Aug. 21, 1945. C. E. SORENSEN 2,383,224

MOLD

Filed Feb. 25, 1942 2 Sheets-Sheet 1

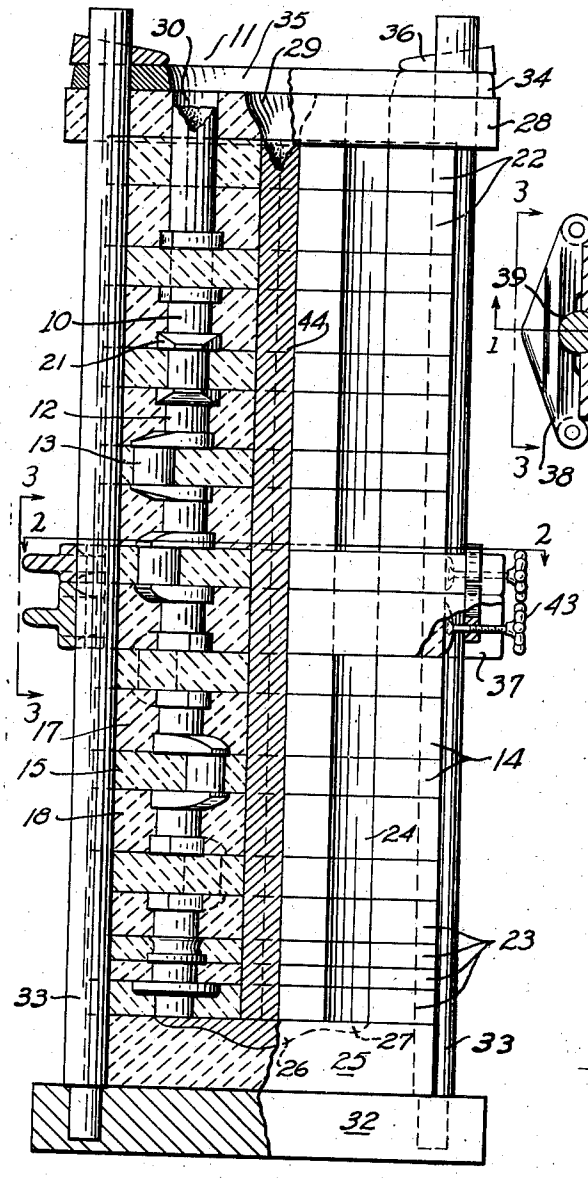


Fig. 1

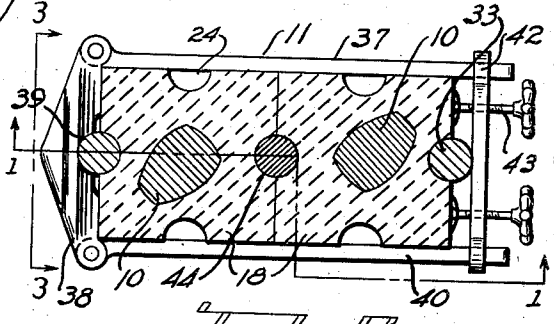


Fig. 2

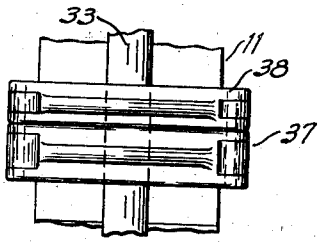


Fig. 3

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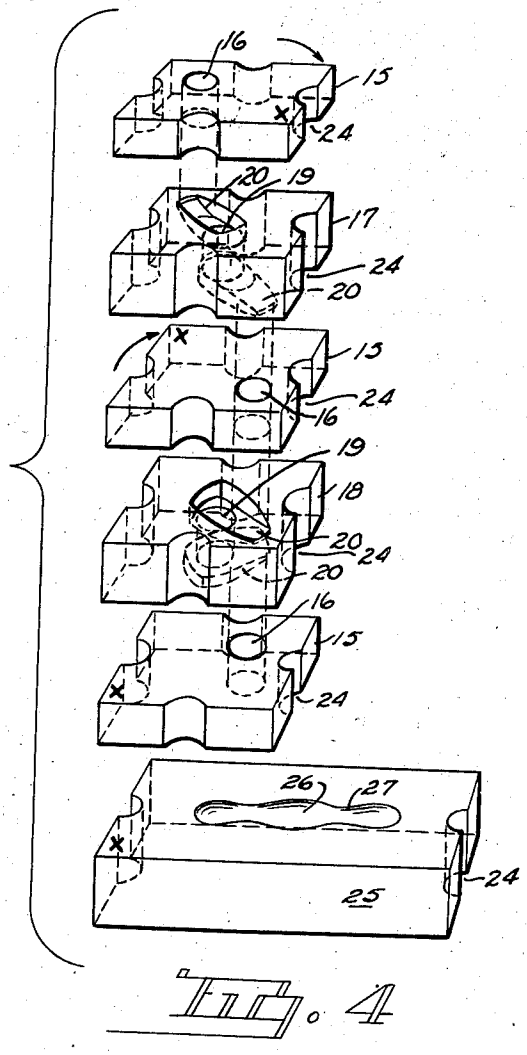


