Dec. 14, 1948. R. NEIMAN 2,456,424

MEANS FOR PRODUCING COMMERCIAL CASTINGS

Filed July 9, 1945

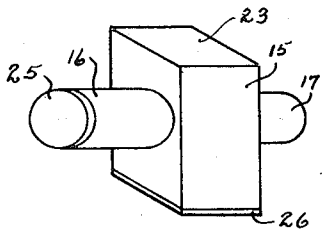


Fig. 1.

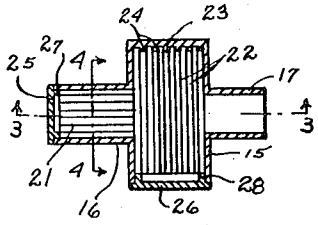


Fig. 2.

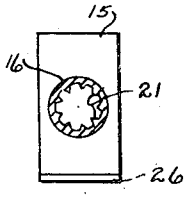


Fig. 4.

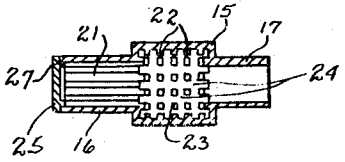


Fig. 5.

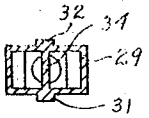


Fig. 9.

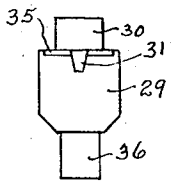


Fig. 5.

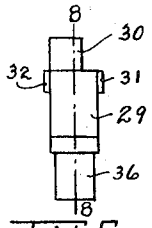


Fig. 6.

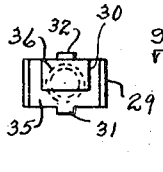


Fig. 7.

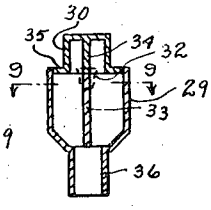


Fig. 8.

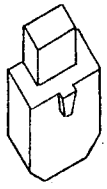


Fig. 10.

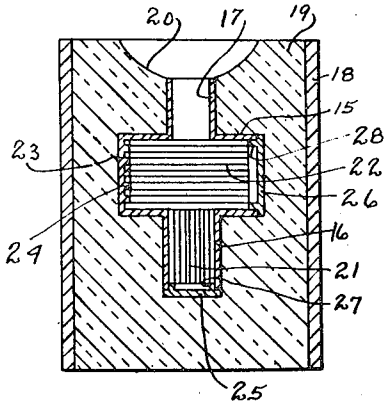


Fig. 11.

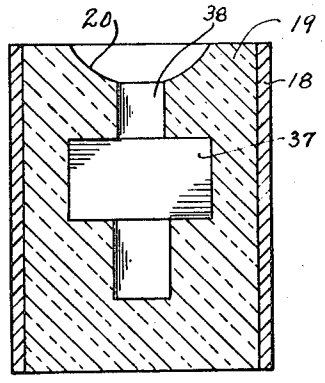


Fig. 12.

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Patented Dec. 14, 1948

2,456,424

UNITED STATES PATENT OFFICE

2,456,424

MEANS FOR PRODUCING COMMERCIAL CASTINGS

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Application July 9, 1945, Serial No. 603,992

6 Claims. (Cl. 22—158)

1

This invention relates to improvements in means for producing commercial castings and particularly to improvements in the means disclosed in United States Patent No. 2,362,507, which issued on November 14, 1944, to E. A. Steinbock and R. Neiman.

It has been found that hollow patterns are subject to stresses during manufacture and use with accompanying strains that result in deflections and deformations. These inaccuracies are usually small, a matter of thousandths of an inch, but nevertheless impart this undesirable condition to the resultant castings.

It is therefore the principal object of this invention to provide patterns which effectively resist the external pressures wherefore accurate castings result.

Another object of this invention is the provision of patterns as disclosed in the above identified patent wherein the wall sections are adequately reinforced without providing a pattern that may produce deleterious results in the mold.

Another object of this invention is the provision of patterns to accomplish the foregoing objects which may be expeditiously and economically produced.

