

1 564 951

- (21) Application No. 50611/76
- (22) Filed 3 Dec. 1976
- (31) Convention Application No. 2 554 414
- (32) Filed 3 Dec. 1975 in
- (33) Fed. Rep. of Germany (DE);
- (44) Complete Specification published 16 April 1980
- (51) INT. CL.³ B22C 15/00
- (52) Index at acceptance
B3G 8J2 8J4B



(54) METHOD AND DEVICE FOR THE MANUFACTURING OF SAND CASTING MOLDS

(71) Wc, ALFEDER MASCHINEN- UND MODEL-FABRIK KUNKEL, WAGNER & Co. KOMMANDITGESELLSCHAFT, of Hannover-sche Strasse 59, 3220 Alfeld/Leine, Federal Republic of Germany, a body corporate organised under the laws of the Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

The invention relates to a method and a device for the manufacture of sand casting molds, whereby sand is compacted within a molding box above a pattern under pressure.

Numerous different molding machines for the manufacture of sand casting molds are known. Customarily the sand is compacted on the pattern by pressure. It is, however, also known to jar the sand during compacting or preferably as initiation of the compacting process, in order to aid the compacting process. In addition to these two known procedures the so-called shot-method is also increasingly used, whereby the sand is "shot in" as a plug into the molding box, which is resting on the pattern support plate. In all three cases, highly developed machines are available, resulting in high quality sand molds.

While noise at a disturbing level is hardly produced during pressure compacting alone, the jarring method leads to excessive noise that can hardly be tolerated under today's requirements for hygienic working conditions and for environmental protection. Also due to the jarring jolts, such machines are mechanically under a high degree of stress and wear more rapidly. Similar considerations with regard to noise development apply to the shot method.

Although, therefore, for these reasons, the press-method is preferred, the area of application of the pressing procedure alone is very limited. It has been attempted to broaden the area of application of this method through the development of special

technology, for instance through high pressure multiple presses or diaphragm presses. However, practice has shown that a satisfactory mold can only be produced by the jarring process. The annoying noise level of the jarring process has, to a great extent had to be tolerated. Noise reduction with the jarring can only be achieved with simultaneous reduction of compacting. Therewith nearly insurmountable limits are placed on the adherence to acceptable noise levels. The use of noise isolating enclosures or the like for the entire molding machine represents a remedy, but at the same time a measure which considerably handicaps the manufacturing process and also makes it more expensive.

The invention seeks to relieve this condition and to provide a simple, economical process, in which the compression of the sand, in particular for difficulties which occur with complicated patterns, can dependably be surmounted without the danger of excessive noise, the possibility of a considerable decrease of the compacting energy is created, and the compression process can be improved and expedited.

According to a first aspect of the invention, there is provided a method for the production of sand casting molds, in which sand is poured over a pattern in a molding box and is compacted by pressure in the molding box after filling with the aid of a press head, wherein the sand mass, the pattern and the press head are kept in an airtight chamber and are subjected to a vacuum which is produced in the chamber at the latest at the start of compacting of the sand and which is maintained throughout the compacting.

In this regard the invention is based on the realization that during the compacting process, the air contained between the sand and the pattern can lead to considerable problems and difficulties. During compacting the air must escape within a short time, in most instances in less than 1 second. Moreover, it must be taken into considera-

50
55
60
65
70
75
80
85
90
95

tion that the compacting during pressing should occur at great speed once the sand mass has been put into motion. During compacting, the mass-inertia of the sand must be utilized to overcome the internal frictional force of the sand. This can be easily understood, if one considers that great variation in frictional force between sliding friction and friction at rest. Once the sand system has come to rest under bridge formation during the compacting, disproportionately high compacting forces have to be expended in order to again bring the sand system into motion and to further compact it. With polymorphic pattern contours, it is particularly difficult for the air to escape along the pattern contour. The enclosed air is therefore compressed in accordance with the dynamic forces of the sand mass becoming effective. This causes "air bubbles" to form on the surface of the pattern, that is, air filled spots of little sand density. With the utilization of the jarring process a few hefty vibrating shocks will, in most cases, be enough to promote the escape of the air and to destroy "air bubbles" in process of forming. Under the jarring effect the sand accumulates evenly and densely on the surface of the pattern. Therefore, the jarring process has been considered indispensable, in particular for difficult pattern shapes.

