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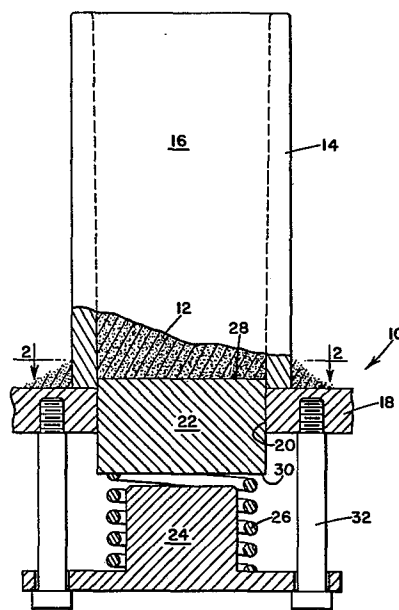
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54 **Method and apparatus for use in making a sand mold.**

57 The removal of a deep bore pattern (14) from a sand mold is facilitated by exerting a force on the sand (12) within the bore (16) to break the bond between the sand and the internal surface of the pattern. The pattern (14) is supported on a pattern plate (18) having an aperture (20) in line with the bore (16). A stripper block (22) is slidably received in the aperture and can extend into the bore. A fixed back plate (24) is supported on the pattern plate, and a compression spring (26) is positioned between the stripper block (22) and the back plate (24). As sand is packed into the mold, and hence the bore, under pressure, the stripper block is forced out of the bore against the spring. When the pressure is removed to allow the pattern to be withdrawn, the spring exerts a force on the stripper block causing it to move back to its initial position, thus breaking the sand free from the inside surface of the deep bore.



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METHOD AND APPARATUS FOR USE IN MAKING A SAND MOLD

This invention relates to a method and apparatus for use in making a sand mold.

Green sand molding is a process wherein a pattern can be formed in a sand mold without the necessity of heating or chemically treating the sand in order to form the pattern. This type of molding process encounters difficulty in deep bore patterns, particularly for example with patterns wherein the height of a bore is greater than its width. Often, when such bores are present, the sand tends to break off on the inside of the bore as the pattern is removed. In order to alleviate this problem, foundry people have either inserted a preformed core into the pattern where they desired to form a bore, or have had to add additional draft which caused excessive machining. Both of these alternatives proved to be expensive and required a great deal of time.

Many prior proposals have been made to remove the finished casting from sand molds, for example using vibratory methods (as in US-PS 1,704,100) or methods involving a sufficiently strong longitudinal force on the casting (as in US-PS 1,960,366). When removing a casting from the mold damage to the sand mold is of no importance, and indeed frequently occurs. However, when removing a pattern piece from the mold, it is important that the sand mold remains intact so that a good casting can be formed. Thus these known methods of removing the casting are unsuitable for removal of the pattern piece from the mold before the mold is put to use.

This invention provides an improved method and apparatus for using in making a sand mold, and is defined in its various aspects in the claims below.

The invention will be described in more detail by way of example, with reference to the drawings, in which:

Fig 1 is a side view of one embodiment of the apparatus of this invention;

Fig 2 is a top view of Fig 1 along line 2--2; and

Fig 3 is a side view of a second embodiment of this invention.

In use the molding sand is pressure packed into the mold, about the pattern and into the bore. The pressure both compacts

the sand around and within the pattern and causes the first member to be depressed against the compression means. Subsequently the pressure is released and the pattern plate is removed. When the pressure is released the compression means forces the first member
5 up into the bore to break the sand free from the deep bore pattern to a sufficient extent to facilitate removal of the pattern.

Referring to Figs 1 and 2, an apparatus 10 is shown for breaking sand 12 free from a pattern 14 having a deep bore 16. The deep bore 16 can have almost any shape but most commonly will be a
10 tubular structure wherein the height of the bore is greater than the width.

For purposes of discussion only and not by way of limitation, the apparatus 10 will be explained as being positioned in the horizontal plane with movement in the vertical plane, as illustrated.

15 The apparatus 10 is attached to a pattern plate 18 which contains an aperture 20 which shares the same central axis as that of the deep bore 16. Preferably, the aperture 20 is of the same shape and has the same cross-sectional dimensions as the deep bore 16.