Fig. 4

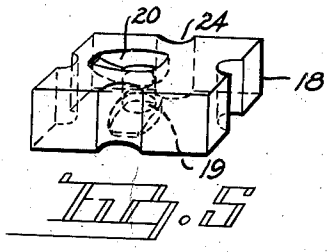


Fig. 5

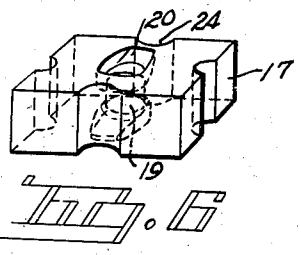


Fig. 6

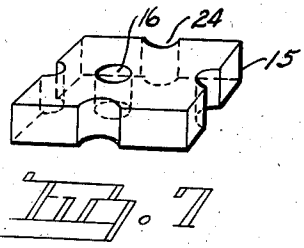


Fig. 7

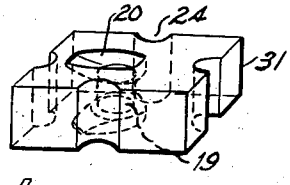


Fig. 8

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UNITED STATES PATENT OFFICE

2,383,224

MOLD

Charles E. Sorensen, Detroit, Mich., assignor to Ford Motor Company, Dearborn, Mich., a corporation of Delaware

Application February 25, 1942, Serial No. 432,214

9 Claims. (Cl. 22—130)

The object of this invention is to provide a segmental mold, particularly designed for the casting of internal-combustion engine crankshafts and adaptable to shafts of any configuration or throw arrangement.

An advantage of this mold is that it is built up from a number of preformed plate segments. These segments are so formed that many different combinations may be built up using only a small number of different standard segments. A further object of this invention is to construct a segmental mold in which a plurality of castings may be made at one time. Yet another object of the invention is to obtain a segmental mold in which the individual segments are provided with automatic registry means and in which the sprue by which the metal is introduced to the mold is automatically formed. Another object of this invention is to provide a construction in which the forces incident to casting are opposed and equalized and in which the segments are provided with the requisite support while they may be easily and readily assembled.

The advantages of the cast shaft per se over one formed conventionally by forging are manifold. These include superior strength, a much more accurate blank, more economical and faster production, and the utilization of manufacturing means which are readily available. These advantages have long been recognized and special means have been devised for casting the smaller shafts used in automobile engines. It is apparent, of course, that conventional molding means cannot be used because of the parting lines required. Further, the special means which have been developed are limited to the smaller shafts and are not readily adaptable to the larger and more complex pieces contemplated here. Therefore, the present mold has been developed to meet this need.

With these and other objects in view, the invention consists in the arrangement, construction and combination of the various parts of the improved device, described in the specification, claimed in the claims, and illustrated in the accompanying drawings, in which:

Figure 1 is an elevation of the mold of this invention, being shown in section on approximately the line 1—1 of Figure 2.

Figure 2 is a sectional view taken on the line 2—2 of Figure 1.

Figure 3 is an end view of the above arrangement as indicated by the line 3—3 on Figures 1 and 2.

Figure 4 is an expanded view of a portion of the mold, showing the alignment of the component segments.

Figures 5, 6, 7 and 8 are views of individual representative segments showing the configuration thereof.

Referring to Figure 1, 10 designates a crankshaft of a particular design and 11 the mold constructed according to this invention in which it is cast. The crankshaft shown is one designed for a 16-cylinder V-type motor; and, as an index of the size of the mold, the shaft is upwards of 12 feet in length. As is customary in shafts of this size, it has a number of axially-aligned main bearings 12, one between each of the throws 13. The throws are arranged in two groups of four each, the throws in each group are at 90° angles and the groups are relatively offset 45°. This represents a most complicated casting problem, but one which this mold handles effectively.

