

Jan. 4, 1966

G. S. MOXLAW ETAL

3,226,785

METAL CASTING PROCESS USING DESTRUCTIBLE PATTERN

Filed March 20, 1964

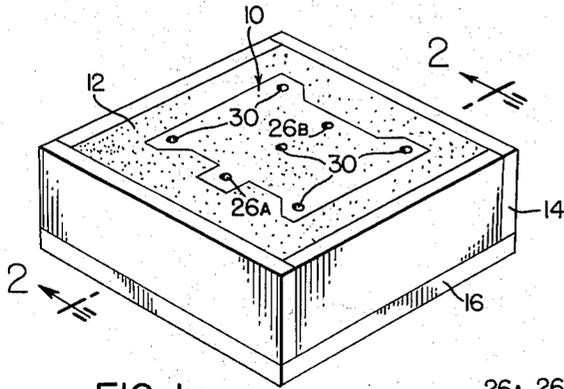


FIG. 1

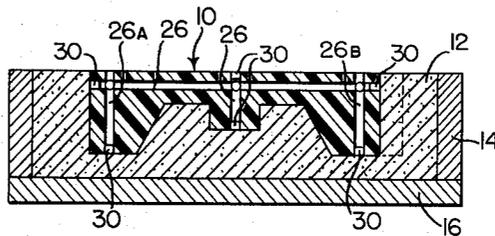


FIG. 2

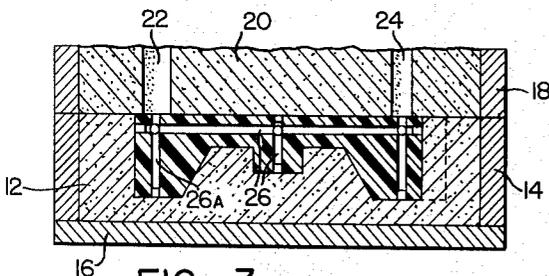


FIG. 3

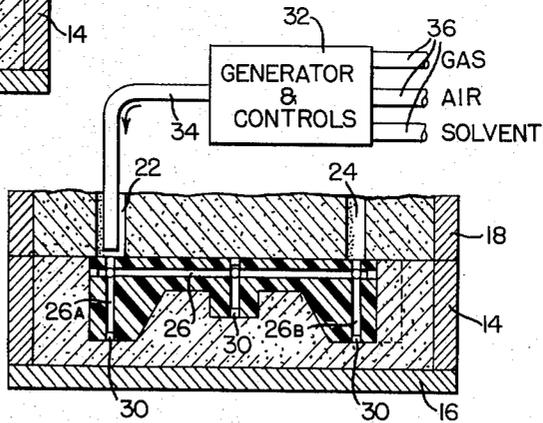


FIG. 4

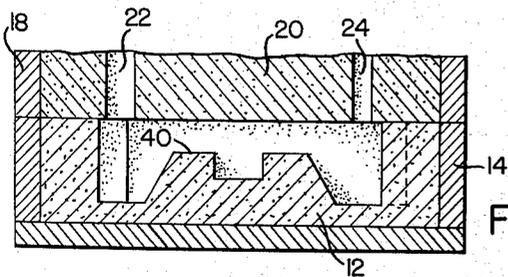


FIG. 5

INVENTORS
GEORGE S. MOXLAW &
ADHEMAR O. DEWITTE

BY

Benjamin W. Gelman

ATTORNEY

1

3,226,785

METAL CASTING PROCESS USING
DESTRUCTIBLE PATTERN

George S. Moxlow, 22644 E. River Road, Grosse Ile,
Mich., and Adhemar O. De Witte, 6133 Northshore
Drive, West Bloomfield Township, Oakland County,
Mich.

Filed Mar. 20, 1964, Ser. No. 353,533
6 Claims. (Cl. 22-196)

This invention pertains to a metal casting process and apparatus therefor and more particularly to improvements in a process in which an expendable plastic pattern is used as a form to produce a mold cavity, the plastic pattern being removed prior to metal pouring by the application of heated vapor and/or gases to the pattern so as to produce a degradation and decomposition of the plastic material at a temperature below the material's combustion temperature, and to effect its decomposition within the mold whereby a mold cavity is formed.