The apparatus 10 includes a first movable member 22, a
20 second fixed member 24, and compression means 26. The first member or stripper block 22, is positioned within the aperture 20 of the pattern plate 18 and partially extends into the opening of the deep bore 16. The exact amount that the first member 22 extends into the deep bore 16 will depend upon the travel distance needed to
25 break the sand 12 free from the inside surface of the deep bore 16. The first member 22 has a top surface 28 and a bottom surface 30. The top surface 28 provides a base for the sand 12 while the bottom surface 30 abuts against the compression means 26. The compression means 26, shown as a coil spring, is positioned between the first
30 member 22 and the second member 24 and serves to yieldably resist the downward movement of the first member 22. The force required to compact the sand 12 into the deep bore 16 is sufficient to compress the compression means 26. Preferably, the top surface 28 of the first member 22 will be flush with the top surface of the
35 pattern plate 18 when the bottom surface 30 contacts the second member 24.

The second member 24 is attached to the pattern plate 18 by support means 32, of which two are shown and serve to hold the

second member 24 away from the first member 22. These support means 32 can be bolts or studs which are screwed into the pattern plate 18.

Turning to Fig 3, a second embodiment is depicted showing the apparatus 10 comprised of several additional elements. In this view, the pattern 14 is securely attached to the pattern plate 18 by machine screws 19, of which one is shown. The apparatus 10 is again attached to the underside of the pattern plate 18 in alignment with the aperture 20. The apparatus 10 is comprised of a stripper block 40 having a top surface 42 and a bottom surface 44. Attached to the bottom surface 44 by screws 46 and a pin 48 is a strip plate 50. The strip plate 50 has a larger cross-sectional diameter than the stripper block 40 and contains a number of apertures 52 located near its outer periphery. The purpose of these apertures 52 will be explained shortly.

Positioned below the strip plate 50 is a back plate 54 which has a stop block 56 fastened to it by a bolt 58. The back plate 54 is approximately the same size as the strip plate 50 and also contains a similar number of apertures 60 located near its outer periphery. The apertures 60 are in alignment with the apertures 52. Passing through each pair of corresponding apertures 52 and 60 is a support means in the form of a machine bolt 62. The support means 62 serve to unite the strip plate 50 and the back plate 54 to the pattern plate 18 while allowing axial movement of the strip plate 50 in the vertical plane.

A collar 64 is concentrically positioned around each support means 62 between the pattern plate 18 and the strip plate 50. These collars 64 limit the upward travel of the strip plate 50. Also concentrically positioned about each of the support means 62, between the strip plate 50 and the back plate 54, is compression means 66, such as a plurality of coil springs of equal compressive strengths. The compression means 66 serve to yieldably resist the downward movement of the stripper block 40 as the sand 12 is compacted and pressed into the deep bore 16 of the pattern 14. The compression means 66 are designed to be gradually compressed by the applied force on the sand 12 until the strip plate 50 contacts the stop block 56. The stop block 56 will prevent further downward movement of the strip plate 50. After the applied pressure on the

sand 12 is released and the pattern plate 18 is being separated from the mold, the compression means 66 will urge the stripper block 40 via strip plate 50 back to its initial position. This upward movement of the stripper block 40 will break the bond between the inside surface of the pattern 14 and the sand 12 thereby
5 allowing the pattern 14 to be fully withdrawn leaving a perfect impression.

Operation

The method for making a green sand mold using a pattern
10 having a deep bore will now be explained. In the molding operation, the pattern 14 is first mounted onto the pattern plate 18. A flask box, which is a four-sided frame, is placed on top of the pattern plate 18 and fully encloses the pattern 14. The sand 12, preferably green sand, is introduced into the flask box. This sand
15 12 can be vibrated or jolted along with the flask box and/or pattern plate in order to assure that all cavities and crevices get filled. The green sand 12 is such that it does not have to be heated or chemically treated in order to set but instead is formed about the pattern 14 by pressure alone. Therefore, pressure is
20 applied to the top surface of the sand 12 and this pressure forces the sand 12 downward into and around the pattern 14, including into the deep bore 16.

