May 20, 1947. R. J. MILLER 2,420,756

METHOD OF MAKING PATTERNS

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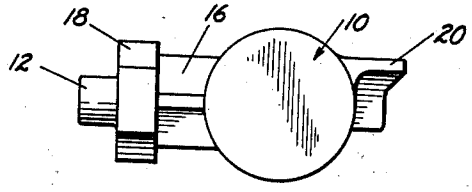


FIG. 1.

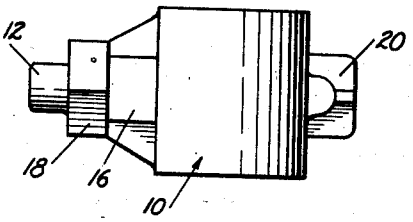


FIG. 2.

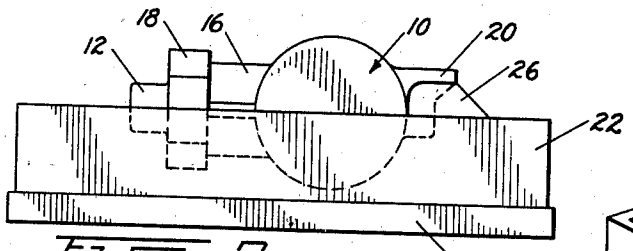


FIG. 3.

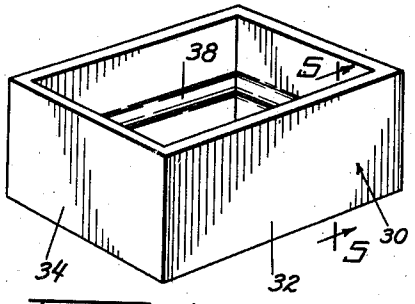


FIG. 4.

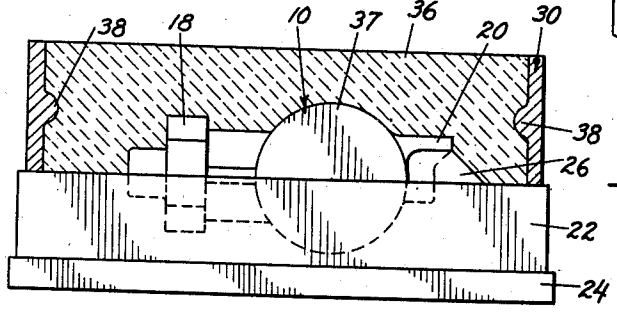


FIG. 6.

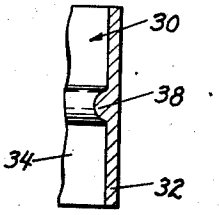


FIG. 5.

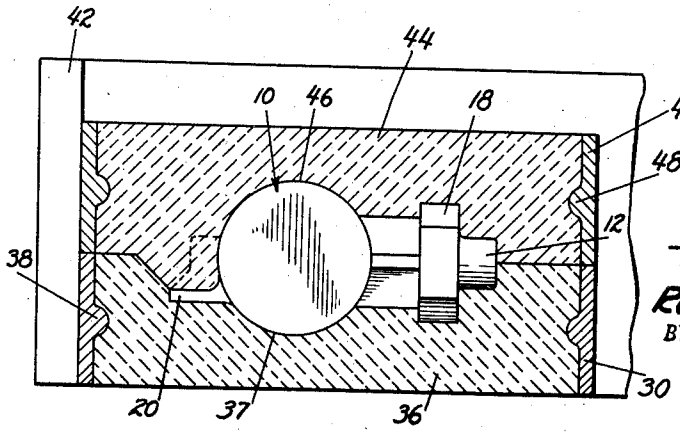


FIG. 7.

