

Oct. 13, 1953

E. E. ENSIGN ET AL
PRECISION CASTING PROCESS

2,654,925

Filed June 23, 1950

3 Sheets-Sheet 1

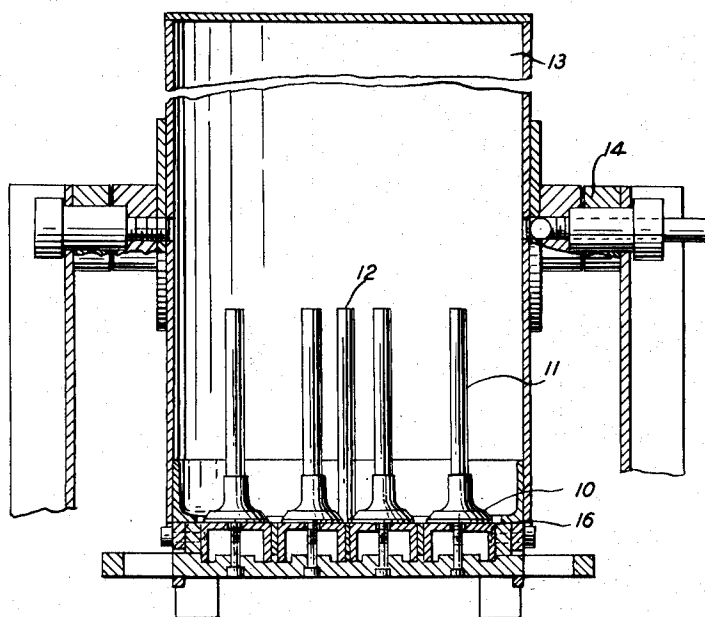


Fig. 1.

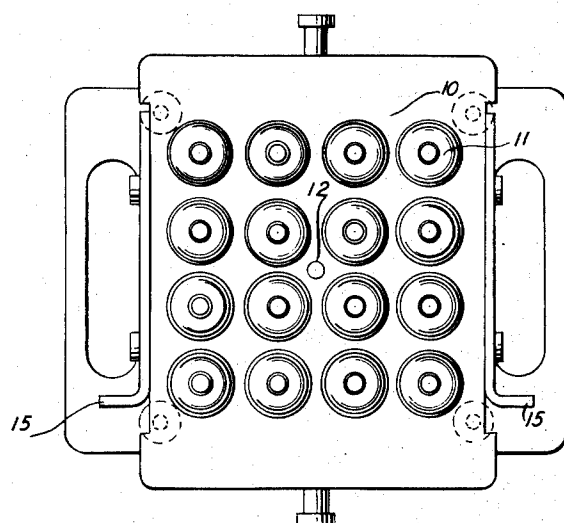


Fig. 2.

E. E. ENSIGN
R. A. VAN PATTEN
INVENTORS
BY E. C. McRae
J. R. Faulkner
H. Oster
ATTORNEYS

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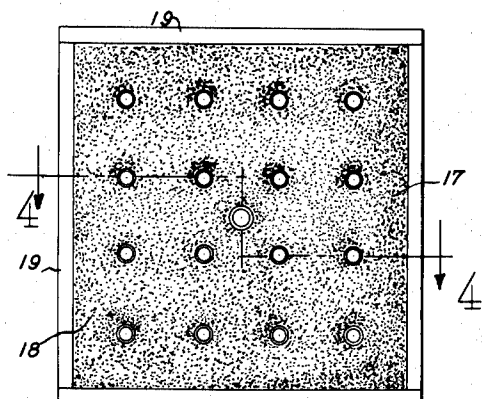


Fig. 3

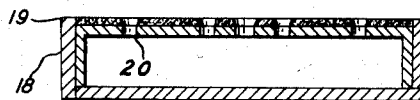


Fig. 4

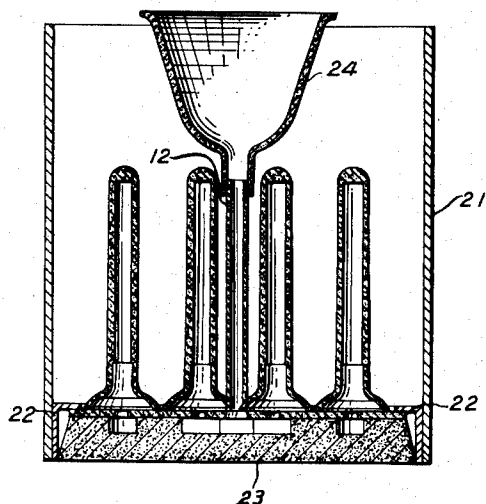


Fig. 5

EE ENSIGN
R.A. VAN PATTEN
INVENTORS
E. C. McRae
BY J. R. Zarekner
D. H. Oster
ATTORNEYS