With the new process, a dependable and most of all also rapid escape of the air and avoidance of forming of air bubbles has been provided without vibrating shocks. Through introducing the sand and the pattern into an airtight space, the existing volume of air is first of all limited to a controllable amount and, at the same time, the condition is created, which allows the evacuation of even this air and at reliable speed from the entire sand system by the utilization of vacuum.

In each event the vacuum must be maintained in the closed-off space during the compacting process. Since every compacting process, especially during pressing, has a certain starting phase, for example because of the acceleration of the moving parts of the press, in many cases the producing and maintaining of the vacuum during compacting will suffice to overcome the indicated difficulties. It may, however, also be particularly practicable, to subject the pattern and the sand mass to the vacuum also immediately prior to the compacting, so that compacting itself occurs in the vacuum.

If the necessary measures are taken, it can be provided that the exhausting of all annoying air from the sand system occurs within a time-span of considerably less than one second. In practical application a time-period of $\frac{1}{2}$ second or less is needed for the exhausting, so that the removal of the air from the sand system does not time-wise

affect the compacting process. In comparison, a jarring time of not less than 2 seconds is required with the jarring method in order to achieve the same result.

According to a second aspect of the invention, there is provided apparatus for producing a sand casting mold comprising a compacting mechanism, a pattern support, a frame-shaped molding box for containing the pattern and a predetermined quantity of sand, and a casing adapted to be fitted over the molding box and compacting mechanism and to be rendered air-tight, wherein channels are provided in the pattern and support and are adapted to be connected to a vacuum source.

With the apparatus according to the invention, any noise excess can be eliminated and at the same time the sand can be distributed evenly and densely on the surface of the pattern without developing "air bubbles". At the time the compacting operation is reduced, as no air, which also has to be compacted, exists. Finally it can be achieved that the sand system, after the beginning of the compacting process, remains in motion more dependably and at lesser pressure, and the danger of the bridge development and the temporary standstill of the sand mass are eliminated.

The invention will now be described in greater detail, by way of example, with reference to the schematic drawings in which:—

Figure 1 shows a side-view of the apparatus for carrying out the method, partly also in vertical section;

Figures 2 to 4 shown in various views and in larger scale partial views of the air outlets of the apparatus, and

Figure 5 shows, in similar presentation to Figure 1 a modified embodiment of apparatus in accordance with the invention.

The device shown in Figure 1 has a lower press plate 2 with pattern support 3, on the top of which the pattern 4 to be formed in the sand is attached. The exposed surface of the pattern 4 is designated 5. From the surface of the pattern support 3, the pattern 4 extends into the molding box defined by the frame 6. On the upper edge of the molding box sits a sand-frame 8 which facilitates filling of the molding box with sand 7. On the sand frame is a further frame 9 which extends up to a cover 10 to which the upper press cylinder 15 is attached. The press cylinder carries on its lower end a press head, the underside of which is designated 16 and which directly transmits the ram pressure onto the sand 7.

Respective gaskets 14, 13, 12 and 11 are provided at the abutting surfaces of the pattern support 3 and the molding box, the molding box and the sand frame 8, the sand frame 8 and the further frame 9 and the

65

125

130

further frame 9 and the cover 10. An airtight space or chamber 30 is thus formed, enclosed between the wall of the cover 10 and the bottom part of the press 2 in the operating position shown, which space or chamber contains the press cylinder 15 as well as the sand mass and the pattern.

