United States Patent [19]

Olsen

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[54] **DRY SAND CORE PROCESS FOR USE WITH LOST FOAM MOLDING PROCESS**

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[52] **U.S. Cl.** **164/34;** 249/62

[51] **Int. Cl.** **B22c 9/04**

[58] **Field of Search** 164/34, 246, 45, 234, 249; 249/61, 62, 63; 425/DIG. 12

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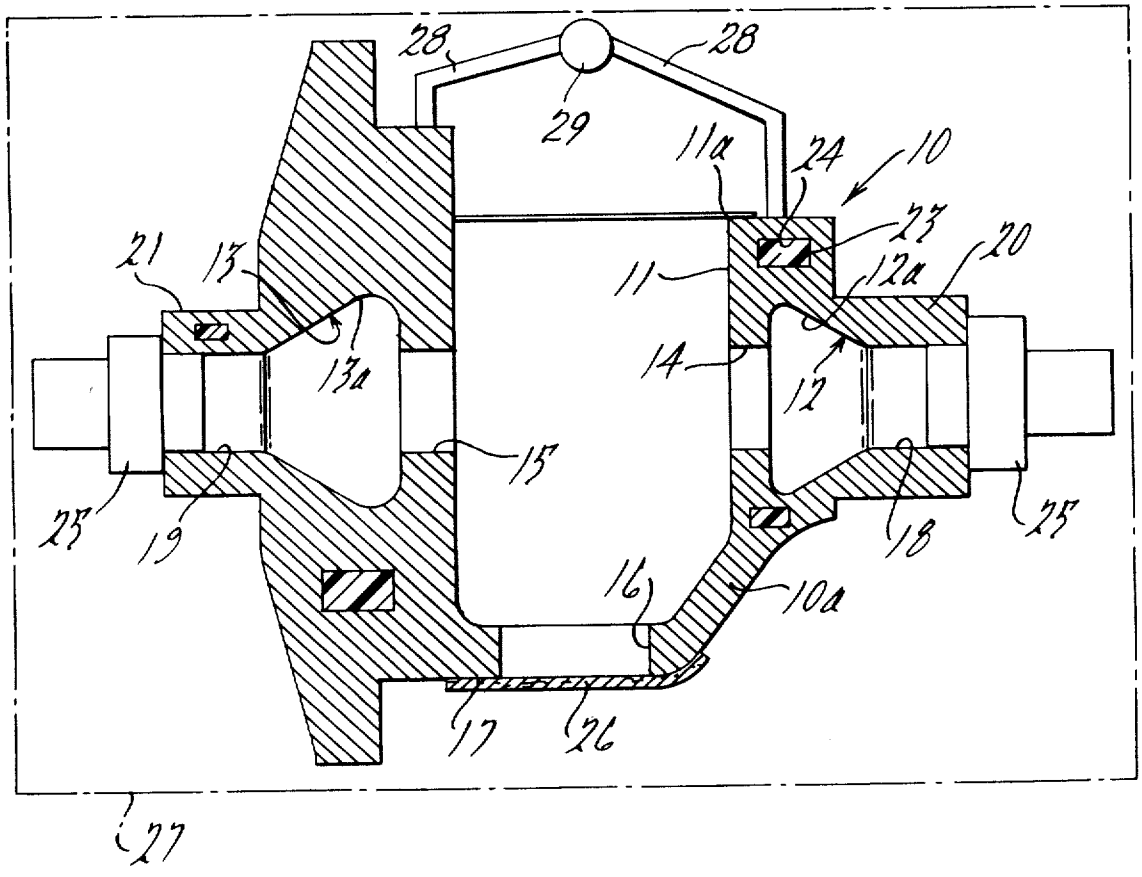
[57] **ABSTRACT**

A method of extending the cavityless molding technique to intricately cored objects to be cast is disclosed. Expanded consumable patterns are prepared in distinct parts capable of being locked together to form a completed assembly by use of integrally formed male and female elements. Openings to the interior of the pattern assembly are closed by pyrolyzible thin materials, such as tape, and one remaining passage is made available for filling the interior of the pattern with sand utilizing the pattern as a core box. The cored pattern is then located in a conventional flask or suitable holding means, filled with molding sand, followed by conventional casting techniques.