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METHOD OF MAKING PATTERNS

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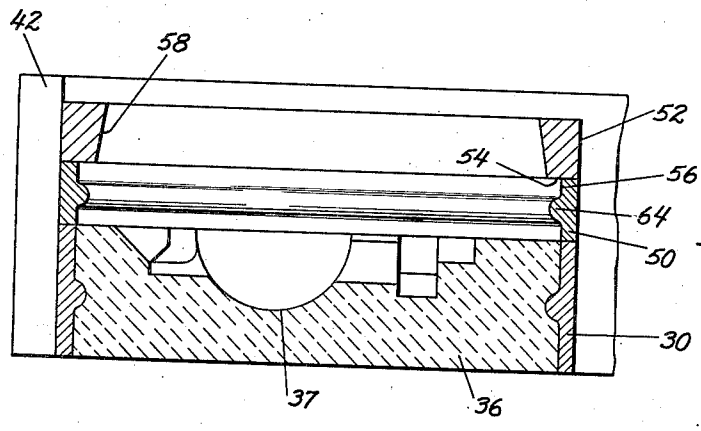


Fig. 8.

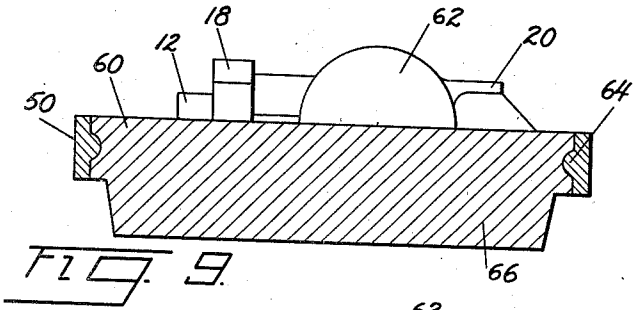


Fig. 9.

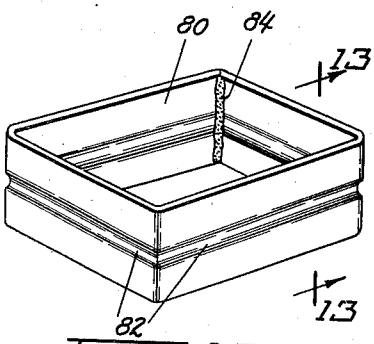


Fig. 12.

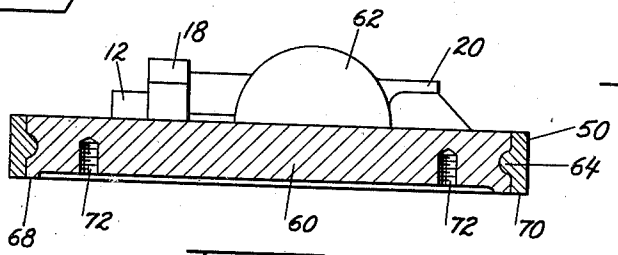


Fig. 10.

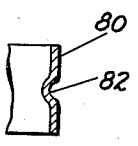


Fig. 13.

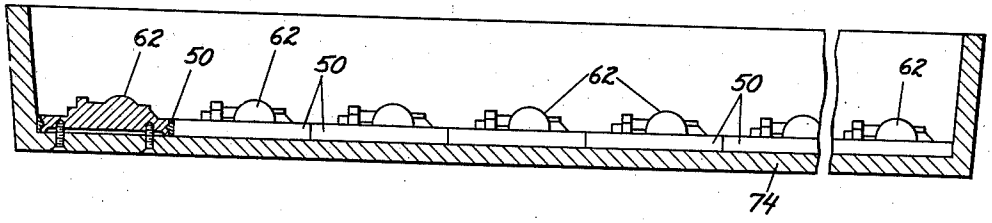


Fig. 11.

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UNITED STATES PATENT OFFICE

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METHOD OF MAKING PATTERNS

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Application August 14, 1942, Serial No. 454,831

2 Claims. (Cl. 22—195)

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This invention relates to the art of casting and more particularly to the making of accurately aligned vertically spaced matched pattern segments of articles having symmetrical or unsymmetrical contours, including those where no simple parting line is available on the article to be reproduced.

Heretofore in the formation of matched patterns great difficulty has been experienced in forming and accurately aligning the vertically spaced segments of the pattern with a sufficient degree of accuracy to produce satisfactory castings. In the making of these matched pattern segments it has been customary to form each segment separately to embody the contours of vertically spaced sections of the article to be reproduced. A great deal of hand and machine work has therefore been necessary to accurately form the pattern sections to the shape and contour of the article to be cast.