The invention seeks to replace the jarring, which is noisy, of the known methods, with a process that is congenial to the environment. The first step in this direction is the sealed enclosing of the sand mass 7 and the pattern 4 in the airtight chamber 30. The second step consists in connecting the chamber 30 for certain phases of the manufacturing process to a source of vacuum. This can be done in various ways.

In the embodiment shown in Figure 1, in particular, the part of the airtight chamber 30 containing the sand mass 7 and the pattern 4 will be connected to the source of vacuum. Thereby the sucking out of the air contained in the sand occurs from both sides, that is, from the underside 16 of the upper press part 15 as well as from the surface 5 of the pattern 4.

For this purpose, suction nozzles 22 are provided in the pattern at predetermined places. The suction nozzles 22 are connected, via channels 21 in the pattern 4, to a suction chamber 17 on the surface of the pattern support 3. From the suction chamber 17, a channel 18 leads to the outside and is connected to a vacuum pipe 19 which can be selectively connected to atmosphere by a valve 20 at 19*b*, or through a filter device 23 to a large volume vacuum container 24, which is constantly held at the desired vacuum by a vacuum pump 28. Before or behind the filter unit 23, which removes possible grains of sand that are carried along by the air-stream, another valve unit 20*a* may be provided, with the aid of which the large volume vacuum container 24 can be by-passed through a secondary pipe 19*a*. Another pipe, branching off from the valve 20, leads to a reservoir 29 for gaseous chemical hardening agents, as they are generally known.

Similar suction nozzles 22 are also provided on the underside 16 of the upper press head. The slit nozzles are connected with a vacuum chamber 25 and through channels 26, which lead through the press head and the upper press part 15, via connecting pipes 27 and 19*b*, to the above described suction and filter-unit. The suction nozzles are for practical purposes cup-like inserts 33, which, between wedge-shaped bars 32 in the bottom, for slits 31, which are narrower on the side 34 towards the sand mass 7 than on the inside. These cup-shaped inserts 33 are inserted at the desired positions on the pattern and/or of the upper press head, where-

by the surface 34 is always turned toward the sand mass 7.

Since for the quality of the sand mold, especially with complex pattern shape, an even, dense distribution of the sand layers near the pattern surface is decisive, it may be particularly advantageous to such the air out of the sand mass from the side of the pattern surface 5, as is shown in Figure 1. In so doing, care will be taken, particularly with a complicated pattern surface, to select the places on the surface the slit nozzles are to be attached, so as to achieve the desired result and simultaneously to ensure that the slit nozzles are only placed where the surface imprint in the sand mold assumed by the slit nozzles does not cause an impairment of the object it will produce. These difficulties do not exist if the suctioning off occurs from the side of the press head 16, as there the cups are situated along those areas of the sand mold, that are irrelevant to the object to be cast.

Particular application has shown that, for the time span required to suck the air out of the sand mass 7, it is without significance whether the air is sucked out from one side, the pattern side or from the press head side, or from both sides simultaneously. The suction time is in any event far less than one second and as a rule is $\frac{1}{2}$ second or less.

It is of course a prerequisite that the connecting channels between the slit nozzles and the vacuum unit have a sufficient cross-section. It has proven to be especially advantageous, if, between the pump and the airtight chamber 30, a vacuum tank of large volume is introduced, which is continuously kept under vacuum and ensures a particularly rapid suction of the air out of the enclosed sand mass 7.