9 Claims, 5 Drawing Figures



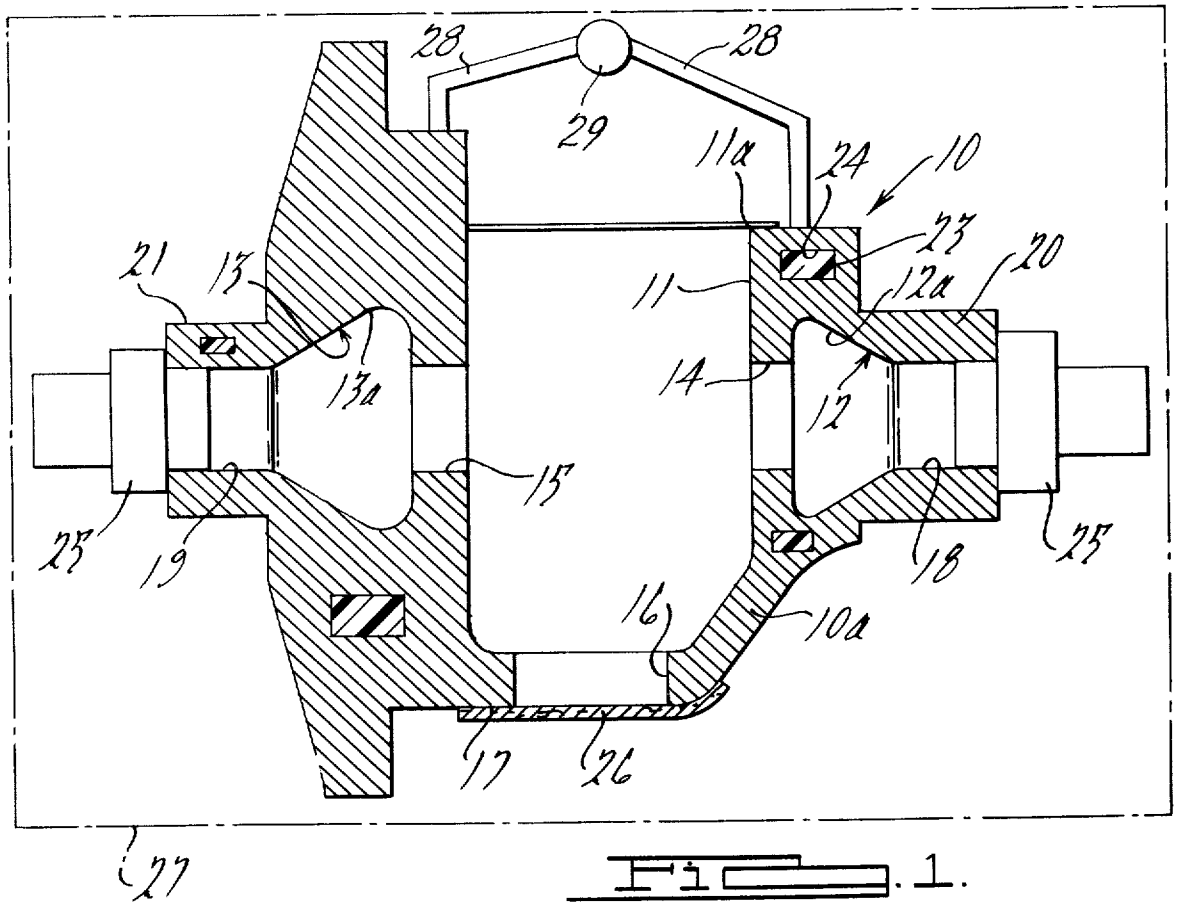

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Fig. 1.

