April 22, 1941. A. T. COLWELL 2,239,381

MOLD FOR MAKING HOLLOW CAST METAL VALVES

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Fig. 1.

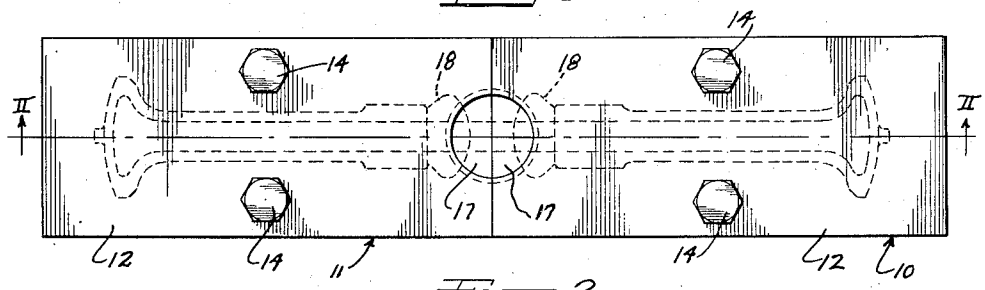
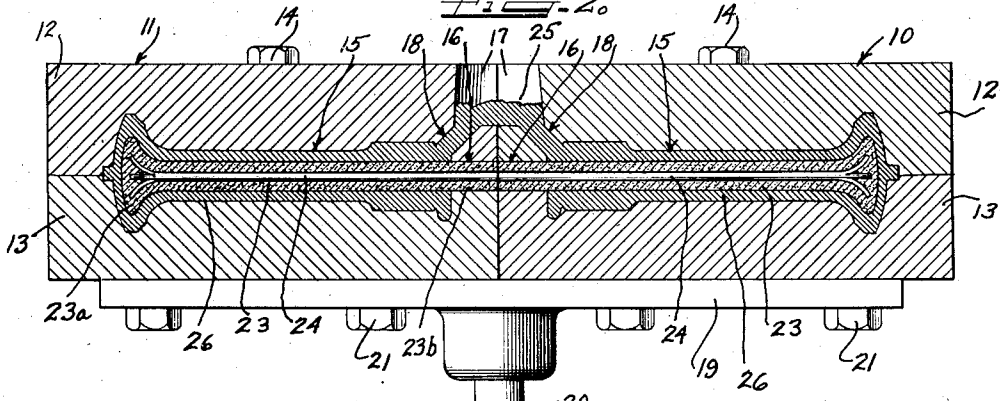


Fig. 2.



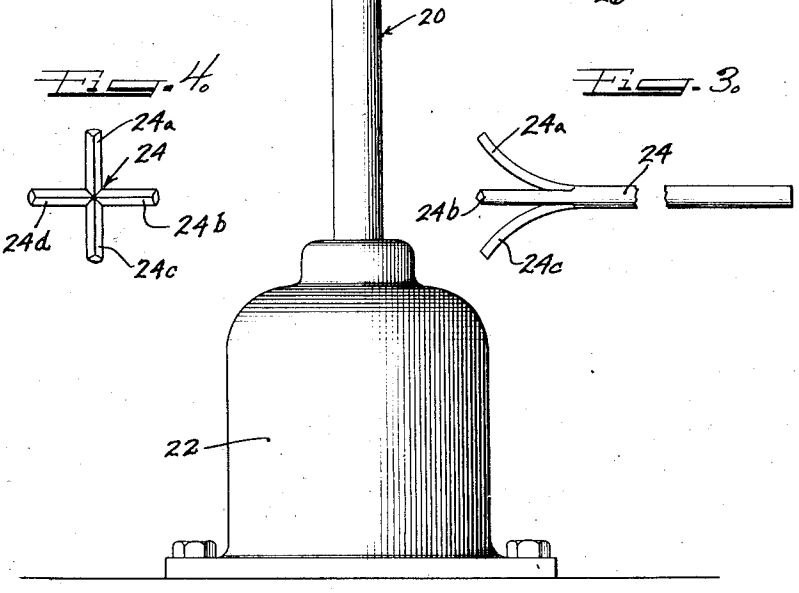


Fig. 4.