In the so-called Capaco process of casting, plaster is used as the mold body. The cope and drag sections of the mold having plaster therein are brought into contact with a die pattern formed of combined pattern and flask elements.

The die pattern may be of any desired size and is preferably subdivided into a plurality of smaller segments to provide greater flexibility in the casting operation. A single pattern may occupy one or more of these smaller sections and many different pattern forms may thus be used simultaneously in the die pattern.

Each pattern segment whether it be a single segment of the die pattern or a larger pattern extending over several of the die pattern segments must be accurately machined to very close tolerances to fit within the flask portion of the die pattern to accurately align the matched patterns in three planes and to avoid the formation between the pattern blocks of cracks into which the mold substance could flow.

A great deal of time and effort is thus required in the formation of each of the pattern segments because each pattern block must be individually machined accurately to a predetermined size after the pattern has been formed thereon. Undesirable expense and delay are thus involved in the formation of the pattern equipment.

In the Capaco process molds having plaster and other dry elements to provide a desired degree of strength are mixed with somewhat of an excess of moisture and are brought into contact with the die pattern. The plaster mold assumes the contour of the pattern and after a substantially predetermined set has been effected the

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mold is removed from the die pattern and is subjected to a drying or baking process whereby virtually all of the moisture in the plaster mold is dissipated. The resulting plaster mold has a very smooth glass-like surface accurately conforming to the contour of the die pattern.

Due to the excess of moisture in the formation of the plaster molds, the dried molds are quite porous and permit the ready escape of entrained air and gases formed during the casting operation. The molds are virtually bone dry and therefore substantially no steam is formed as the molten alloy or metal is poured into the assembled molds.

The ingredients of the plaster molds are such as to provide a mold having sufficient strength to support the molten alloy or metal when poured but are not sufficiently strong to resist the forces exerted thereon during the shrinkage of the castings after solidification. These molds collapse or break up as the metal shrinks whereby cooling stresses are avoided in the castings.

Due to the smooth surface of the plaster molds the articles cast have exceptionally smooth surfaces and can generally be used without any machining operations because the castings follow the shape and contours of the patterns with a high degree of accuracy.

My co-pending application Serial No. 421,115, filed December 1, 1941, discloses a process whereby matched patterns of articles having variously contoured vertically spaced sections can be accurately and economically reproduced with a high degree of accuracy. In that development female impressions of vertically spaced portions of the article to be reproduced are formed in a substance possessing the characteristics of accurately conforming to the contour of a model of an article to be reproduced without injury to the surface of the model, and male production patterns are formed of a moldable substance, from these female impressions. The matched pattern segments may be accurately located with reference to each other by suitable locators or dowel pins positioned in the die block outside of the pattern contour.

In the use of these matched patterns in certain types of casting equipment such as the Capaco process referred to above, it is necessary to accurately machine the exterior pattern carrying blocks to a predetermined size and shape. Considerable time and effort is required to prepare the patterns for use after they have been completely formed.

The instant invention is directed more par-

ticularly to a method of forming matched pattern segments on blocks of accurate predetermined size and shape in such a manner that the minimum time and effort will be required to prepare the patterns for use in various types of casting equipment after the pattern segments have been formed.

An object of this invention is therefore to provide matched pattern segments formed in accurately dimensioned frames.

A further object of the invention is to provide pattern segments formed by a reproduction process in accurately dimensioned frames adapted to be accurately aligned vertically during the formation of the pattern segments to form accurate matched patterns.

Another object is to provide matched pattern equipment formed in accurately dimensioned frames adapted to be aligned vertically by means of a right angle to provide matched pattern segments in the frame members by a reproduction process.

Yet another object of the invention is to provide a production plate pattern by a reproduction method in a frame formed to accurate dimensions by superimposing a production pattern frame and a riser frame on a female impression frame and accurately aligning the frames vertically in a right angle, and thereafter limiting the vertical height of the pattern frame by removing the riser to accurately locate the bottom of the production pattern.