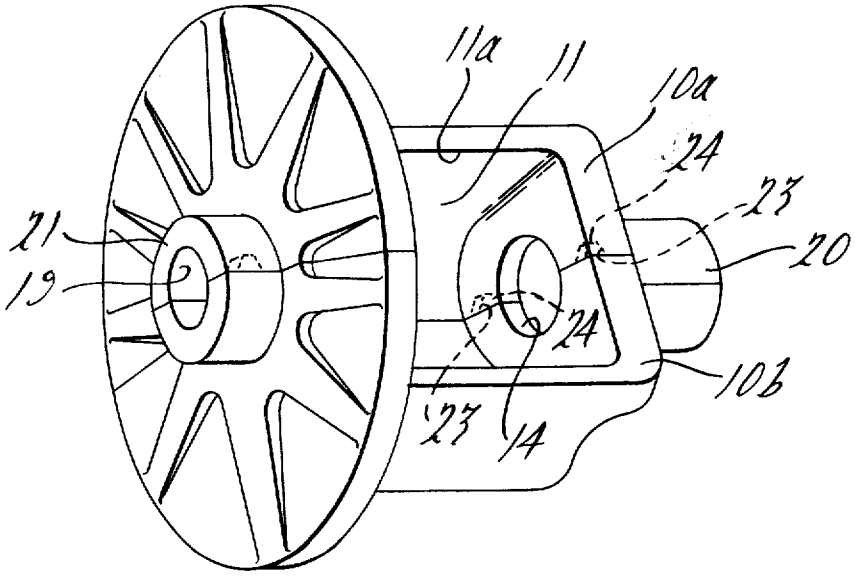
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Fig. 2.

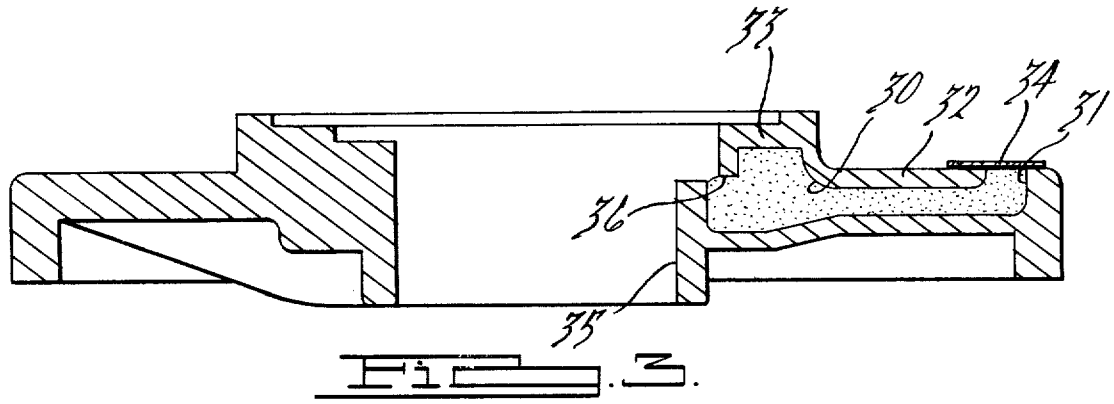

Fig. 3.

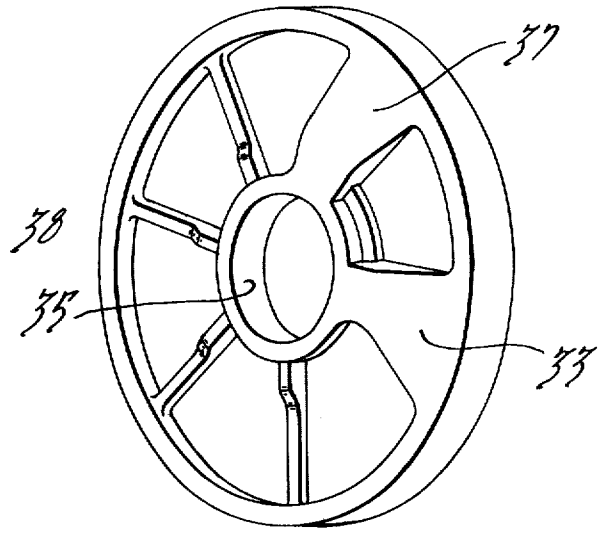

Fig. 4.