The invention involves a process for the casting of metal and the apparatus utilized in such process. The process comprises a few basic steps. The first of these is the embedding of a plastic pattern in the sand of a mold box, flask or drag substantially according to conventional practice. The plastic material from which patterns are currently being made and for which the process of this invention was particularly designed is the foamed or expanded polystyrene, a thermoplastic material which begins to distort, degrade, soften and melt at about 175° F. Upon subjection to higher temperatures, degradation and decomposition are accelerated, so that when heated vapors and/or gases are introduced to the foamed polystyrene pattern relatively large masses can be decomposed and melted in a few minutes.

In some casting processes, particularly the cavityless mold process, molten metal is poured directly into a mold box containing the foamed polystyrene pattern. Such processing generates intense smoke throughout the foundry area, fills the foundry with relatively toxic or noxious irritating fumes, and causes the operator to lose sight of the ingate so the metal is sometimes poured on the foundry floor, resulting in poor castings due to intermittent pouring. Breathing the irritating odors and smoke issuing from burned polystyrene patterns causes labor complaints. In view of such difficulties in processing, and since patterns of foamed polystyrene are being provided in increasing numbers by foundry customers and pattern makers because of their lower cost in comparison to conventional wood patterns, the inventive processing and apparatus disclosed and described herein was created to resolve such problems.

The invention involves forming a cavity in a mold box, flask or drag rammed with sand about an expanded or foamed plastic pattern by introducing to the pattern while in the mold box a continuous flow of heated vapor and/or gases at a temperature or temperatures substantially above the decomposition temperature of the plastic material forming the pattern, until the plastic material has been melted and a cavity formed in the mold box which is substantially the complement of the pattern. During their application to the plastic material, the heated vapor and/or gases are maintained at a temperature or temperatures within a range of from somewhat above the temperature at which distortion of the plastic material occurs by heating along and the temperature at which burning or combustion of the plastic material is effected. Within such range of temperatures, degradation and decomposition occur without appreciable smoke or fumes, and when the plastic material is subjected to heated vapor and/or gases at elevated temperatures of the range, decomposition is

2

accelerated. To further increase the rate and relative uniformity of pattern decomposition, where the pattern embodies sections of substantial thickness and disproportion when compared to other major sections of the pattern, the inventive process provides for boring or otherwise forming holes in the thicker sections longitudinally thereof so that the heated vapors and/or gases will find their way into all major sections of the pattern at about the same time, and decomposition will proceed in all such sections penetrated at a relatively uniform rate. A marked advantage of such heat and vapor distribution is that one surface section of the mold sand will not become over-cured by heat in comparison to mold sand surfaces exposed to such heat for a shorter period of time at the end of the pattern decomposition step.

A principal object of the invention is to provide a cavity mold for the casting of metal, the cavity being formed upon the degradation and decomposition of a plastic pattern embedded in the mold box by the application of heated vapors and/or gases to the plastic pattern material. Another object is the provision in such process of the application of heated vapors and/or gases at a temperature or temperatures below the temperature at which the plastic material is combustible and above a temperature at which the material will not distort upon heating alone. A further object is to degrade and decompose the plastic material, whereby to form a cavity mold, without the generation of noxious fumes, gases and smoke.

Various further and more specific objects, features and advantages of the invention will appear from the description given below, taken in connection with the accompanying drawing, illustrating by way of example a preferred form and embodiment of the invention.

Reference is now made to the drawing annexed hereto, forming an integral part of this specification and in which FIGURE 1 is a perspective view of a mold box containing a plastic pattern embedded in sand and having an upper surface exposed to view.

FIGURE 2 is a vertical sectional view taken substantially on the line 2-2 of FIGURE 1.

FIGURE 3 is a vertical sectional view, similar to FIGURE 2, showing the cope in place upon the mold box.

FIGURE 4 is another vertical sectional view showing the apparatus, principally in diagrammatic outline, for applying heated vapors and/or gases to the plastic pattern in the mold box.