Oct. 13, 1953

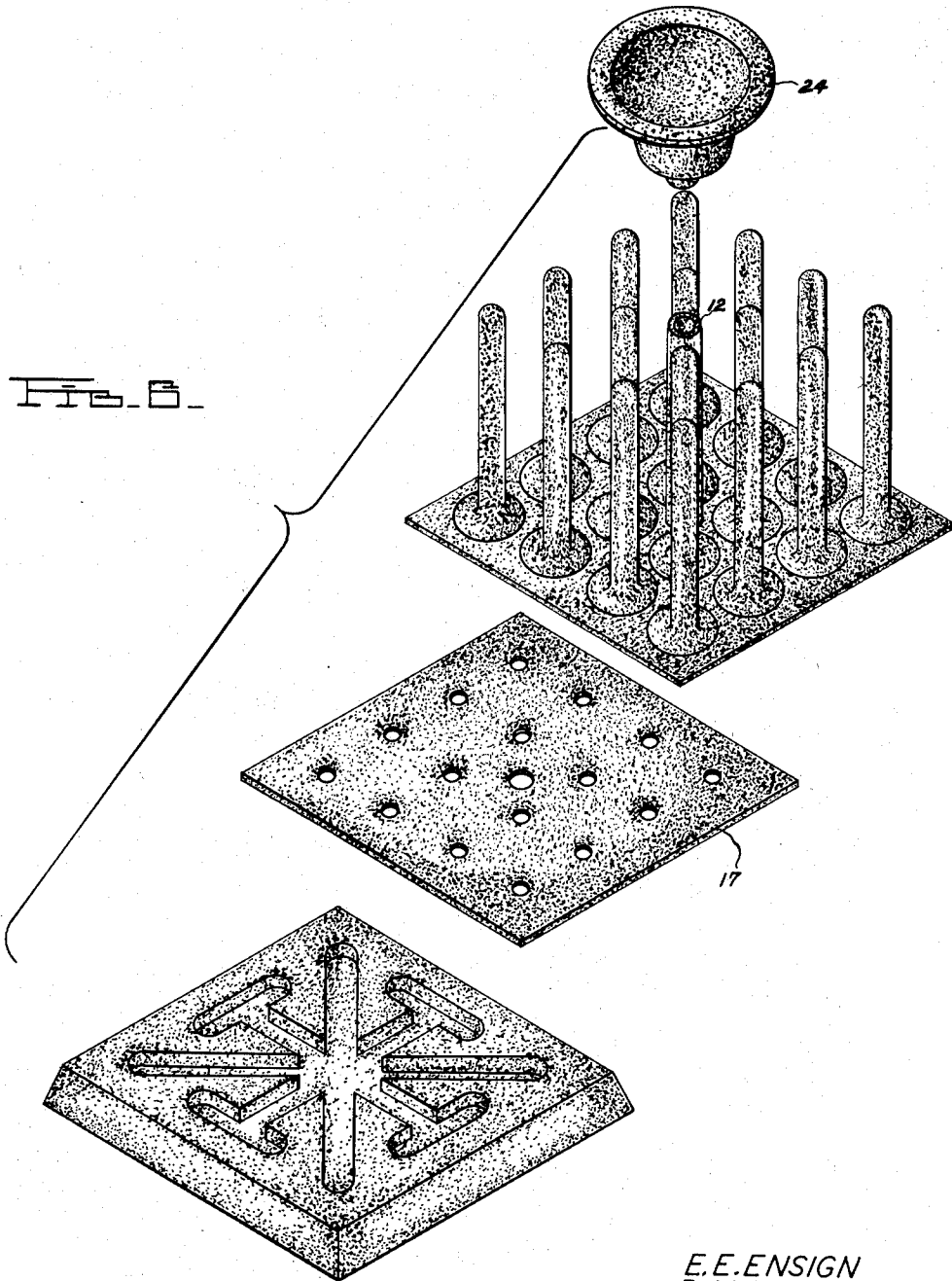
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3 Sheets-Sheet 3

Fig. 5



E. E. ENSIGN
R. A. VAN PATTEN
INVENTORS
BY *E. C. McRae*
J. R. Faulkner
L. H. Oster
ATTORNEYS

UNITED STATES PATENT OFFICE

2,654,925

PRECISION CASTING PROCESS

Elbert E. Ensign, Ypsilanti, and Royal Arch Van Patten, Garden City, Mich., assignors to Ford Motor Company, Dearborn, Mich., a corporation of Delaware

Application June 23, 1950, Serial No. 170,008

5 Claims. (Cl. 22-193)

This invention is concerned with the founding industry in general and more specifically with a process for the simultaneous casting of a large number of identical pieces to very close tolerances and at low cost.