Another object is to form patterns by a reproduction method in accurately dimensioned frames whereby the pattern is accurately aligned in three planes with the model to be reproduced.

A further object is to provide an improved method of accurately controlling the over-all dimensions and vertical height of a pattern block for use in casting operations wherein multiple closely spaced patterns are employed.

Yet another object of this invention resides in the formation of production patterns on accurately finished blocks adapted to meet in surface contact whereby a single mold impression may be formed from a plurality of patterns.

Another object is to provide pattern supporting frames of accurate dimension having internal means to locate and support the pattern at a desired height with reference to the frame.

Other objects and advantages of this invention will be apparent from the following detailed description considered in connection with the accompanying drawings, submitted for purposes of illustration only, and not intended to define the scope of the invention, reference being had for that purpose to the subjoined claims.

In the drawings wherein similar reference characters refer to similar parts throughout the several views:

Fig. 1 is a side elevation of a master pattern or model of a typical article to be reproduced.

Fig. 2 is a plan view of the pattern or model illustrated in Fig. 1.

Fig. 3 is a view similar to Fig. 1 showing the pattern with parting material applied thereto to eliminate back draft.

Fig. 4 is a perspective view of a frame member adapted to be positioned on the parting material of Fig. 3 to surround the exposed portion of the pattern or model it is desired to produce.

Fig. 5 is a sectional view taken substantially on line 5—5 of Fig. 4, looking in the direction of the arrows.

Fig. 6 is a sectional view illustrating the frame

of Fig. 4 positioned in assembled relation with the pattern or model of Fig. 3 and having a moldable substance applied therein to form a female impression of the exposed portion of the pattern or model of Fig. 3.

Fig. 7 is a sectional view similar to Fig. 6 showing the article in the inverted position with the parting material applied in the step of Fig. 3 removed and a moldable substance applied to the exposed portion of the model to form a female impression in a frame of the remainder of the pattern or model to be reproduced.

Fig. 8 is a sectional view of the female impression formed by the step illustrated in Fig. 6 with a pattern frame and a riser frame in position thereon preparatory to forming a male match pattern from the female impression.

Fig. 9 is an inverted sectional view of the male pattern formed by applying to the female impression of Fig. 8 a moldable substance possessing the characteristics of filling the space within the frames of Fig. 8 without fusing with the material of which the female impression is formed.

Fig. 10 is a view similar to Fig. 9 showing the riser removed and the pattern body section threaded preparatory to applying it to casting equipment.

Fig. 11 is a longitudinal sectional view of molding equipment showing a plurality of production pattern members in place.

Fig. 12 is a perspective view of a modified form of pattern frame member.

Fig. 13 is a sectional view taken substantially on the line 13—13 of Fig. 12.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Figs. 1 and 2 are illustrative of a master pattern or model 10 of any article which it is desired to form by a casting process. The pattern or model 10 may be formed of any desired material such as wood, plaster, metal, alloy or a composition and may be symmetrical or unsymmetrical in form and need not have a straight parting line.

The pattern or model 10 may for example represent a hose fitting having an internally threaded shank 12 communicating with a transversely extended bore by way of a hollow passageway extended through a neck 16. The fitting may have a hexagonal wrench engaging portion 18 and a boss 20 whereby it may be secured in place. Cores may be employed to form the hollow sections.

In the formation of matched patterns for reproducing the article, the master pattern or model 10 may be embedded in parting material 22 positioned on a plate 24 as illustrated in Fig. 3. The parting material 22 may be built up around the boss 20 as illustrated at 26 to eliminate back draft on the pattern or model 10 and to divide the article into vertically spaced segments adapted to be duplicated on the pattern equipment.

After the article to be reproduced has been embedded in the parting material as illustrated in Fig. 3, a generally rectangular shaped frame 30 having smooth external surfaces 32 and 34

preferably disposed at right angles to each other and accurately machined to desired predetermined dimensions, is positioned on the parting material 22 to surround the pattern or model 10 as illustrated in Fig. 6.