Fig. 3.

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MOLD FOR MAKING HOLLOW CAST METAL VALVES

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Fig. 5.

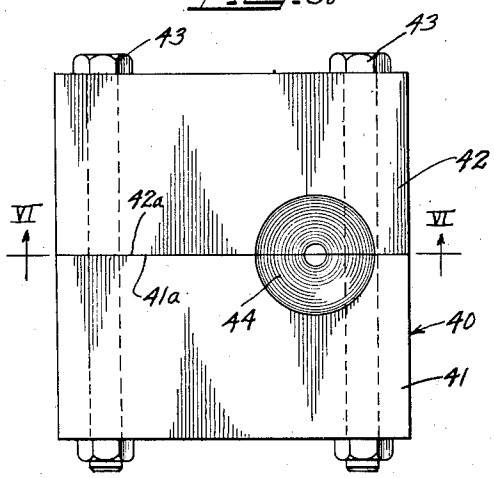


Fig. 6.

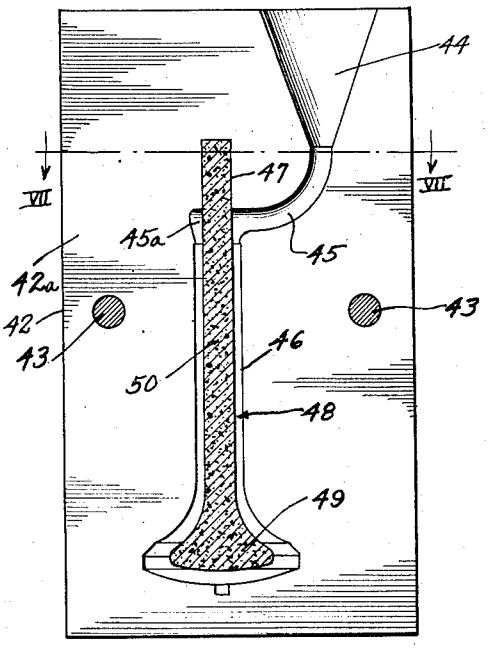
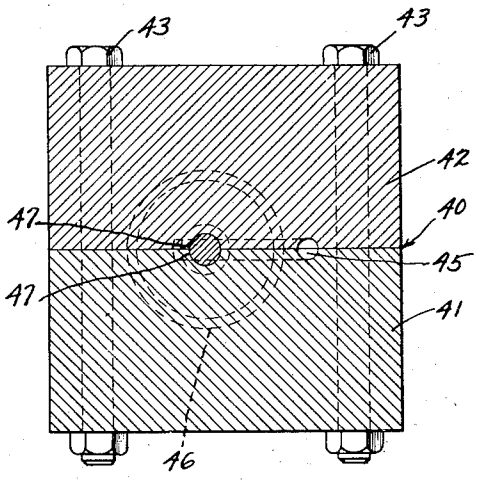


Fig. 7.



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MOLD FOR MAKING HOLLOW CAST METAL VALVES

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Fig. 8.

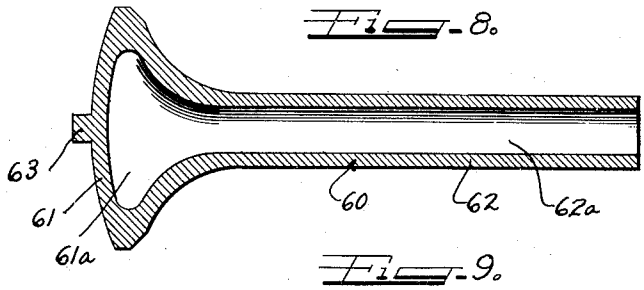


Fig. 9.