FIGURE 5 is a vertical sectional view of the mold box and cope showing the cavity formed in the mold box prior to introduction of molten metal.

It is to be understood that the form and configuration of the plastic pattern illustrated and described in this specification was selected simply for the purpose of illustrating a representative embodiment of a structure upon which the process and apparatus herein disclosed can operate. The pattern configuration is not of any particular significance except insofar as it contains recesses and bosses to indicate that a relatively complex pattern form as well as a more simple configuration can be used in connection with the inventive process herein disclosed.

As shown in the several views of the drawing, the plastic pattern 10 is embedded in mold sand 12 contained within the mold box 14. In conventional practice, the pattern 10 is placed on a plate (not shown) in a manner such that its internal recesses, if any, are exposed upwardly for filling with sand from above. Then the mold box is covered with a plate 16 and inverted so that the pattern 10 is exposed at the top of the mold.

The plastic material of which many such patterns, in any desired configuration, are currently made and upon which the invention has been practiced is a foamed or expanded polystyrene, a thermoplastic material of light-

weight-low density and low thermal conductivity. One such material is that produced by the Dow Chemical Company of Midland, Michigan, under the trademark "Styrofoam." The material tends to melt away from a source of heat, but it does have a flash ignition temperature at slightly under 700° F., the self-ignition temperature being slightly under 800° F.

Other materials to which applicants believe the invention would lend itself without modification include the expanded polyethylene and the expanded polyurethane materials. The foamed or expanded polyethylene performs substantially as do the polystyrenes when subjected to heat—it melts away to create a void around such heat sources, but burning is not initiated except with an open flame and in the presence of oxygen. In the case of the polyurethane foamed material, it is relatively stable to about 250° F., some swelling taking place from about 250° F. to 300° F., and above 300° F. shrinkage and polymer degradation result.

After the pattern has been properly embedded in the mold sand, a cope 13 filled with sand 20 is placed above the mold box 14. The cope sand is arranged with an ingate opening 22 to one or more areas of the pattern and a riser opening 24 at one or more areas of the pattern. The cope sand is packed closely about and upon the pattern 10 so that the contact planes of sand and pattern in the mold box and cope will define the pattern after it has been removed and the mold cavity formed.

Some pattern configurations lend themselves to embedding only in a mold box, the sand being rammed and packed about the pattern on all sides. In such case, the ingate opening and the riser opening or openings are formed directly in the mold box sand.

Where the pattern 10 is of such configuration that its degradation and decomposition or melting under the application of heat will proceed with appreciable speed and relative uniformity throughout the pattern, or where the pattern sections are relatively thin, the pattern is embedded without perforation. However, where pattern section thickness or thicknesses are appreciable, or the pattern is relatively large and massive, or because of the pattern's mass it would require a substantial period of time under the application of heated vapors and/or gases to degrade, decompose or melt, so that the mold sand would be unfavorably affected and a poor quality casting result, then under such circumstances the process of this invention calls for perforation of the pattern at and through sections thereof to provide passageways 26 from the ingate opening 22 to the several sections of the pattern, preferably interconnected together unless otherwise indicated, in order that a through-flow of heated vapor and/or gases can be passed through the several passageways 26 in sections of the pattern to the riser opening 24. Such a flue system in the pattern provides a relatively uniform distribution of heat to the pattern sections with a resultant relatively uniform degradation, decomposition and melting of the pattern.

Perforation of the pattern, of course, is done before the pattern is embedded in the mold sand. A conventional drill or other suitable perforating tools can be used. In order to prevent mold sand from entering the passageways 26, their ends are plugged with polystyrene plugs 30, the ingate perforation 26a and riser perforation 26b being capped so that the caps can be easily removed after the ingate opening 22 and riser opening 24 have been formed in the cope sand 20 packed closely upon the pattern. The passageways 26 may be disposed in any direction, but their location, direction and attitude should preferably be such that they afford the greatest and most uniform distribution of heat to all sections and surfaces of the pattern, whereby the pattern will degrade, decompose and melt at a relatively even rate throughout.