A moldable substance 36 possessing the characteristics of accurately conforming to the exposed surfaces of the master pattern or model 10 without injuring the surfaces thereof may be introduced into the space within the framework 30 to form a female impression of the exposed portion of the pattern or model 10.

The substance 36 may be any suitable material possessing the enumerated characteristics, such for example as plaster, alloys, metals, plastic or granular materials. Where the pattern 10 to be reproduced is formed of wood, such for example as mahogany or pine, the substance 36, if an alloy or metal, should possess the characteristics of flowing under temperature conditions not injurious to the surface of the wood of which the pattern or model 10 is formed.

Illustrations of desirable alloys for this purpose are Cerrobend having a pouring temperature of approximately 160° F., Cerrobase having a pouring temperature of approximately 310° F., and Cerromatrix having a pouring temperature of approximately 350° F. These alloys may safely be used with mahogany or pine wood patterns or models because these woods possess the physical characteristic of charring at approximately 380° F. and igniting at approximately 488° F. The Cerro alloys possess the characteristics of flowing and hardening under substantially constant volume conditions.

The substance 36 may if desired be a plastic, either of the thermoplastic or thermosetting type, and preferably embodies the characteristic of negligible variation of volume upon solidification. The substance 36 may also be a plaster or gypsum or any fine grained material possessing the characteristic of accurately following the contour of the master model in such a manner that the pattern may be removed to leave a female impression 37 of the illustrative pattern or article 10. Suitable allowance should be made in the formation of the pattern 10 for any change in volume whether by shrinkage or expansion of the substance 36.

The substance 36 may be anchored or secured within the frame 30 by means of an inwardly directed bead or flange 38 formed in the inside walls 32 and 34 of the frame member 30. After the substance 36 has been applied to the master pattern or model 10 in the manner illustrated in Fig. 6 the assembly may be inverted and the parting material 22 and 26 removed leaving exposed the portion of the pattern 10 formerly covered by the parting material 22 and 26.

Another frame member 40 preferably of the same external dimensions as the frame 30 is now superimposed on the frame 30 as illustrated in Fig. 7. The frames 30 and 40 are accurately aligned with each other by means of a right angle 42 positioned to engage the side and end walls of each of the frames 30 and 40 to accurately align their vertical edges.

The portion of the pattern or article 10 formerly covered by the parting material 22 and 26 is now exposed above the substance 36 within the frame 40. A substance 44 similar to the substance 36 but not fusible therewith, by reason of its physical characteristics or by reason of the addition of a parting material, is introduced into the space within the frame 40 to cover the exposed portion of the pattern 10 to form a female impression 46 accurately conforming to the exposed portion of the pattern 10. The substance 44 is securely anchored within the frame 40 by means of an inwardly extended bead or flange 48 formed in the frame member 40.

The frames 30 and 40 may now be separated and the pattern or model 10 removed to expose the female impressions 37 and 46 in the substances 36 and 44 of the frames 30 and 40 respectively. These female impressions accurately conform to the shape and contour of the vertically spaced portions of the pattern 10 and are accurately spaced horizontally and vertically relative to each other by the location of the substances 36 and 44, fixed in the frames 30 and 40 respectively.

Male matched pattern segments accurately conforming to the shape and contour of the pattern 10 may be formed from the female impressions 37 and 46 by a reproduction process. To accurately align the male matched patterns vertically and horizontally additional frames of the same external dimensions as the frames 30 and 40 may be employed. For example, the frame 30 having the female impression 37 in the substance 36 may be again positioned in the right angle 42 as illustrated in Fig. 8. A male pattern frame 50 of the same longitudinal and lateral dimensions as the frame 30 is superimposed on the frame 30 and is accurately aligned therewith by means of the right angle 42.

A riser frame 52 having an inwardly offset portion 54 positioned to lie inside of the inner edge 56 of the frame member 50 may be superimposed on the pattern frame 50. The outer edges of the riser frame 52 may be aligned with the female impression frame 30 and the male pattern frame 50 by means of the right angle 42. The riser frame 52 is preferably provided with a tapered inner wall 58 to facilitate removal of the riser frame from the substance of which the male pattern segment is formed.