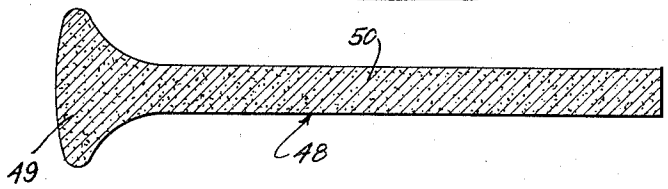


Fig. 10.

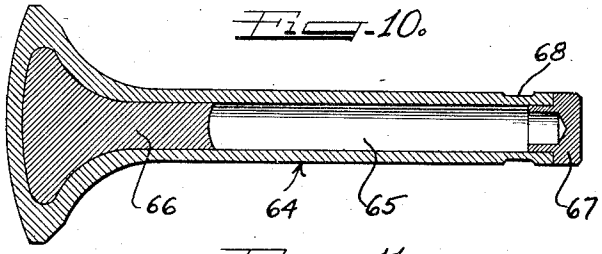


Fig. 11.

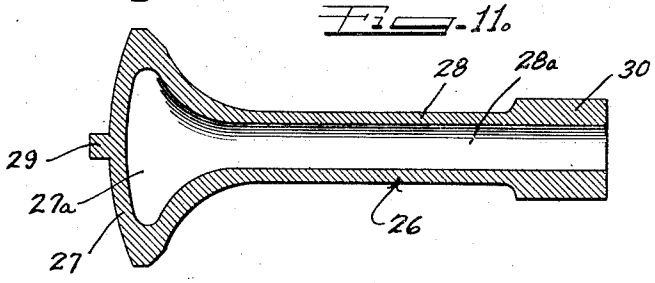
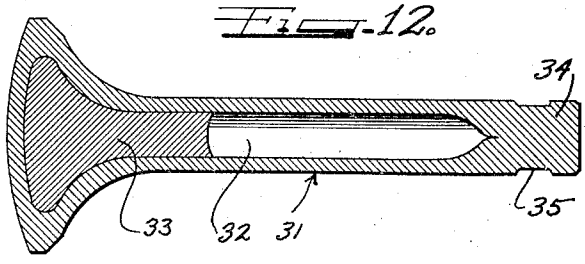


Fig. 12.



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UNITED STATES PATENT OFFICE

2,239,381

MOLD FOR MAKING HOLLOW CAST METAL VALVES

Archie T. Colwell, Cleveland, Ohio, assignor to Thompson Products Incorporated, Cleveland, Ohio, a corporation of Ohio

Application March 16, 1939, Serial No. 262,091

2 Claims. (Cl. 22—152)

This invention relates to hollow head poppet valves for internal combustion engines and to a method of making the same.

More specifically the invention relates to the casting of poppet valves having hollow head and stem portions in a manner avoiding the necessity for appreciable machining or grinding of the casting.

Hollow poppet valves are usually prepared by metal working operations such as forging. The forging operations are expensive and many desirable metals for poppet valves do not lend themselves to the forging processes because they are very difficult to forge and, in many cases, cannot be forged at all.

According to this invention, however, hollow poppet valves are formed by casting molten metals to the desired external shape and by forming the cavity in the head and/or stem at the same time with suitable cores. The castings of this invention so closely approximate the desired final valve shape that very little machining or grinding is necessary.

Since hollow poppet valves must have uniform walls, it is necessary that the core member for the valve castings be suspended in the valve cavity of a mold so as to be equally spaced from the cavity walls at each portion of the cavity. Thus while the valve head may have walls of different thickness than the valve stem, one side of the valve head should not be thicker than the other side, nor should one side of the valve stem be thicker than the other side.

