reduced end 5 is forced into the recess in such a manner that the tip extends toward the bottom of the blank.

The blank is then forged with the insert 4 in place to form a member having a head 6 and stem 7 as shown in Figure 2. In this operation the metal filler 4 is drawn out to form a rod as shown at 8, and the enlarged recess is maintained. The walls of the stem are thickened intermediate their ends at 9 and also at the end 10 for a purpose hereinafter to appear.

The copper rod is then drilled out so as to leave a recess 11 of preferably cylindrical shape in the valve stem. This recess extends from the end of the valve stem to the recess 3 in the head portion.

The stem portion is reheated to a forging temperature and the thickened portions 9 of the wall

of the stem are worked so as to form a bridge 12 in the bore 11 dividing it into chambers 13 and 14. When this has been done the thickened portion 10 is worked to form an end member or second bridge 18.

By the use of a suitable drill, aperture 19 of cylindrical shape is drilled in the bridge 18. The frusto-conical aperture 15 in the bridge 12 is preferably drilled in the same operation.

The chamber 13 is partially filled with the cooling medium and a plug 17 is inserted in the opening 15 to close the chamber 13. The cooling medium may be any substance which has a heat conductivity much greater than the heat conductivity of the metal of the valve and which will be in a liquid state at about 200° F. Another essential quality of such cooling medium is that it must wet the inside of the valve when heated to a liquefying temperature. For this purpose metallic sodium and salts such as lithium nitrate and potassium nitrate, have been found most useful, the former being the preferred substance.

The plug 17 is preferably force-fitted into the aperture 15. However, any suitable method may be used to secure the plug 17 such as using a screw threaded or welded joint.

The end is then externally threaded as shown at 20. If desired, sodium may then be inserted in the chamber 14. It is to be understood that this chamber may be left as a dead air space or may be utilized for some medium for carrying off heat such as water. A plug 21 having a head 22 is then inserted and preferably welded in the aperture 18 so as to permanently close the chamber 14. The head 22 of the plug 21 is formed of a very hard steel alloy so as to resist wear, as this part is fitted into the cup shaped seat on the reciprocating rod.

The valve is then reheated and the head worked into the proper shape. It is to be understood that the reshaping of the head may take place simultaneously with one of the other operations such as the forming of the second bridge 18.

It is to be understood that the method of forming the chambers 13 and 14 and the bridges 12 and 18 described above is the preferred one. The bridge 12 and aperture 15 may be formed before the metal 10 has been worked. In this case the chamber 13 is partially filled with the cooling medium and the plug 17 inserted before the stem is again reheated for working the thickened wall 10 to form the bridge 18.

Figures 7 and 8 illustrate two steps of an alternate method of constructing the valve. In this case the forging or casting is drilled as before but the copper plug 4 is not inserted in the cavity 2 formed therein. The casting is heated and forged to the shape shown in Figure 8, this action leaving a chamber 22 in the head thereof. The stem 25 thus formed has thickened portions 23 and 24 similar in all respects to the thickened portions 9 and 10 in the other construction. The stem 25 is then bored with a suitable drill so as to leave a passage therethrough, similar to the passage 11, to the chamber 22. The thickened portions 23 and 24 are then reheated and worked to form bridges similar to the bridges 12 and 18 in the preceding construction. The valve is then filled with the cooling medium and completed by steps similar in all respects to those described with reference to the first described mode of construction.

It will be seen that I have provided a valve which has a cooling medium within its stem in a chamber, such chamber being so large as to ena-

ble the cooling medium to come in contact with the overheated parts of the valve without the necessity of relying upon the conductance of the heat through a considerable part of the outer metal.

It will also be seen that I have provided a method of making such a valve which is simple, expedient and economical in large production.

Many changes may be made in the proportion and arrangement of parts and also the arrangement of the steps of the method and I do not wish to be limited otherwise than is necessary by the prior art and the scope of the present claims.

I claim as my invention:

1. The method of making a valve which comprises forming a cup shaped blank with an enlarged bottom portion, the recess in the cup shaped blank also being large at the bottom portion, inserting a plug of soft metal into the recess in the cup, forging the blank to form a head and stem thereon, thereby forming the metal plug into a rod, drilling out the metal rod to leave a bore in the stem, reworking the metal of the stem to form a partition therein, boring an aperture in the partition and filling the stem beyond the partition with a fusible cooling medium, plugging the stem and reshaping the valve.

2. 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, filling the recess with a copper insert, forging the blank so as to form a head and stem thereon, and so as to leave a thickened portion adjacent the end and intermediate the head and end of the stem, and also to form the copper insert into a rod, drilling out the copper rod, reworking the stem so as to form partitions at the end and intermediate the end and head of the valve stem, boring apertures through the partitions, filling the valve with a fusible cooling medium and plugging up the apertures in the partitions.

3. 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, placing a soft metal insert in the recess, forging the blank and insert so as to form a head and stem on the blank, a thickened portion at the end of the stem away from the head of the blank, and another thickened portion on the stem intermediate said end and the head, and also to form the soft metal insert into a rod, drilling out the rod, reworking the thickened portions of the stem to form partitions inside the stem, boring apertures through the partitions, filling the valve with a fusible cooling medium, and plugging up the apertures in the partitions.

4. 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, placing an insert in said recess, forging the blank and insert so as to form a head and stem on the blank, a thickened portion at the end of the stem away from the head of the blank and another thickened portion on the stem intermediate said end and head, removing said insert to provide a cavity extending along said stem into said head, reworking the thickened portions of the stem to form partitions inside the stem, boring apertures through said partitions, introducing a fusible cooling medium into the cavity of said stem and head and plugging up said apertures in said partitions.

5. The method of making a valve which comprises forming a cup shaped blank having an enlarged recess at the bottom thereof, inserting in the blank a plug having a reduced end portion extending into the enlarged recess and a shank portion snugly engaging the side walls of the recess, working the blank to form a head and stem thereon thereby forming the plug into a rod having substantially the same diameter as the reduced end portion of the original plug, removing the rod and reworking the stem to form a valve with a hollow head and stem adapted to receive a cooling medium therein.
6. The method of making a valve which comprises forming a cup shaped blank with cylindrical inner walls and an enlarged recess at the bottom thereof, inserting in the blank a metal plug having a reduced end portion extending into the enlarged recess and a shank portion engaging the cylindrical walls of the blank, working the blank to form a head and stem thereon thereby forming the plug into a rod having the same diameter throughout as the reduced end portion of the original plug, drilling out said rod, reworking the stem to form a bridge portion intermediate the ends thereof and an end closure, forming apertures through said bridge and closure, filling the stem between the head and bridge partition with a fusible cooling medium and plugging the apertures.

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