Other objects and advantages of the present invention should be readily apparent by reference to the following specifications considered in conjunction with the accompanying drawings forming a part thereof and it is to be understood that any modifications may be made in the exact structural details there shown and described, within the scope of the appended claims, without departing from or exceeding the spirit of the invention.

In the drawings:

Fig. 1 is a perspective view of a pattern involving the principles of this invention.

Fig. 2 is a vertical central section of the pattern illustrated in Fig. 1.

Fig. 3 is a sectional view taken at right angles to that of Fig. 2 as seen from line 3—3 on Fig. 2.

Fig. 4 is a view partly in section and partly in elevation as seen from line 4—4 on Fig. 2.

Figs. 5, 6, and 7 are, perspectively, front elevation, side elevation and top plan view of a pattern of a part different in configuration from that of Figs. 1 to 4 inclusive and illustrate a modification in the invention.

Fig. 8 is a vertical sectional view of the modified pattern as seen from line 8—8 on Fig. 6.

Fig. 9 is a sectional view taken at right angles to that of Fig. 8 on line 9—9 on said Fig. 8.

2

Fig. 10 is a perspective view of the casting resulting from the pattern illustrated in Figs. 5 to 9.

Fig. 11 is a vertical sectional view through a mold in which is encased one of the patterns of the present invention.

Fig. 12 is a view similar to Fig. 11 illustrating the same after the pattern and sprue former have been eliminated.

Throughout the several views of the drawings similar reference characters are employed to denote the same or similar parts.

As was mentioned above and as illustrated in United States Patent No. 2,362,507, supra, hollow patterns have been employed in the formation of molds for casting purposes. The molds are formed of cementitious materials by encasing, so called, disappearing patterns in said material. These disappearing patterns have in the past been made of wax or plastic materials. Various advantages and difficulties are present when the different types of materials are employed. Wax patterns present the least difficulty in the burnout, that is in dispensing of the pattern after the mold has set, since wax has a low melting point and does not have the strength on expansion of affecting the mold.

The usual wax patterns soften at approximately 130° F. and actually melt into a fluid at approximately 155° F., and have been found very satisfactory in the production of dental restoration castings and the like, but the wax patterns do not have sufficient strength for commercial work due to the frequent rough handling when extremely accurate metal castings are required.

Plastics do have the strength to withstand the usual handling in the production of commercial castings, but when in fixed section have a greater total thermal expansion which may result in a cracking of the mold and a casting imperfection due to this cracked mold. Plastics seldom soften below 175° F. and then do not melt but become viscous and remain so up to approximately 300° F., and since plastics become viscous rather than liquid, they have a tendency to "ball up" and do not dissipate into the pores of the investment as molten wax does. This characteristic of the molten wax entering the pores of the molds relieves pressure due to expansion, and the water of the investment turning to steam helps to soften and remove the wax from the mold which is not the case with plastics.

As was mentioned in the above identified patent, the above reaction of plastic patterns was particularly noticed when thick wall patterns were employed, while relatively thin wall patterns

did not so react with the result that accurate castings or accurate reproduction of objects was attained. The limitations on section thickness depends considerably upon the actual design of the whole pattern as well as on the design of the sprue hole through which the softened pattern makes its exodus. The nature of the investment, its property of elasticity, its strength and its expansion at low temperatures have a considerable effect in limiting the pattern size and thickness.

In order to overcome this difficulty, the pattern of the above identified patent was developed and it was found that by the use of patterns having wall thicknesses preferably 1/64 inch to 1/16 inch, the difficulty of mold cracking and distortion was eliminated and in addition the time required to dissipate the pattern is greatly reduced because the pattern can collapse easily and is of sufficiently low bulk to volatilize more rapidly. It was found, however, that patterns of wall thicknesses within the range above noted has a tendency to sag, that is, to slightly concave between the ends thereof with the result that castings were produced having this concavity. Furthermore, the cementitious investment surrounding the pattern exerted a pressure on the pattern walls causing the said walls to deflect with a resulting casting having this concavity. This deflection is more or less depending, of course, on the expanse or length of the wall from edge abutment to edge abutment. It was to overcome this difficulty that the present mechanism was devised.