The mold in which this crankshaft is to be cast is built up from a number of plate segments 14 made of baked core sand, each of which defines a certain portion of the shaft. Thus, one plate designated 15 has a simple cylindrical opening 16 defining the throw 13 of the shaft, other plates 17 and 18, which define the bearings 12, have a cylindrical central opening 19 and, on opposite faces, depressions 20 communicating with 19 and defining adjacent cheeks 21 of the crankshaft. Various forms of bearing plates are required, 17 being one in which the throws are 180° apart and 18 having them at a 90° angle. Other plates such as 22 or 23 are used at the top and bottom to define the special end portions of the shaft.

Each of the plates is preferably square in plan. In the bearing plates 17 or 18 the opening 19 is at the center of the plate, while in the throw plates the openings 16 are offset from the center of the throw radius. At the midpoint of each side of each plate is a registry notch 24 preferably semicircular in section. A bottom feeder plate 25 which accommodates two of the regular plates is also provided. It has a central reservoir 26 from which runs 27 lead to a point where they will communicate with the co-operating plate openings and it has registry notches on its ends only. Similarly, a large top plate 28 has a central pouring funnel 29 and risers 30. All of these plates are formed of baked core sand and are, of course, used to pour only one casting. It will be understood that the mold fabricated from them includes a number of duplicates and hence the number of different pattern plates required is greatly reduced.

The permanent parts of the mold include a

heavy metal base plate 32 to which are secured the lining dowels 33. A weighting plate 34 has its center cut away as at 35 to allow access to the funnel 29 and the risers 30 and is secured in place by wedges 36 driven into slots in the dowels 33. Provision is made for a flask using a number of individual jackets 37, which includes the flanged back 38 which has a seat 39 engaging the dowel 33, sides 40 hinged thereto, and a front bar 42 locking the free ends of the sides 40 and having adjustable compressing means 43.

In assembling the mold, the bottom feeder plate 25 is placed on the base plate 32, its end notches engaging the dowels 33. One now proceeds to build up two stacks of plates, side by side, on the base plate, the end registry notches 24 of each plate engaging the lining dowels 33 and the abutting notches in adjacent faces forming the sprue 44. The first plates are those identified as 23 which form the bottom end connections of the crankshaft. Thereafter, referring to Figure 4 which in the interests of clarity does not show the bottom plates, a throw plate 15 is added. After this, a 90° bearing plate is placed, which is followed by another throw plate 15 revolved 90° as shown by the relative position of the "X" on one corner of the plate. This, in turn, is followed by a 180° bearing plate 17 and another throw plate 15 now revolved a further 180°. When the phase angle between the groups is encountered, a plate 31, such as shown in Figure 8 in which the angle is 45°, may be used.

This procedure is followed, adding successive plates as required by the particular design, until the entire mold is completed. The top plates 22 and 28 are then added and the metal weighting plate 34 is finally placed and secured by the wedges 36 extending through slots in the upper part of the dowels 33. The building of the two stacks is carried on simultaneously to permit easier placement of successive plates.

It will thus be seen that all of the individual plates are aligned by reason of the registry notches 24 will respect to the dowels 33 and to each other; and that the centrally occurring notches co-operate to form the necessary sprue 44. Furthermore, the dowels are held in the proper relative position by the top weighting plate 34 which also prevents any longitudinal displacement of the individual segments by its own weight and by the anchoring action of wedges 36. It is thus apparent that the segments are securely aligned and firmly held against the forces exerted in casting. The provision made for casting two or more of the shafts at once is important, particularly in the matter of forming the pouring sprue; but also has advantages flowing from the fact that the crankshafts may be oppositely arranged in the adjacent stacks, as best shown in Figure 2, so that the throws and the metal therein may to some extent counteract each other in each stack and prevent undue distortion. It is well known that when a crankshaft is cast, because of the unsymmetrically disposed weights, considerable allowance must be made for shrinkage as explained in my Patent No. 1,992,677. Substantially the same advantages claimed there may be obtained in the present case, when that is found necessary, by appropriately shaping those plates which are used in but one position of revolution. Thus, the shaft, when cool, will be approximately straight.

To complete the mold, the individual jackets 37 are applied. They may be used along the entire length of the mold to form a complete flask or they may be distributed at such points therealong as the conformation of the shaft requires. In applying them, it is only necessary to engage the seat 39 in the back 38 with the appropriate dowel, bring the hinged side members 40 along the sides of the plates, engage them with the front bar 42, and operate the clamping means 43 to force the two or more plates enclosed into the proper close relationship. When this is done, it is apparent that the individual plates are protected from breaking under any of the forces normally encountered and that a complete mold results in which failure is well-nigh impossible in ordinary usage.