With the apparatus 10 in axial alignment with the aperture
20 of the pattern plate 18, the applied force on the sand 12 will depress the first member 22 against the second member 24. This
25 action will compress the compression means 26. The amount of pressure required to depress the first member 22 downward to a point where the top surface 28 is flush with the top surface of the pattern plate 18 will depend upon a variety of factors. Such factors include: the type of sand, the composition of the sand, the
30 size of the pattern, the size of the deep bore, the type of equipment the sand mold is being formed on, and the shape of the deep bore. Normally, on a conventional green sand molding machine, the applied pressure is between 800 and 2000 psi (about 5500 and 14000
35 kPa), preferably between 1000 and 1500 (about 7000 and 10000 kPa) and most preferably 1350 psi (about 9300 kPa).

After the sand 12 has set about the pattern 14, the applied pressure is removed and the flask box is stripped from the pattern

14. As this occurs, the first member 22 is simultaneously forced back to its initial position by the compression means 26. This action breaks the sand 12 free from the inside surface of the pattern 14 thereby allowing the pattern 14 to be fully removed from the sand mold without having the sand 12 shear off within the deep bore 16. The pattern 14, the pattern plate 18 and the apparatus 10, all three being permanently connected together, are then ready to be used over again.

The sand mold which has just been formed, is then rotated 180 degrees and is filled with molten material, for example metal. This molten material will fill the impression left in the sand 12 made by the pattern 14. The cast mold is then cooled and the sand 12 is broken away leaving the finished casting.

To assist in breaking the sand 12 free from the inner surface of the pattern 14, a slight tapered draft can be used. This tapered draft, shown on the inner wall of the pattern 14 in Fig 1, should be about one degree and preferably about one half of a degree. It should be noted that the insertion of this slight draft may require extra machining of the finished casting if close tolerances are crucial to the finished product.

The system illustrated facilitates in the removal of a pattern from a sand mold, particularly a deep bore pattern from a green sand mold and has a number of advantages. These include a reduction in the amount of draft required on the inside of a deep bore, and the ability to form deep pockets in the cope half of molds where cores cannot be used. The system furthermore can provide both a time and cost saving over the conventional method.

It will be appreciated that many modifications can be made to the specific examples illustrated.

CLAIMS

1. A method of making a sand mold using a pattern having a bore, particularly a deep bore, the method comprising at least the steps of firming sand about the pattern and into the bore, and removing the pattern from the sand, and wherein a force is exerted on the sand within the bore to at least assist in breaking sand free from the pattern to facilitate removal of the pattern.
2. A method according to claim 1, in which the bore has a movable member positioned at the bottom of the bore, and the said force is exerted on the sand within the bore by moving the movable member into the bore.
3. A method according to claim 2, in which the movable member is resiliently loaded so as to be biased towards the bore.
4. A method according to claim 3, in which the pressure applied to the sand during the firming step is sufficient to displace the movable member outwardly of the bore against its resilient loading.
5. A method according to claim 3 or 4, in which the resilient loading is sufficient to bias the movable member to a position where it enters the bore.
6. A method according to claim 3, 4 or 5, in which the extent of the movement of the movable member against the resilient loading is limited by a stop.
7. A method according to any preceding claim, in which the pattern is supported on a pattern plate having an aperture therein arranged in line with the bore.
8. A method according to any preceding claim, in which the bore has a greater depth than width.

9. A method according to any preceding claim, in which the sand is green sand.

10. A method according to any preceding claim, in which in the firming step the sand is subjected to an applied pressure in the range 800 to 2000 psi (approximately 5500 to 14000 kPa) and preferably in the range 1000 to 1500 psi (approximately 7000 to 10000 kPa).

11. Apparatus for use in making a sand mold comprising a pattern plate for supporting one surface of the mold and having at least one aperture arranged in line with the position of a bore in a pattern (14), and including freeing means for at least assisting in breaking sand free from a pattern used to form the mold to facilitate removal of the pattern, the freeing means comprising a first member (22) movably positioned in the bore, a second member (24) supported in a spaced-apart relationship to the pattern plate (18) and compression means (26) positioned between the first and second members for yieldably resisting movement of the first member towards the second member.