Referring to the drawings the pattern illustrated in Figs. 1 to 4 inclusive has a body portion 15 from one side of which projects a cylindrical portion 16. This pattern will produce a casting having a solid cube-like body of an area and volume equal to the pattern portion 15 with a stud or cylindrical protuberance from one side thereof equal to the length and volume of the pattern cylindrical portion 16. The pattern has a wall thickness quite thin as can be seen from the cross-hatched outline of the pattern. Secured to one of the surfaces of the pattern body portion 15 is a sprue former 17 illustrated as a cylinder and may be conveniently formed of the same material as the pattern is formed and formed integral with the pattern at the time of producing the pattern or the sprue former 17 may be secured to the pattern after it is formed and in the latter instance may be of the same plastic material as that of the pattern or may be of wax or other readily dissipatable material.

With the pattern as just described it is disposed substantially centrally of a mold forming ring 18 and the cementitious mold forming material 19 run in and around the pattern filling the ring to the upper end of the sprue former whereupon a depression 20 is formed to constitute the crucible for the molten metal prior to its descent to the mold cavity.

The cementitious material 19 is naturally heavy and with thin walled patterns has a tendency to distort the same and retain the said walls in the distorted position as the mold material dries and hardens. To overcome this and to insure the walls remaining parallel to one another, or retaining the desired relationship of said walls whether parallel or otherwise contoured, means are provided to strengthen said walls. As illustrated in Figs. 2, 3 and 4, this strengthening comprises the formation of ribs 21 longitudinally of the cylindrical portion 16 of the pattern. As illustrated in Fig. 4 these ribs simulate a corrugation of the inner surface of the pattern wall and

effectively prevent the said wall from sagging or otherwise being deformed. The walls of the body portion 15 are likewise provided with ribs 22 projecting interiorly of the pattern cavity and are illustrated as of double the thickness of the wall proper. The end wall 23 of the pattern body portion 15 is illustrated as provided with bars 24 extending in each direction and crossing one another wherefore it is particularly strengthened to withstand manufacturing operations as will be presently described.

It will be appreciated that in the formation of hollow plastic articles or castings retractible cores are necessarily employed and when forming an end wall such as 23 a slight vacuum may be created in the withdrawing of the core from the body portion 15 of the pattern. In the formation of the cylindrical portion 16 of the pattern a core is likewise provided. In order to close the ends of the pattern or plastic casting through which the cores are withdrawn use in made of caps such as 25 and 26, respectively, having a depending flange 27 and 28 adapted to enter the apertures of the withdrawn cores. These caps are secured in position by suitable plastic cement or solvent which adequately unites the parts to one another. Since a slight deformation of the sprue former 17 is of no consequence, no means are provided to guard against its deformity so long as the resulting sprue hole is ample for the introduction of molten metal to the mold cavity.

It has been found that the reinforcement of the pattern walls as above described adequately and completely overcomes any deformities that were previously noted and that metal castings result having dimensions as desired and within extremely narrow limits in the nature of .001 of an inch.

The reinforced pattern walls during the burnout have insufficient volume to affect the mold during the burn-out thereof since the hollow interior of the patterns provide ample room for the inward collapsing of the pattern material as it became softened.

The pattern illustrated in Figs. 5 to 9, inclusive, discloses another adequate method of reinforcing a plastic pattern other than the corrugation of the inner surface of the walls. This pattern comprises a body portion 29 from the upper end of which projects a rectangular projection 30. Outwardly extending from the sides of the body portion 29 are keystone shaped lugs 31 and 32. The problem particularly involved was the maintenance of accurate dimension across the faces of the body portion 29 and the outer surfaces of the lugs 31 and 32 as well as the similar faces of the projection 30. To insure this dimension being held, use was made of a partition or reinforcement 33 within the body portion 29 of the pattern and similarly a partition 34 was placed between the walls of the projection 30. As was above noted, in order to produce hollow patterns or plastic castings, use is made of a retractible plunger and the open end resulting from the use of this plunger in the pattern is closed by a cap which, in the case of the pattern here being described, including the portion 30 of the pattern together with the flange 35 at the base thereof which was designed to rest on the upper edge of the long walls of the body portion 29 and fix between the narrow walls thereof as clearly illustrated in Figs. 5, 7 and 8. To finish the pattern for use it is illustrated as having formed integral therewith a sprue hole former 36 which, as above described, may be a separate piece attached to the

pattern upon its completion and be hollow as illustrated or solid or made of wax.