The foundry industry has for some time been familiar with a molding procedure referred to as the shell process. This process is described in detail in a publication by the Office of Technical Services of the United States Department of Commerce identified as FIAT Final Report No. 1168, PB81284 bearing the date of May 30, 1947. Briefly this process includes the formation of molds by contacting a pulverulent molding material with a heated polished metal pattern. The molding material is preferably clean, fine sand with which has been mixed intimately five to ten per cent of an uncured phenol formaldehyde resin containing the usual hexamethyltetramine as an accelerator. The molding material clings to the heated pattern and the resin partially cures in place by virtue of the heat derived from the pattern. This partially cured mold still on the pattern is now heated in an oven for a short time to complete the cure of the resin bond. This yields a mold having remarkable permeability and which imparts a very fine finish to castings. Ferrous and non-ferrous metals may be cast in such molds with equal facility.

This invention is not concerned with the broad process above outlined but rather with certain molding procedures appurtenant thereto which are perhaps best understood by reference to the drawings in which

Figure 1 is a sectional view of a certain gang pattern enclosed in a container employed for applying the sand resin mixture to the heated poppet valve pattern.

Figure 2 is a plan view of the gang pattern shown in section in Figure 1.

Figure 3 is a plan view of a mold employed to produce a gate plate useful in the molding procedure. This mold is shown with a gate plate in place.

Figure 4 is a sectional view of the mold shown in Figure 3.

Figure 5 is a sectional view of a completed mold assembly ready to receive the molten metal.

Figure 6 is an exploded perspective view of the runner plate, gate plate and gang mold.

The assignees of the instant inventors are producing by this process exhaust valves for internal combustion engines. These valves are poured from electric furnace steel having about the following analysis:

	Per cent
Carbon-----	0.30 to 0.45
Manganese-----	0.80 to 1.30
Chromium-----	18.0 to 20.8
5 Nickel-----	7.5 to 8.5
Silicon-----	2.75 to 3.25
Phosphorous-----	0.03 maximum
Sulphur-----	0.03 maximum

Despite the high melting point and syrupy consistency of this highly alloyed steel, it has been found possible to consistently produce a high percentage of acceptable castings with an overall yield in excess of 50%. For a casting produced by this process to be acceptable, its finish and dimensional accuracy must be such that the only machining required is a final grind. In comparison with this performance the usual sand casting procedure gives only about a 33% yield and requires a rough cut and a fine cut to remove the excess metal before the finish grind. The conventional sand castings must, of course, be rattled prior to machining. This rattling is unnecessary when using the shell process.

In the preparation of molds for the casting of valves use is made of a metal gang pattern designated in general by the numeral 10. This gang pattern comprises in this case sixteen individual valve patterns 11 arranged in four rows of four valves in each about a central down sprue 12. These same parts are of course shown in the plan view in Figure 2.

In the preparation of the mold the metal gang mold 10 is first dipped in a parting composition and then heated to about 300° Fahrenheit. The preferred parting composition is an aqueous emulsion containing about 5% of any of the many commercially available silicones which are marketed as foundry parting compounds. When the mold 10 has been given a coating of parting agent and heated to 350° Fahrenheit, container 13 is rotated on trunnions 14 through 180° from the position shown in Figure 1. This container is partially filled with a molding compound comprising about 7% of an uncured phenol formaldehyde resin intimately ground with fine clean sand. For the sake of clarity the molding compound has been omitted from Figure 1. With the container 13 rotated into the position described, the gang pattern 10 is inverted so that the valve stems point downward and securely fasten to the open end of container 13 by means of latches 15 (Figure 2). The entire assembly is then rotated through another 180° to the position shown in Figure 1 and permitted to remain in that position with the entire gang

pattern 10 submerged in the sand resin mixture. The sand resin mixture adheres in a thin layer to the heated pattern as the resin starts to cure. At the expiration of a predetermined period of time, container 13 with the attached gang mold pattern 10 is again rotated through 180°, latches 15 are released and gang pattern 10 removed.