In some instances, but one plate of one specific pattern may be required in making up the mold—as, for instance, the 180° bearing plate 17. In these, the side registry notches may be omitted since they are not needed for alignment with the dowel or to form the sprue and this would correspondingly lower the chances of misplacing the plate in the assembly. However, one of the greatest advantages lies in the use of the smallest number of individual patterns to make the largest number of assemblies and, in general, each segment should be usable in any of four rotated positions with either side up, making a total of eight different positions. In each, though, the alignment and sprue means are available.

It is believed that the manifold advantages of this construction have been pointed out in full in describing it, but it may be well to state further that it is applicable to crankshafts of many designs and that in any event it obviates the requirement of a large number of differently formed segments; that it, it utilizes in different alignment or arrangement a small number of standard segments. Moreover, a suitable pouring sprue is obtained without unduly extending the size of the segment, weakening it or requiring additional labor which would otherwise be required. Finally, this sprue is located intermediate the shaft molds, and the hot metal therein keeps the metal in the sprue at the desired fluidity to supply additional metal required to make up the contraction in the shaft on cooling.

Some changes may be made in the arrangement, construction and combination of the various parts of my improved device without departing from the spirit of my invention and it is my intention to cover by my claims such changes as may reasonably be included within the scope thereof.

I claim:

1. A mold for casting engine crankshafts having a plurality of axially aligned main bearing sections spaced therealong and having axially offset crankpin bearing sections integral therewith, comprising, adjacent stacks, each comprising a plurality of superimposed baked core sand plates, all of said plates having openings therethrough, certain of said plates having depressions on the faces thereof in communication with said openings, notches correspondingly located on the sides of each plate, said notches aligning throughout when said depressions and openings are in register, the notches on the adjacent faces of said stacks co-operating to form a pouring sprue.

2. A mold for casting engine crankshafts having a plurality of axially aligned main bearing

sections spaced therealong and having axially offset crankpin sections integral therewith, comprising, a supporting base, a plurality of registering dowels secured to said base and extending therefrom, adjacent stacks of superimposed baked core sand plates on said base, said plates having openings therethrough, certain of said plates having depressions on the faces thereof in communication with said openings, registry notches on the sides of said plates, certain of said notches aligning with and receiving said dowels, the notches on the adjacent faces of said stacks aligning and co-operating to form a closed central pouring sprue through said stacks.

3. The structure of claim 2 which is further characterized in that certain of said plates making up a stack are of the same centrally offset pattern, said similar plates being rotated through an angle equal to a multiple of the angle between registry notches to obtain different mold conformations, said notches aligning throughout to receive said dowels and to form said pouring sprue.

4. The structure of claim 2 which is further characterized in that one continuous plate underlies said stacks and engages said dowels, a depression formed in said block to receive molten metal from said sprue, and runs leading from said depression and communicating with said openings to admit the molten metal to the mold defined by said stacked plates.

5. The structure of claim 2 which is further characterized in that a flask is formed thereabout, said flask comprising a plurality of jackets having aligning engagement with said dowels and releasably embracing said stacks, and adjustable means to support said stacks and maintain the adjacent engagement therebetween.

6. In a mold for casting engine crankshafts having a plurality of axially aligned main bearings and having axially offset crankpins, the angles between said crankpins being multiples of 90°, a uniform mold segment to define the successive offset portions of said crankshaft, said segment having an axially offset opening therethrough, and registry means on the sides of said segment spaced at 90° intervals, whereby said segment may be rotated to various right-angle positions to define the different offset portions while being maintained in proper registry.

7. In a mold for casting engine crankshafts having a plurality of axially aligned main bearings and having axially offset crankpins, the angles between said crankpins being multiples of 90°, a uniform mold segment to define the successive offset portions of said crankshaft, said segment being formed of baked core sand rectangular in elevation and square in plan, said segment having an axially offset opening therethrough, vertically extending notches formed midway of each vertically extending side thereof, whereby said segment may be rotated through various right-angle intervals to define the various offset portions, said notches aligning throughout.

8. In a mold for casting engine crankshafts, two stacks of substantially square mold segments adjacently disposed, registry notches extending vertically substantially midway of the vertical faces of said segments, the notches aligning to form continuous vertically extending indentations on the vertical faces of said stacks, the indentations on the adjacent faces of said stacks co-operating to form a pouring sprue, and registry means engaging the indentations on other of said faces.

9. In a mold for casting engine crankshafts, a mold segment formed of baked core sand, said segment being substantially rectangular in elevation and square in plan, a vertical notch at the mid-point of each vertical side thereof, and an opening offset centrally through said segment.

CHAS. E. SORENSEN.