The pattern of Figs. 5 to 9 is encased in the same manner by cementitious material 19 within a mold forming ring 18 and then dissipated as by heat. In each case a mold as illustrated in Fig. 12 having the casting forming cavity 37 substantially centrally thereof results with a sprue hole 38 projecting therefrom to the crucible 20.

The casting of Fig. 10 resulting from the pattern of Figs. 5 to 9 inclusive was found to be accurate within extremely narrow limits in the nature of .001 of an inch.

This invention, as noted above, pertains primarily to the reinforcement of thin section hollow plastic patterns or plastic castings and may be made or formed from various materials such for example as polyesters of acrylic and methacrylic acids. Mixtures of these, such as those including methyl methacrylate and polystyrene, permit variations in physical properties, molding properties, stability on aging, and molding characteristics. These materials do not carbonize upon heating, but merely go through a softening, then become liquid, and then gaseous. In some cases this is merely a depolymerization process. Furthermore these plastics are thermoplastic, and may be shaped as desired by heating and retain such shape upon cooling. This process may be repeated and is reversible. It has been found that these plastics are decomposed and reduced to a gaseous state at temperatures below 900° F. Thermosetting plastics do not permit this handling.

Among the many plastics available may be listed the phenolic-aldehyde resins, Bakelite, for example; vinyl resins, styrene, hydroxy-carboxylic resins, such as Glyptal and Rezyl; cumaron and indene resins, cellulose nitrate, cellulose acetate, and cellulose ethers, such as ethyl cellulose or mixtures of the aforementioned, sometimes including natural waxes and resins. Most of these are inferior to the polyesters of acrylic and methacrylic acid but may be used where price considerations are important. Where it is necessary to raise the mold temperature quite high to receive the molten metal, then a plastic that carbonizes is not at a great disadvantage. Many of these resinous plastics may become sticky during the heating process and destroy the mold cavities by pulling particles of the surface away. Some of these plastics are sufficiently water absorbed to cause a distortion.

The patterns illustrated in the drawings are of a relatively simple nature and have been utilized merely for illustrative purposes. It will be appreciated that patterns having a much greater area and far more complicated exterior contour can be formed on compression plastic casting machines. In these cases it may be desirable to utilize undulated or ribbed surface walls in addition to a partition spanning the hollow interior of the pattern or casting and extending from undulated wall to undulated wall. In other cases it may be desirable to utilize two or more partition reinforcing members with or without the undulated or ribbed pattern inner wall. In each case, and as noted above, plungers or cores of some nature are employed and the openings for the entrance and exit of these plungers and cores suitably closed by cap members, which are formed of the same material and constitute in the final assembly a part of the pattern. In other instances it may be necessary to make the patterns in section each section including a portion of the final exterior contour of the casting to be reproduced and each of the sections having its walls reinforced as determined by its own shape and contour.

By the way of further explanation, for example, a pattern may be made with a wall thickness of .040 of an inch and yet show concavity whereas the same pattern might be made with a wall proper of but .025 of an inch and by means of ribs of about .030 of an inch the overall thickness will be .055 of an inch to resist direct thrust better and yet the volume of material used will be the same or less, depending on the spacing of the ribs. This will provide quicker cooling of the pattern during its manufacture, thus speeding up production, and perhaps above all the pattern will collapse quicker during heating because the .025 of an inch portion will heat up more rapidly and soften sufficiently to prevent the expanding pattern from disrupting the encasing investment.

The ribs may be of any desirable shape, curved, triangular, square, or the like, or a combination. They may be thicker near the center of long spans and may run at any angle to facilitate forming and to produce the most sound mechanical structure.