Suction can also be utilized to good advantage for the really simple and even and dosed introduction of a gas for chemical hardening, which is injected into the sand mass 7 after its final compacting. For this purpose the gaseous hardening agent can be sucked from the reservoir or storage container 29 into the chamber 30, which is kept under vacuum during the entire compacting process, by reversing the valve 20. The small spaces of the compacted sand system, from which the air has been evacuated, thereby suck the hardening gas evenly into the entire system. After the required hardening period the excess amount of gas can be sucked out of the chamber 30 and out of the hardened sand mold by again switching to the vacuum pump via the line 19*a*, before the vacuum chamber 30 is exposed by opening the valve 20, so that, also as opposed to the methods which include chemical hardening known heretofore, environmental pollution from the excess gases is really not to be feared with the new process. For this purpose, after

leaving the pump, the extracted amounts of gas and air must still pass to facilities, in themselves known, which filter the environmentally hazardous gas components, and

5 chemically decompose, retreat or burn them. Because of the rapid suction this can take place during the actual compacting, although in many events it is expedient to begin with the suction and to follow directly with the compacting process. In any event the chamber 30 remain on vacuum during the entire compacting process. Experience has shown, that, with this method, a very even, dense layer of sand is ensured on the pattern surface, even with complicated patterns and the sand mass can be compacted with considerably less effort more uniformly and without the danger of bridge or bubble-forming. The entire process is rather shorter than with the conventional methods. Primarily however, the environmental noise excess, as with the jarring method, can be completely eliminated.

Figure 5 shows a device for the application of the new process in a compacting device, which consists of a high-pressure multiple stamp press. The press 42 shows numerous stampers 41, which operate spaced closely parallel to each other, so as to compact the sand system across the pattern. In this embodiment, no nozzle slits have to be installed in the stamper part, as the slits 45, remaining between the press heads 41 suffice to suck the air from the sand mass from the side of the press. For this purpose the connecting piece between sand frame and cover is provided with a connection for the vacuum pipe 44. Otherwise the device operates in the same manner as previously described.

WHAT WE CLAIM IS:—

1. A method for the production of sand casting molds, in which sand is poured over a pattern in a molding box and is compacted by pressure in the molding box after filling with the aid of a press head, wherein the sand mass, the pattern and the press head are kept in an air-tight chamber and are subjected to a vacuum which is produced in the chamber at the latest at the start of compacting of the sand and which is maintained throughout the compacting.

2. A method according to claim 1, wherein the pattern and sand mass are subjected to the vacuum before the start of the compacting operation.

3. A method according to claim 1 or claim 2, wherein the air is removed from the sand mass by suction through the surface of the pattern.

4. A method according to claim 1, 2 or

3, wherein the air is removed from the sand mass by suction in a direction away from the pattern surface.

5. A method according to any one of claims 1 to 4, wherein, after compacting, the airtight chamber is separated from the vacuum and at the same time is connected to a source of gaseous chemical hardening agent.

6. A method according to claim 5, wherein at the end of the hardening phase and before opening of the airtight chamber, said chamber is cut off from the source of gaseous hardening agent and is re-connected for a limited period to the vacuum source.

7. Apparatus for carrying out the method according to claim 1, comprising a compacting mechanism, a pattern support, a frame-shaped molding box for containing the pattern and a predetermined quantity of sand, and a casing adapted to be fitted over the molding box and compacting mechanism and to be rendered air-tight, wherein channels are provided in the pattern and support and are adapted to be connected to a vacuum source.

8. Apparatus according to claim 7, wherein the airtight chamber is connected by said channels to a large container, in which a constant vacuum is maintained.

9. Apparatus according to claim 7 or claim 8, wherein the airtight chamber can be connected to a source of a gaseous chemical hardening agent.

10. Apparatus according to any one of claims 7 to 9, wherein the compacting mechanism comprises a plurality of individual compacting stampers, and wherein suction nozzles are formed by gaps between the individual stampers.

11. Apparatus according to any one of claims 7 to 9, wherein suction nozzles, in the form of several slit nozzles, are distributed over the respective border surfaces of the airtight chamber and communicate with suction channels.

12. Apparatus according to claim 11, wherein the slit nozzles are provided in the surface of the pattern and/or in the surface of the compacting mechanism.