12. Apparatus according to claim 11, in which the first member is slidably disposed within both the bore (16) and the aperture (20).

13. Apparatus according to claim 11 or 12, in which the second member (24) is provided with a stop block for limiting movement of the first member against the compression means.

14. Apparatus according to any of claims 11 to 13, in which the first member (22) has an initial position in which it extends beyond the pattern plate (18) into the bore (16).

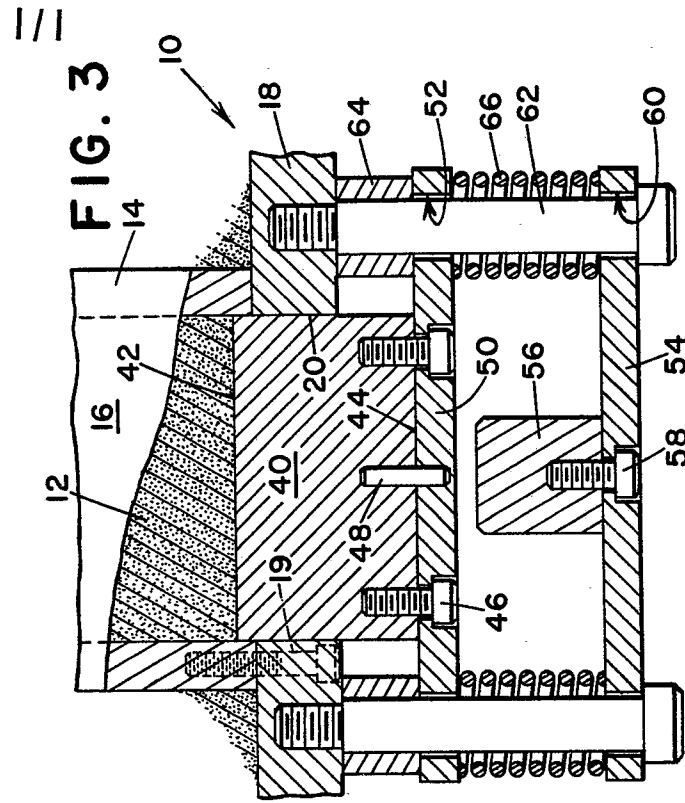
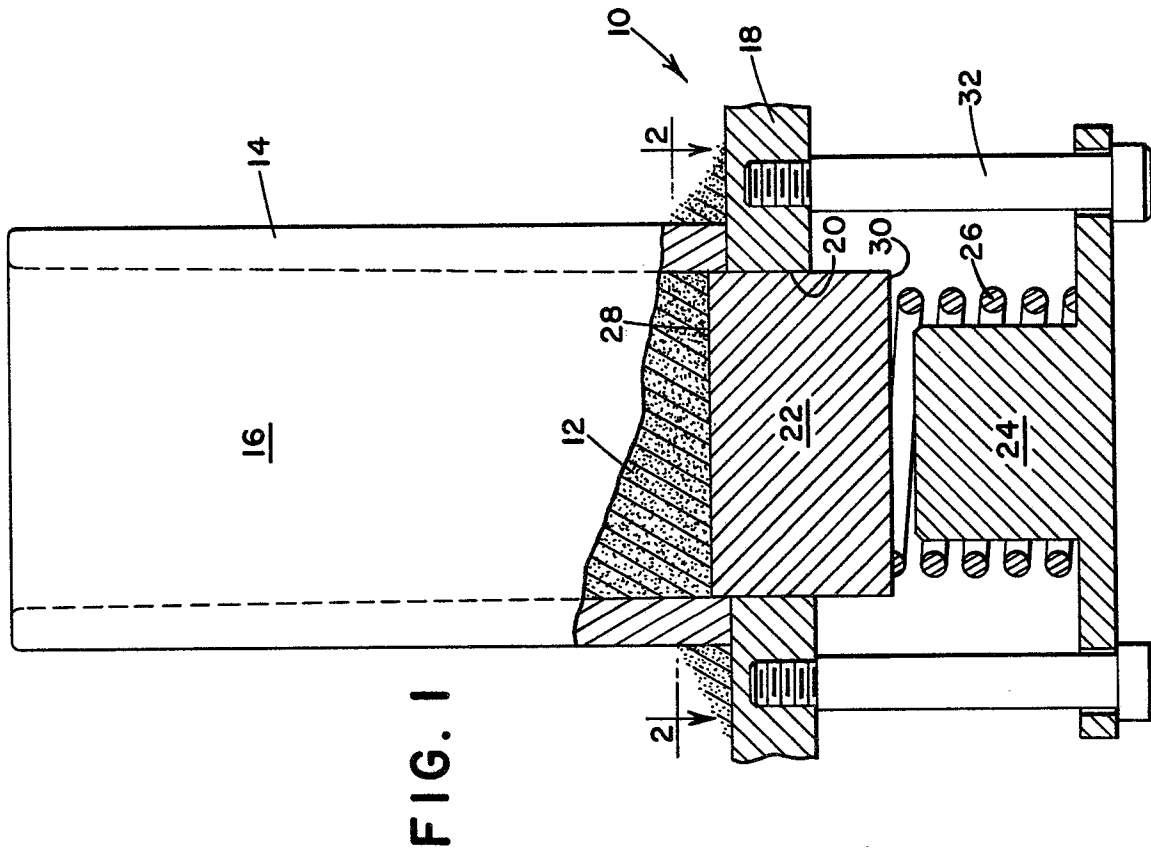
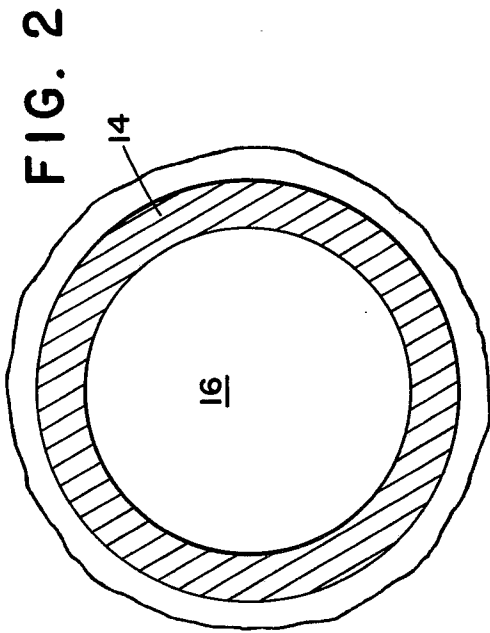
15. Apparatus according to any of claims 11 to 14, in which the compression means comprises one or more coil springs (26; 66).