To effect such degradation and decomposition, the process of this invention provides for the application of heated vapor and/or gases to the pattern 10 by way of

the ingate opening 22, the riser opening 24, or both such openings. The application of heat is provided by a generator and control unit designated generally by the reference numeral 32, a conduit 34 leading from the unit, and a plurality of conduits 36 for the admission of air, combustible gas and solvent to the unit 32. The generator comprises generally a burner unit in which a mixture of gas and air is formed and ignited to produce a gas combustion at an elevated temperature. The generator can also include a heater for plastic solvent with or without air, and a device for blowing or otherwise causing the solvent, now in vapor form and at an elevated temperature, to be directed under pressure through conduit 34 to the pattern 10. The heated air-gas mixture is also forced under pressure to the pattern whereby the latter is rapidly suffused internally with heated gas or, when a solvent is used, with a heated vapor. If a gas-air mixture is used, the plastic pattern distorts, degrades and melts; and if a heated solvent vapor is employed, the pattern material distorts, degrades and decomposes. Although heated gases issue from the riser opening 24, it is accompanied by little if any solids in the form of a heavy dense smoke such as issues when molten metal is poured directly to a plastic foamed polystyrene pattern.

The temperature to which the heated vapor and/or gases are generated and applied by the unit 32 fall within the range defined, at the lower limit, by the distortion or degradation temperature of the plastic material upon heating alone and, at the upper limit, by its ignition temperature without flame. Since these materials vary widely in respect to such temperatures, because of density differences, composition formulations, open or closed cell structures and other factors, there may well be some variation and departure from the temperatures set forth in this specification. However, the primary function of the temperature of the heated vapor and/or gases is the rate of degradation, decomposition and/or melting, and a relatively wide range of such temperatures is available and its limits for any plastic pattern material are easily and readily determinable.

Upon application of heated vapor and/or gases to the plastic pattern 10 and its consequent destruction, the cavity 40, defined by the pattern 10, is formed in the mold box 14, ready for acceptance of molten metal to form a casting which will be, in all material respects, substantially a reproduction in configuration of the pattern. Upon completion of the decomposition or melting of the plastic pattern 10, the generator and control unit 32 and the output conduit 34 are removed from the mold for admission thereto of the ladle or other vessel or device containing and discharging molten metal to the mold box. When molten metal is poured through the ingate opening 22, it will fill the cavity 40 and rise through the riser opening 24, forming the desired casting. This casting step is thus taken without the generation of plastic smoke or other such emanation from the mold box.

The gases which can be utilized and combined by the generator unit 32 include air and natural combustible gas, and oxygen and such gas. Solvents which can be heated to vaporization by the generator include, among others, methylene chloride, perchlorethylene, and trichlorethylene. The controls for such gases and vapors in their heating and expulsion from the unit include on-off switches, in-lime valves, pressure valves, solenoid valves responsive to the temperature of the vapors and/or gases in the heating generator for admitting and closing off such gases or solvent from the generator, and where required or desired a blower unit for expelling the heated vapor and/or gases under pressure from the generator and through the output conduit 34 to the pattern 10.

In essence, the process of this invention comprises the steps of embedding a plastic pattern in sand in a mold box, covering such pattern with mold sand in a cope or in the mold box, providing an avenue of entry through

5

the sand to and from the embedded pattern for the application of heated vapor and/or gases, generating such heated vapor and/or gases, applying such heated vapor and/or gases to the plastic pattern, degrading, decomposing and melting the pattern to form a cavity in the mold which is substantially the complement of the pattern, and pouring molten metal to the mold cavity to form a casting substantially a reproduction of the pattern.

The apparatus by which such process is operable comprises a generator for heating solvent vapor, or igniting a combustible gas-air or gas-oxygen mixture, conduits passing solvent or solvent vapor, air or oxygen, and combustible gas to the generator, controls for the generator comprising on-off switches, in-line valves, solenoid valves, pressure valves, and optionally a blower unit to expel heated vapor and/or gases from the generator under pressure.