13. A method for the production of sand casting molds substantially as described herein with reference to the drawings.

14. Apparatus for producing sand casting molds substantially as described herein with reference to the drawings.

For the Applicants:
J. F. WILLIAMS & CO.,
Chartered Patent Agents,
113 Kingsway,
London, WC2B 6QP.

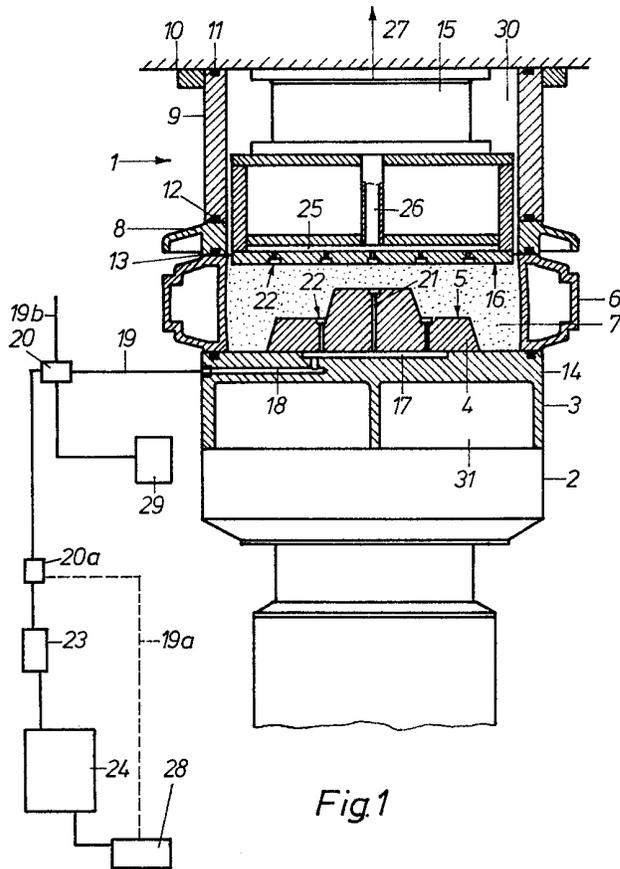
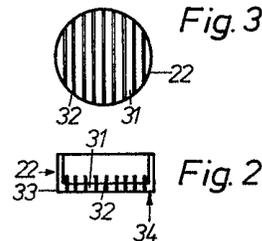
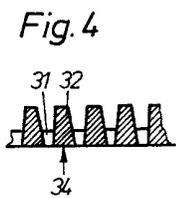


Fig. 1

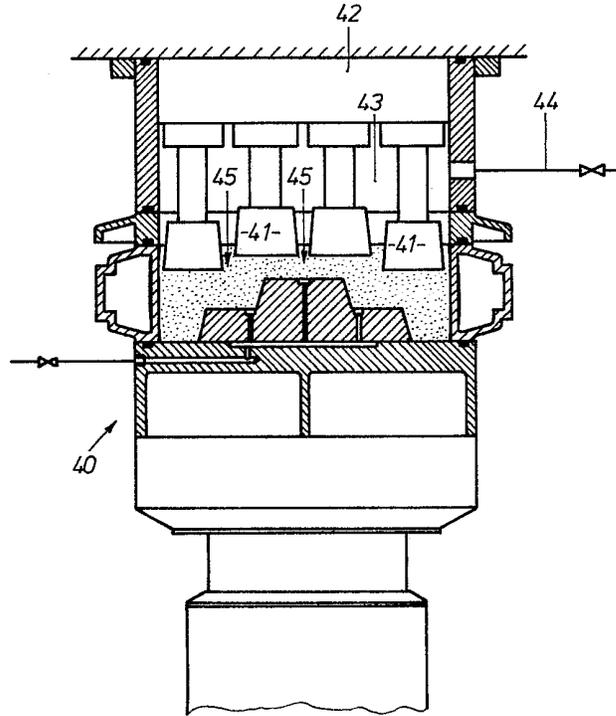


Fig. 5