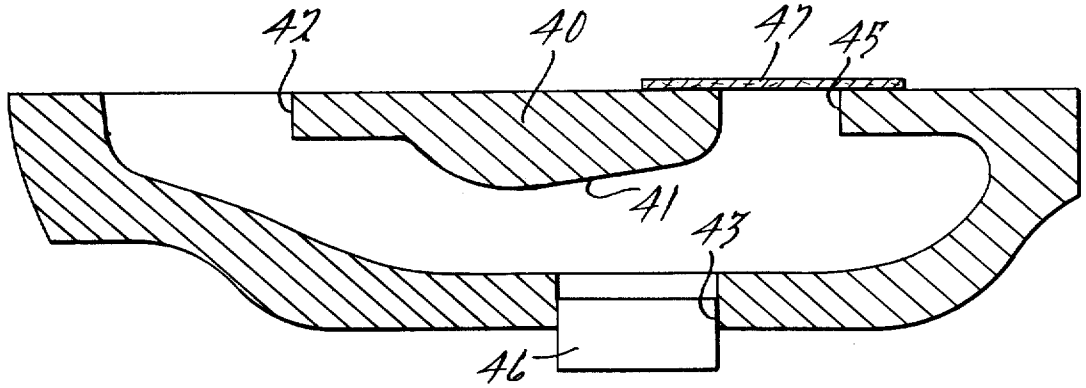

Fig. 5.

DRY SAND CORE PROCESS FOR USE WITH LOST FOAM MOLDING PROCESS

BACKGROUND OF THE INVENTION

Cavityless molding is a method whereby consumable patterns, such as polystyrene foam plastic, are coated with a permeable refractory wash and then embedded in foundry sand to be eventually replaced by molten metal. The molten metal vaporizes the foam-type pattern and a metal duplicate of the pattern is the result. The cavityless feature is derived from the fact that the pattern is not removed from the mold, but rather it is replaced by the molten metal so that the mold is always full of material at any one time. In all other casting processes, a cavity must be provided before the metal can be poured. An important feature of the cavityless method is the fact that unbonded sand can be used which opens up an entirely new field for foundry development.

To this date, the cavityless method has shown good results when concerned with only patterns of a generally uncored configuration or of a cored configuration which is simple and has relatively large openings so that normal sand filling about the pattern will simultaneously fill the interior spaces of the pattern. Little attempt has been made to provide patterns in other than a single unitary form. In those instances where the prior art has attempted to provide a pattern with an interior void, to be filled with sand, pivotal problems of adequate compaction of the filled material has arisen.

SUMMARY OF THE INVENTION

The primary object of this invention is to provide an improved method whereby the cavityless method of casting can be extended to intricately cored parts or parts requiring special interior configurations.

Specific features pursuant to the above object is the provision of consumable type pattern parts which are designed to interfit together when assembled for forming completed patterns. The pattern parts have integrally formed female and male elements adapted to press fit together when the parts are assembled. Openings to the assembled pattern are closed except for a remaining passage through which the pattern may be filled with unbonded sand and compacted assuring that all voids therein are occupied by densified sand. Alternatively, the patterns may be filled in their open or split condition with unbonded sand; a thin consumable membrane is placed thereacross permitting gas pressure to exert force against the membrane to compact the sand. The latter encased pattern parts, with the supply of semi-cored sand therein, are then assembled together with mating membranes in engagement with each other. The membranes are consumed upon casting by contact with the molten metal.

SUMMARY OF THE DRAWINGS

FIG. **1** is a central sectional elevational view of a consumable type pattern in the unassembled condition and having separately prepared coring sand therein, the pattern assembly being ready for insertion into a molding flask;

FIG. **2** is an isometric view of the part of FIG. **1** mated to a complimentary part to form a pattern assembly;

FIG. **3** is a central sectional elevational view of another pattern part illustrating a different embodiment;

the pattern part has at least one passage therein prefilled with sand;

FIG. **4** is an isometric view of the part of FIG. **3** mated to a complimentary part to form a completed pattern assembly; and

FIG. **5** is yet still another pattern embodiment shown as a central sectional elevational view.