According to this invention, the core member is provided with a head portion and a stem portion that is longer than the stem of the cast valve. The mold is formed with a stem end receiving cavity for the core in axial alignment with the valve cavity in the mold. This stem end receiving cavity snugly seats the end portion of the core stem projecting beyond the valve cavity of the mold and suspends the core in proper spaced relation from the walls defining the mold cavity.

Sand or metal molds can be used. The molds can be stationary or mounted for centrifugal rotation.

The core is made of the usual core material such as core sand and binder molded to shape and baked. A feature of the invention includes reinforcing the core with a metal rod having a pronged end. The rod extends axially through the core and the pronged end thereof spreads out into the core head for holding the core material together. The pronged end of the rod is resilient and readily withdrawn through the valve stem.

It is, then, an object of the invention to make hollow poppet valves by casting metal to the desired external shape and by simultaneously forming the cavity in the head and stem with suitable coring means.

Another object of the invention is to provide cast hollow poppet valves.

A further object of the invention is to suspend cores for hollow poppet valves in valve-forming molds in such a manner as to insure the production of uniform hollow casting.

Another object of the invention is to provide casting molds for poppet valves having seats for core ends to suspend the main body of the core in uniform spaced relation from the walls defining the mold cavity.

Other and further objects of the invention will become apparent to those skilled in the art from the following detailed description of the annexed sheets of drawings, which disclose preferred embodiments of the invention.

The invention will hereinafter be described as involving the use of permanent metal molds, but it should be understood that sand molds are operative.

On the drawings:

Figure 1 is a top plan view of a pair of permanent molds mounted in axial alignment for centrifugal rotation.

Figure 2 is a vertical cross-sectional view, with parts in elevation, taken along the line II—II of Figure 1.

Figure 3 is an enlarged broken side elevational view of a core rod shown in Figure 2.

Figure 4 is an end elevational view of the rod shown in Figure 3.

Figure 5 is a top plan view of another form of mold suitable for preparation of cast hollow valves according to this invention.

Figure 6 is a vertical cross-sectional view taken along the line VI—VI of Figure 5.

Figure 7 is a horizontal cross-sectional view taken along the line VII—VII of Figure 6.

Figure 8 is a longitudinal cross-sectional view of a valve casting formed in the mold shown in Figures 5 to 7 inclusive.

Figure 9 is a longitudinal cross-sectional view of a core used in the mold shown in Figures 5 to 7 inclusive.

Figure 10 is a longitudinal cross section of a finished valve made from the casting shown in Figure 8.

Figure 11 is a longitudinal cross-sectional view

of a valve casting formed in the mold shown in Figures 1 and 2.

Figure 12 is a longitudinal cross-sectional view of a finish valve formed from the casting shown in Figure 11.

As shown on the drawings:

In Figures 1 and 2 the reference numerals 10 and 11 designate generally complementary molds each composed of cope and drag sections 12 and 13 respectively. The copes and drags of each mold 10 and 11 are held together by means of bolts such as 14. The molds 10 and 11 are of the permanent or metal type.

Each mold 10 and 11 defines a valve shaped cavity 15 therein and axially aligned core-receiving cavities 16.

Each cope 12 of the molds 10 and 11 has a complementary semi-cylindrical pour hole 17 extending downwardly from the top thereof at the inner ends of the molds. The pour hole sections communicate at their bottoms with gate holes 18 joining the pour hole with the mold cavities 15.

As best shown in Figure 2, the molds 10 and 11 are bolted in axial alignment on the platform 19 of a centrifugal device 20 by means of bolts such as 21. The platform 19 can be rotated at a desired speed by the motor 22 of the centrifugal device.

Core members 23 are mounted in the molds 10 and 11 in spaced relation from the walls of the mold cavity 15. These cores 23 have mushroom-shaped head portions 23*a* and elongated stem portions extending from the head 23*a* axially through the mold cavities 15. The ends 23*b* of the stems are snugly seated in the cavities 16 of the molds. In this manner the cores 23 are suspended in the mold cavities.