In those cases requiring greatest accuracy or involving wide spans the ribs may be extended entirely across the hollow space between opposite walls and thus form a partition or brace as shown in Fig. 9. In the figure it is noticed that the partitioning rib changes an otherwise rectangular cross sectioned pattern with unequal stresses to a structure comprising two squares. The square structured cross section of the pattern in Fig. 3 is quite symmetrical and strong due to equal and short stresses. The longitudinal cross section of Fig. 4 has the stresses taken care of and sagging eliminated by the long reenforcing ribs, Fig. 2.

From the foregoing, it is believed now evident that there has been provided a hollow pattern or plastic casting which accomplishes the objects initially set forth without losing any of the advantages disclosed in U. S. Patent 2,362,507.

What is claimed is:

1. A pattern formed of plastic having the exterior conforming accurately to the exterior of the part to be produced and the mold cavity forming portion formed of spaced apart walls of thin sections and with hollow space between the inner surfaces of said walls whereby they will collapse, during dissipation, inwardly, and ribs projecting from the inner surface of said spaced apart walls for reinforcing the thin sections thereof against distortion except when the pattern is being dissipated.

2. A pattern formed of plastic having the exterior conforming accurately to the exterior of the part to be produced and the mold cavity forming portion formed of spaced apart walls of thin sections and with hollow space between the inner surfaces of said walls whereby they will collapse, during dissipation, inwardly, and a brace having its ends integral with two opposed of said spaced apart walls and traversing the interior of the mold cavity forming portion between the said spaced apart walls with hollow space between the sides of the brace and the spaced apart walls, said brace reinforcing the walls against distortion except when the pattern is being dissipated whereupon the pattern walls and brace collapse into the space between the brace and pattern walls.

3. A pattern formed of plastic having the exte-

rior conforming accurately to the exterior of the part to be produced and the mold cavity forming portion formed of spaced apart walls of thin sections and with hollow space between the inner surfaces of said walls whereby they will collapse, during dissipation, inwardly, and ribs projecting from the inner surface of said spaced apart walls for reinforcing the thin sections thereof against distortion except when the pattern is being dissipated, and a sprue hole former secured to and projecting from the pattern.

4. A pattern formed of plastic having the exterior conforming accurately to the exterior of the part to be produced and the mold cavity forming portion formed of spaced apart walls of thin sections and with hollow space between the inner surfaces of said walls whereby they will collapse, during dissipation, inwardly, and a brace having its ends integral with two opposed of said spaced apart walls and traversing the interior of the mold cavity forming portion between the said spaced apart walls with hollow space between the sides of the brace and the spaced apart walls, said brace reinforcing the walls against distortion except when the pattern is being dissipated whereupon the pattern walls and brace collapse into the space between the brace and pattern walls, and a sprue hole former secured to and projecting from the pattern.

5. A pattern formed of plastic having the exterior conforming accurately to the exterior of the part to be produced and the mold cavity forming portion formed of spaced apart walls of thin sections, whereby a hollow plastic pattern is formed with at least one end of the hollow

communicating with the atmosphere, ribs projecting from the inner surface of said spaced apart walls for reinforcing the thin sections thereof against distortion except when the pattern is being dissipated, and a plastic closure member secured to said open end.

6. A pattern formed of plastic having the exterior conforming accurately to the exterior of the part to be produced and the mold cavity forming portion formed of spaced apart walls of thin sections, whereby a hollow plastic pattern is formed with at least one end of the hollow communicating with the atmosphere, a brace having its ends integral with two opposed of said spaced apart walls and traversing the interior of the mold cavity forming portion between the said spaced apart walls with hollow space between the sides of the brace and the spaced apart walls, said brace reinforcing the walls against distortion except when the pattern is being dissipated whereupon the pattern walls and brace collapse into the space between the brace and pattern walls, and a plastic closure member secured to said open end.

ROBERT NEIMAN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,583,459	Hansen	May 4, 1926
2,362,507	Steinbock et al.	Nov. 14, 1944