DETAILED DESCRIPTION

The cavityless casting method has been applied to the production of castings which either do not have internal passages or which have internal passages largely opened or exposed which will easily fill with dry unbonded sand during the flask filling and compacting process.

The purpose of this invention is to provide a unique approach to pattern preparation of the consumable type wherein the pattern assembly may constitute the core box for the coring sand. The pattern may be simultaneously filled with sand to define such cored body at the same time the pattern assembly is enveloped by sand within a flask. Alternatively, the internal passages of the patterns may be filled with dry unbonded sand, compacted sufficiently to achieve good castings, all prior to the introduction of the filled pattern assembly into the flask or molding bed.

As shown in FIG. **1**, a transmission case pattern **10** is illustrated which has a large internal cavity interconnected with smaller cavities **12** and **13** by openings **14** and **15** respectively. Cavity **11** has a wide mouth **11a** opening the upper wall of the case and has opening **16** communicating with the cavity **11** and passing through the bottom wall **17** of the case. The smaller cavities are shaped as cones **12***a* and **13***a* and each have a smaller cylindrical opening **18** and **19** passing through a hub **20** and **21** respectively. The pattern assembly will be defined by pattern parts which here are conveniently split across a parting line conforming to the section plane of FIG. **2.**

A preferred method of forming the metallic casting of FIG. **2** by way of the pattern of FIG. **1** would comprise the following:

a. Prepare a plurality of consumable pattern parts (such as **10***a*) from material which is substantially combustible without residue upon contact with molten metal. A preferred material is expanded polystyrene beads having a density no greater than 2 lbs./ft.^{3}. The parts should cooperatively define at least one cavity (such as **11**) within a single pattern **10** when assembled together. Male and female means **23** and **24** are respectively located on said parts, formed integrally of the same material, and are useful in promoting a press lock therebetween when the parts are mated,

b. Assemble said parts (such as **10***a* and **10***b*) together with said male and female means interlocked to define said predetermined pattern and cavity therein; restrict all the openings through said pattern walls (such as **19, 18** and **16**) except for one passage **11**a. A rigid refractory plug **25** may be used to close openings **18** and **19**; a thin membrane **26,** such as impregnated or adhesive paper tape, may be used to close opening **16,**

c. Fill said pattern with sand through said passage **11***a*, while agitating said pattern to compact the filled sand therein to a density of at least 50–70% and to add greater strength to the pattern assembly, said sand should preferably have irregular particles,

d. Adjust the assembled pattern to return to its original predetermined configuration if distorted by the filling operation, and

e. Locate said filled pattern within a molding apparatus, such as flask **27**, and introduce sand about the exterior thereof. Sprues **28** and risers **29** are located in appropriate alignment in said flask and are arranged to provide for bottom pouring or filling of the consumable pattern. The gating of said system is designed to limit the rush of molten metal to the pattern so as to prevent a torrent of metal within the pattern which might wash away some of the cored sand.

Alternatively, the pattern assembly may be filled simultaneously with the filling of the flask. To facilitate this, a special internal passage or pouring spout may be used to deliver the free-flowing dry unbonded sand to the interior of the pattern. Finally subject said sprues and consumable pattern to the molten charge to displace the same for defining a completed casting.

Other alternative embodiments may be designed in as many pieces as required to define internal passage shapes. The pattern pieces would be assembled into a unit pattern using snap together joints or press-fit type male and female elements. The complete pattern assembly will be filled with dry molding sand and, depending on the shape and intricacies of the internal passages, a simultaneous vibration and/or light vacuum would be applied. To facilitate vacuum compaction, a thin membrane may be placed across each exposed interior of the separated pattern part; the membrane should be of the consumable type. Then suction can be applied through one of the openings to allow exterior pressure on the membrane to compact the sand in the part. The sand or molding medium contained within the pattern cavity serves to rigidify the assembly during subsequent movement and handling in or out of the flask. Containment can be provided by a removable cover, such as tape or snap-on cover or in special cases, by a rigid refractory based plug which is driven into the opening and extends beyond the pattern itself. The type or degree of containment required would depend on the configuration of the part and the degree of exposure to the final flask filling and compacting. Should the filling or drive plug insertion cause distortion, the initial shape of the foam pattern may be adjusted to compensate. The pre-filled pattern has increased rigidity and particularly in the case of long slender patterns. Thus the potential distortion due to sand compaction in the filled flask is decreased.