Reinforcing rods 24 can be inserted into the centers of the cores when the cores are prepared for reinforcing the cores. The rods 24 are preferably cross-split at one end thereof and four prongs 24*a*, 24*b*, 24*c*, and 24*d* are bent outwardly as best shown in Figures 3 and 4. The pronged ends of the rods project into the heads 23*a* of the cores to hold the core material together even under the centrifugal force of the whirling operation.

In assembling the mold for the casting operation the copes 12 are removed and the mold cavities of both the copes and drags are coated with graphite. The cores 23 have their ends 23*b* seated in the cavities 16 of the drags 13. The copes 12 are then bolted in position on the drags 13 and the complementary cavities 16 of the copes clamp the cores in position to hold the same in spaced relation from the valve-shaped mold cavities 15. The pair of molds 10 and 11 are then mounted on the platform 19 of the whirling device 20 and molten metal 25 is poured into the pour hole 17 from which it flows through the gate holes 18 into the mold cavities. The platform 19 is rotated by the motor 22 thus forcing the metal 25 outwardly to fill up the entire mold cavities 15. The centrifugal action drives out all of the air and gas in the cavities and the molds are rotated until the metal solidifies. The motor 22 is then stopped and the molds are opened. The gates are cut or broken off and two valve castings 26 are removed. The valve castings 26 have the cores 23 therein. These cores are readily removed since the cores are frangible and the pronged ends of the reinforcing rods will collapse as the rods are retracted through the stems of the castings 26.

As best shown in Figure 11, the casting 26 has a head portion 27 provided with a mushroom-shaped cavity 27*a* and a stem portion 28 extending from the head portion 27 and provided with a cylindrical cavity 28*a* merging with the cavity 27*a*.

A centering boss 29 is integrally cast on the center of the head 27. The boss 29 can serve as a center point for a lathe pivot.

The end of the stem 28 has a thickened portion 30 thereon.

The casting 26 is made into the finished valve 31 shown in Figure 12. The valve 31 has a sealed cavity 32 in the head and stem thereof. The cavity 32 is partially filled with a cooling material such as metallic sodium 33. The thickened portion 30 of the casting 26 is worked down to form the solid end 34 of the stem of the valve 31. This solid portion 34 seals the cavity 32 and preferably has an annular recess 35 cut in the side thereof for receiving a retainer collar (not shown). The centering lug 29 is ground or cut off of the casting to produce a smooth head for the valve 31.

The cavities 27*a* and 28*a* of the casting 26 need not be ground to form the cavity 32 of the finished valve but it is advisable to polish the cavity 28*a* in the stem 28 of the casting 26 with emery cloth and to sandblast the cavity 27*a* in the head 27 of the casting 26.

As shown in Figures 5 to 7, a stationary vertical mold 40 can be used to form cast valves according to this invention in place of the rotary horizontal molds shown in Figures 1 and 2.

The mold 40 is composed of two complementary metal halves 41 and 42 secured together by means of dowel pins or bolts 43. Each mold section 41 and 42 has complementary cavities in their inner faces defining together a conical pour hole 44 in the top of the mold, a gate hole 45 joining the bottom of the pour hole 44 with a poppet valve shaped molding cavity 46, and a core suspending hole 47 axially aligned with the cavity 46 but extending above the gate 45.

A core member 48 having a mushroom-shaped head portion 49 and an elongated stem portion 50 extending from the head portion 49 is provided for forming the cavity in the cast valve.

As shown in Figure 6 the stem 50 of the core 48 is longer than the valve-forming cavity 46 and is of the same diameter as the hole 47. The end of the stem is thus snugly received in the hole 47 so that the cavity-forming portion of the core is suspended in spaced relation from the walls of the mold-forming cavity 46.

As shown in Figures 6 and 9, the core 48 is premolded in the shape of the desired cavity in the cast valve and need not be provided with a reinforcing rod. The core can be composed of the usual core sand and binder and is baked to form a hard, cohesive mass.