A substance 60 capable of filling the female impression 37 and the space within the pattern and riser frames 50 and 52 respectively without fusing with the substance 36 in which the female impression is formed is introduced thereinto. The substance 60 may possess generally similar characteristics as the substance 36 and may if desired be of the same material, the physical properties of the substance or suitable parting means being provided to avoid fusing.

Upon solidification of the substance 60 the riser frame 52 may be removed and the pattern frame 50 with the substance 60 secured therein separated from the frame 30 and the substance 36 containing the female impression 37, as illustrated in Fig. 9. A male pattern 62 of the female impression 37 is thus formed in the substance 60 and is secured to the frame 50 by means of an inwardly extended bead 64 of the pattern frame 50.

A riser portion 66 of the substance 60 formed within the riser frame 52 may be removed to permit the male pattern 62 to rest on the bottom of the frame 50 as illustrated in Fig. 10. The inwardly offset portion 54 of the riser frame 52 provides a flange portion 68 in the substance 60 accurately aligned with a bottom edge 70 of the frame 50. In removing the riser portion 66 all that is necessary is that the substance 60 be removed down to a point beyond the flange 68 as illustrated in Fig. 10. If desired, a portion of the substance 60 adjacent the bottom of the pat-

tern carrying block may be removed to reduce the weight of the pattern equipment. The substance **60** carrying the male pattern **62** may be provided with attaching means such for example as threaded holes **72** to permit attaching the pattern members to a flask plate **74** as illustrated in Fig. 11.

A substance known as "moulage" may be advantageously used in the making of this pattern equipment. Moulage is a substance having a wax or paraffin base and negative moulage may be applied to the male impression of the pattern or model by the application of heat and moisture to form a female impression of the article to be reproduced. The negative moulage is preferably prepared for application by the application of heat in a double boiler, a little water or other liquid being added to bring the negative moulage to the desired consistency. The negative moulage possesses considerable elasticity and may advantageously reproduce contours where there is a considerable back draft. After the female impression has been formed in the negative moulage and it has been permitted to set, male impressions may be formed by applying moulage to the female impression of the negative moulage.

The frames which carry the male patterns may be of considerably less height than the frames in which the female impressions are formed because the frames for the female impressions must be deep enough to accommodate the portion of the pattern or model being reproduced, and this condition does not exist with respect to the frames for the male patterns.

Where the male patterns **62** and supporting member therefor are made of the Cerro alloys, a relatively high riser portion **66** is desirable because these alloys require a relatively high head to form with a desired degree of density. Where the male patterns are formed of other alloys or substances the high riser frame is unnecessary and in many instances may be dispensed with entirely. Risers may also be employed where the female impressions are formed of the Cerro alloys.

In view of the fact that the male pattern **62** is formed by a reproduction process directly from the female impression of a portion of the pattern or model **10**, the male pattern follows the shape and contour of the master pattern or model with a high degree of accuracy.

No dowels or locators are needed to align the matched production patterns because each of the production patterns is accurately aligned in three planes with reference to its associated carrying frame in the process of forming the patterns. This result is achieved by reason of the fact that the female impressions of vertically spaced portions of the master pattern or article **10** are accurately aligned with reference to each other by the use of the frames **30** and **40** accurately superimposed on each other by means of the right angle **42**. The matched male patterns being formed by a reproduction process in frames accurately aligned in two horizontal planes by means of the right angle **42** and vertically by the mating edges of the frames with reference to the frames **30** and **40** are thus accurately located horizontally and vertically with reference to each other.

The male pattern **62**, frame **50** and flask **74** (Fig. 11) form what may be called a die pattern. This die pattern may be divided into any desired number of equally or unequally spaced sections. An individual pattern may occupy one or more of these equally spaced sections. The frames **50** carrying the matched pattern segments are accurately aligned with each other to locate the various male patterns positioned in the flask **74** in proper alignment and to avoid the formation of cracks between the pattern block members into which the mold material might flow.