Although a certain particular embodiment of the invention has been specifically disclosed herein for purposes of explanation, it will be apparent to those skilled in the art to which the invention pertains that additional embodiments and further modifications thereof, after study of this specification, can be practiced or made. Reference should be had to the appended claims in determining the scope of the invention.

We claim:

1. In a metal casting process, embedding a pattern of expanded plastic material in the sand of a mold, providing at least one ingate opening and one riser opening in said mold leading to and from said pattern, applying heated solvent vapor capable of degrading and decomposing said material to said pattern through one or more of said openings, degrading and decomposing said expanded plastic pattern in said mold to form a casting cavity therein substantially the complement of said pattern, pouring molten metal to said mold cavity to form a casting substantially a reproduction of said pattern, said heated vapor being applied to said pattern at a temperature below the combustion temperature of said expanded plastic material and above the temperature at which said material distorts under heating alone, and prior to embedding said pattern in said sand perforating sections of said pattern to provide passageways for conduction of said heated solvent vapor internally of said pattern, prior to embedding said pattern in said mold sand.
2. The process defined in claim 1, including closing off the ends of selected ones of said passageways against admission of mold sand thereinto.
3. In a metal casting process, embedding a pattern of expanded plastic material in the sand of a mold, providing at least one ingate opening and one riser opening in said mold leading to and from said pattern, applying heated gases capable of degrading, decomposing and melting said material to said pattern through one or more of said openings, degrading, decomposing and melting said expanded plastic pattern in said mold to form a casting cavity therein substantially the complement of said pattern, pouring molten metal into said mold cavity to form a casting substantially a reproduction of said pattern, said heated gases being applied to said pattern at a temperature below the combustion temperature of said expanded plastic material and above the temper-

6

ature at which said material distorts under heating alone,

and perforating sections of said pattern to provide passageways for conduction of said heated gases internally of said pattern, prior to embedding said pattern in said mold sand.

4. The process defined in claim 3, including closing off the ends of selected ones of said passageways against admission of mold sand thereinto.

5. In the process of making a casting mold having a mold cavity,

embedding a pattern made of plastic material in the sand of a mold, providing ports of ingress to and egress from said pattern in said mold,

applying heated gases capable of degrading, decomposing and melting said material to said pattern through one or more of said ports,

said heated gases being applied at a temperature below the combustion temperature of said plastic material and above the temperature at which said plastic material distorts under heating alone,

degrading, decomposing and melting said plastic pattern in said mold to form a casting cavity therein substantially the complement of said pattern,

prior to embedding said pattern in said sand perforating sections of said pattern to provide passageways therethrough for conduction of said heated gases internally of said pattern,

and closing off the ends of selected ones of said passageways against admission of mold sand thereinto, prior to embedding said pattern in said mold sand.

6. In the process of making a casting mold having a mold cavity,

embedding a pattern of a material degradable, decomposable and meltable under heat in the sand of a mold,

providing ports of ingress to and egress from said pattern in said mold,

applying heated gases capable of degrading, decomposing and melting said material to said pattern through one or more of said ports,

said heated gases being applied at a temperature below the combustion temperature of said pattern material and above the temperature at which said pattern material distorts under heating alone,

degrading, decomposing and melting said pattern material in said mold to form a casting cavity therein substantially the complement of said pattern,

prior to embedding said pattern in said sand perforating sections of said pattern to provide passageways therethrough for conduction of said heated gases internally of said pattern,

and closing off the ends of selected ones of said passageways against admission of mold sand thereinto, prior to embedding said pattern in said mold sand.

References Cited by the Examiner

UNITED STATES PATENTS

2,362,507	11/1944	Steinbock et al.	22-196
2,518,040	8/1950	Mann	22-196
2,815,552	12/1957	Turnbull et al.	22-196
2,830,343	4/1958	Shroyer	22-196
3,059,282	10/1962	Smith	22-196
3,094,751	6/1963	Horton	22-196
3,132,388	5/1964	Grant	22-196

MARCUS U. LYONS, *Primary Examiner.*