When the mold sections 41 and 42 are clamped together by means of the bolts or dowel pins 43, the end of the stem 50 of the core will be securely clamped in position in the hole 47 provided in the mold. This will automatically suspend the main body of the core in the proper spaced relation from the walls defining the valve cavity 46. As shown in Figure 6, the gate hole 45 has a portion 45*a* extending around the projecting stem 50 of the core 48 so as to freely join the cavity 46 with the pour hole 44.

Molten metal is introduced into the pour hole 44 and flows downwardly by gravity to fill the entire cavity 46. The mating faces 41*a* and 42*a* of the mold sections 41 and 42 are purposely

left in a rough condition so that air can escape along the joint between the mold sections as the molten metal is poured into the mold cavity. The molten metal fills the entire cavity around the core 48 to provide a valve casting 60 (Figure 8). The casing 60 has a mushroom-shaped head portion 61 with a cavity 61a therein and an elongated cylindrical stem portion 62 extending axially from the head portion and provided with a cylindrical cavity 62a merging with the head cavity 61a. The head 61 has a centering lug 63 on the center thereof.

The mold 40 is preferably coated with graphite before the core and molten metal are introduced therein. The core is readily removed from the resulting casting 60 since it is composed of sand or other frangible material.

The casting 60 then can be ground to remove the centering lug 63 and other casting irregularities to produce a finished poppet valve 64 as shown in Figure 10. The valve 64 has a cavity 65 in the head and stem portion thereof. The cavity 65 is partially filled with a cooling material such as metallic sodium 66 and the open end of the stem is closed by a cap 67 welded, brazed, or force-fitted into the stem end.

The stem can be provided with an annular groove or recess 68 in the end portion thereof for receiving a retainer collar (not shown).

The valve 64 can be completely formed from the casting 60 without metal-working operations, since all of the finishing can be done by grinding. This makes possible the use of non-machinable alloys for producing valves according to this invention.

Suitable metals for forming the valve castings of this invention are: nickel, chromium, and iron alloys such as Nichrome steels; nickel, molybdenum and iron alloys such as Hastelloy steels; non-ferrous nickel-chromium alloys such as Brightray and cobalt, chromium and tungsten alloys such as Stellite. It should be understood, of course, that the invention is not limited to the use of such alloys but a number of these very hard alloys do not lend themselves to forging and at the same time are highly desirable metals for poppet valves. This invention now makes possible the use of these non-forgeable and even non-machinable alloys.

From the above descriptions it should be understood that permanent molds or sand molds are provided with poppet valve-shaped molding cavities and core stem receiving cavities spaced from the molding cavities to suspend the main body of the core in proper spaced relation from the walls of the mold cavities. The core stem receiving cavities, provided for suspending the cores, are axially aligned with the mold cavities and are of sufficient length to receive an appreciable portion of the core stem so that a mere seating of the core stem in the cavity will automatically align the body of the core with the mold forming cavity.

It will, of course, be understood that various details may be varied through a wide range without departing from the principles of this invention and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

I claim as my invention:

1. A mold for forming cast hollow poppet valves which comprises complementary mold sections defining together a molding cavity having an enlarged head portion and a reduced stem portion, a core suspension cavity spaced longitudinally from the mold cavity adapted to receive the end of a core member therein for suspending the main body of the core in fully spaced relation from the walls of the mold cavity, and a gate cavity between the mold cavity and suspension cavity whereby the gate and core are readily removable from the casting formed in the mold.

2. A mold for the simultaneous casting of a plurality of hollow poppet valves which comprises complementary mold sections defining an open-ended core suspension cavity adapted to snugly receive the stem ends of poppet valve shaped cores to firmly hold the same in cantilever fashion, said mold sections also defining a pair of poppet valve shaped molding cavities extending radially outward from the suspension cavity, gate cavities between the suspension cavity and molding cavities, and a common pour hole for the gate cavities.

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