In FIGS. **3** and **4**, another embodiment is illustrated wherein an auxiliary intricate cavity **30** must be filled as a core. Opening **31** through the wall **32** of the pattern part **33** is closed by a membrane **34.** Opening **36** is retained open for filling of cavity **30.** The other opening **35** in the part is so large that it can be filled by sand during normal flask filling in accordance with prior art techniques. The pattern has complimentary part **37** which is lockingly mated at parting line **38** by means of tape **39.**

Still another embodiment is shown in section in FIG. **5.** Here part **40** has an intricate cavity **41** in communication with three passages or openings **42, 43** and **45.** Opening **43** extends through the bottom of the part **40** and is closed by a rigid refractory plug **46** driven into the opening **43.** Opening **45** is closed by a thin consumable membrane **47.** Opening **42** is retained open for filling of cavity **41.**

I claim as my invention:

1. A method of forming metallic castings, comprising:

a. prepare a pattern from material which is combustible substantially without residue upon contact with molten metal, define said pattern with a remote internal cavity and a plurality of openings passing through the walls of said pattern to communicate with said cavity,

b. close off all except one of said openings substantially with refractory material either in the rigid form or loose particulate form supported by a thin consumable membrane,

c. locate said pattern in a molding apparatus,

d. fill said pattern with dry unbonded sand through said opening either simultaneously with filling of said apparatus with dry unbonded sand or prior to the filling of said apparatus with dry unbonded sand, compact said sand both within and about said pattern to achieve a density of at least 50–70%, and

e. introduce molten metal to pattern to displace said material.

2. A method of forming metallic castings, comprising:

a. preparing a plurality of consumable pattern parts substantially combustible without residue upon contact with molten metal, said parts cooperatively defining at least one cavity within a single pattern when assembled together, male and female means being respectively located on said parts effective to promote a press lock therebetween when mated,

b. assembling said parts together with said male and female means interlocked so as to define said predetermined pattern and cavity therein, and restricting all openings through said pattern except for one passage,

c. filling said pattern with sand through said limited passage, compacting said sand to form a core within the pattern while insuring a full filling of all voids therein,

d. adjusting the assembled pattern to return into its original predetermined configuration if distorted by filling, and

e. locating said filled pattern within a molding flask, introducing said sand about the exterior of said pattern while arranging sprues and risers in appropriate alignment therewith, and finally subjecting said sprues and pattern to a molten charge to displace said pattern for defining a completed casting.

3. The method as in claim **2,** in which said parts for said pattern are defined so as to render access for conveniently shaping the interior thereof and so that all internal surfaces are fully exposed when viewed from the internal side of said parts.

4. The method as in claim **2,** in which said male and female means are each formed from the same material as said pattern parts, all of said parts being constituted of expandable polystyrene having a density no greater than 2 lbs./ft.^{3}.

5. The method as in claim **2,** in which the openings through said pattern except for said limited passage are closed by a thin membrane subject to being consumed upon contact with said molten metal without substantial residue.

6. The method as in claim **1,** in which said thin membrane is comprised of an adhesive paper tape.

7. The method as in claim 2, in which said gating system defined by said sprues leading to said pattern are sized to prevent a torrent of molten metal consuming said pattern to wash away sand constituting said core.

8. The method as in claim 2, in which the sand used to fill said pattern is comprised of irregular particles effective to obtain an interlock therebetween with a green strength to sustain said sand body if lifted.

9. The method as in claim 2, in which said spruce and riser is effective to introduce molten metal to said pattern through the bottom thereof.

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