In the Capaco process referred to above, die patterns 12" x 18" dimensions have heretofore been employed. These die blocks are divided into twenty sections, each section being approximately $1\frac{3}{4}$" x $5\frac{7}{16}$" x $\frac{15}{16}$" high. Each of these pattern carrying unit sections in the Capaco process must be accurately machined to a tolerance of approximately plus .0000 minus .00025, after the production pattern has been formed thereon. Time consuming and expensive operations are thus involved.

These operations are entirely unnecessary when my improved process is employed because a number of pattern frames may be accurately formed to a desired dimension and may be used over and over again whenever the patterns are changed, the substance **60** of which the production pattern is formed being removed when it is desired to change the die pattern. If Cerrobend is used to make the male patterns, it may be readily removed by placing the frame with the pattern in place in water and boiling it because the Cerrobend has a pouring temperature of 160° F. and this temperature is not sufficiently high to spring or warp the frame.

In forming castings from the die pattern illustrated in Fig. 11, the mold forming substance may be applied to the die pattern to form the vertically spaced cope and drag sections of the mold. Any desired substance may be employed as the mold material such for example as plaster, cement, sand, any granular substance possessing the desired characteristics, etc., and the castings poured after the molding substance has been properly treated.

It will be understood that the patterns formed in this manner embody suitable dimensions to compensate for shrinkage of the casting. If the female impressions or the male patterns are formed of substances which do not possess the characteristic of substantially constant volume upon solidification, suitable allowance should be made to compensate for the expansion or contraction of the material of which the pattern is formed.

Figs. 12 and 13 illustrate a modified form *a* the invention wherein a frame member **80** may be formed of sheet metal, stamped or rolled to form an inwardly extended ridge or bead **82** to retain the material of which the pattern segments are formed. The frame member **80** may be welded together as at **84** and the outer surfaces may be machined or ground to bring the frame to the desired dimensions. If desired, cast frames having roughened internal surfaces and smooth external surfaces may also be employed.

Segmental patterns formed of a plurality of individual blocks may be formed in segmental frames of keystone, triangular, circular or any other configuration to form circular, annular or other shaped articles such for example as flywheels, pistons, etc.

The patterns formed as disclosed herein may be used for casting any alloys or metals, and are not limited to use where a die pattern having a plurality of pattern blocks are employed.

Cores may be employed with this pattern method by merely locating suitable core prints

on this pattern as is well known in the art. Impressions of these core prints are transferred by the foregoing process to the female impression so they are reproduced in this final pattern equipment for the placement of the cores upon closing the mold.

It will be understood that this frame method of forming patterns may be used to form a base for stripper plates of the types disclosed in my co-pending application Serial No. 421,115, filed December 1, 1941.

I claim:

1. The method of making production patterns on bases of predetermined accurate external dimensions which comprises forming an accurately dimensioned frame to carry the pattern thereby assuring accuracy as to length and width and providing an indication as to the desired height, forming a frame having similar length and width dimensions to carry a mold having an impression of the pattern to be formed, superimposing the pattern carrying frame on the mold carrying frame, and superimposing on the pattern carrying frame a third frame having similar external length and width dimensions adapted to overlie the inner wall of the pattern carrying frame to establish a point for dimension change of a pattern forming substance cast into the pattern carrying frame and the mold impression of the pattern to be formed to serve as an indication of the amount of material to be removed to cause the pattern base to conform to the desired height dimension.

2. The method of making production patterns on bases of accurate external dimensions in three planes which comprises forming prefabricated pattern carrying frames having accurate length width and height, forming prefabricated mold carrying and riser frames having accurate length and width dimensions corresponding with the length and width dimensions of the prefabricated pattern carrying frames, forming a mold impression of a master pattern in the mold carrying frame, removing the master pattern from the mold impression, superimposing the pattern carrying and riser frames on the mold carrying frame, aligning the edges of said frames, introducing a pattern forming substance to fill the mold impression, pattern carrying frame and extend into the riser forming frame, removing the pattern carrying frame and pattern from the molding carrying and riser forming frames, and removing the riser.

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