The gang pattern with the adhering mold is now transferred to an oven maintained at about 650° Fahrenheit and exposed to this temperature for about one minute. This completes the curing of the mold which can now be stripped from the gang pattern. This stripping is accomplished in the instant case by causing the valve patterns 11 which are individually supported on cylinders 16 to retreat into the surface of the gang pattern.

In the use of the mold so prepared, it has been found helpful to employ a gate plate which is indicated by the numeral 17 in perspective in Figure 6. The manufacture of this gate plate is best shown in Figures 3 and 4. This gate plate is produced in a gate plate mold 18 shown in plan in Figure 3 and section in Figure 4. This gate plate mold comprises a shallow steel box formed by side walls 19 and bottom plate 20. The bottom plate 20 contains a plurality of perforations, one for each of the valves and one for the down sprue.

To form the gate plate the heated gate plate mold 18 is filled with the sand resin mixture and struck off level as shown in Figure 4. When the gate plate mold 18 is so filled and struck off, perforations are formed in the gate plate so molded corresponding to the perforations existing in the gate plate mold 18. This procedure has the further advantage that these perforations in the gate plate assume a conical shape the angle of which is equal to the angle of repose of the sand resin mixture. This conical shape is very useful in securing a clean break of the castings from the sprue as will be brought out below.

Figures 5 and 6 are respectively a sectioned assembly and an exploded perspective view of the mold, the gate plate and the runner plate. In Figure 5 the mold, the gate plate and the runner plate are shown assembled in a box 21 which is provided with angles 22 which serve to hold the assembly together. The entire assembly is mounted upon slab 23.

For the introduction expeditiously of the molten metal, runner cup 24 is fitted to the top of down sprue 12. The use of runner cup 24 permits the workman to fill this cup with molten metal in one quick operation without the necessity of awaiting the flow of metal to the many remote sections of the mold. The box 21 is filled with sand, spent shot or similar granular metal which serves to support the mold against the hydrostatic pressure of the metal.

It can readily be appreciated from a study of Figures 5 and 6 the gate plate 17 is actually used in a position which is the reverse of that in which it is produced in the gate plate mold. This causes the narrow portion of the perforations to be adjacent the valve heads and the smooth surface of gate plate 17 produced against gate plate mold 18 to form the upper surfaces of the valve head. This produces a smooth valve head and permits a clean break-off.

This process has been particularly described in connection with sand-resin mixtures but its scope is not so limited. The process can be employed with the conventional drying oil bound core

mixes, or any of the other known molding materials.

We claim as our invention:

1. The process of producing a perforated gate plate for use in the production of a number of castings in a single mold comprising applying a layer of molding material and binding agent to a plate having a perforation for each perforation desired in the gate plate, striking off said layer of molding material on said plate and curing the gate plate so produced on said plate whereby a gate plate having truncated conical perforations with their small diameters the same size as the plate perforations are produced.

2. The process of producing a perforated gate plate for use in a foundry mold comprising applying a layer of molding material to a plate having a perforation corresponding to the desired perforation in the gate plate, striking off said layer of molding material on said plate and curing the gate plate so produced whereby a gate plate having a truncated conical perforation with its small diameter the same size as the plate perforation is produced.

3. The process of producing a perforated gate plate comprising applying a layer of heat settable molding material to a heated plate having a perforation corresponding to the desired perforation in the gate plate, striking off said layer of molding material on said heated plate, further heating the combination of the heated plate and the struck off molding material to complete the cure of the molding material, and freeing the gate plate from the heated plate to produce a gate plate having a truncated conical perforation with its small diameter the same size as the plate perforation.

4. The process of producing a perforated gate plate comprising dipping momentarily a heated plate into an aqueous parting emulsion, applying a layer of heat settable molding material to the heated plate having a perforation corresponding to the desired perforation in the gate plate, striking off said layer of molding material on said heated plate, further heating the combination of the heated plate and the struck off molding material to complete the cure of the molding material, and freeing the gate plate from the heated plate to produce a gate plate having a truncated conical perforation with its small diameter the same size as the plate perforation.

5. The process set forth in claim 4 in which the parting emulsion includes a silicone compound.

ELBERT E. ENSIGN.

ROYAL ARCH VAN PATTEN.

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