16. Apparatus according to claim 15, in which there are a plurality of coil springs (66) of equal compressive strength.

17. Apparatus according to claim 15 or 16, in which the second member (24) is supported by a plurality of support members (62) arranged around its periphery, the first member has a corresponding plurality of apertures (52) around its periphery through which the support members pass, and the coil springs (66) are carried by the support members.

18. Apparatus according to claim 17, including collar members (64) on the support members to limit movement of the first member into the bore.

19. Apparatus according to any of claims 11 to 18, in which a pattern (14) is physically attached (19) to the pattern plate (18).





European Patent
Office

EUROPEAN SEARCH REPORT

0050507

Application number

EP 81 30 4872

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	<u>DE - A - 2 809 608</u> (DEERE & CO.) * Page 4, lines 23-27; page 5, page 6, lines 1-7; figures 1,2,3 *	1-6,9,11-15	B 22 C 17/00 B 22 C 7/04
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X	<u>US - A - 3 238 576</u> (R.W. TACCONE) * Whole document *	1-5,9,11,12,14	
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X	<u>US - A - 1 475 935</u> (C.W. COLEMAN) * Whole document *	1,8,9	TECHNICAL FIELDS SEARCHED (Int.Cl. ³)
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X	<u>FR - A - 2 034 928</u> (BUHRER) * Figures 1,2 *	1,9	B 22 C B 28 B
	--		
X	<u>DE - B - 1 210 517</u> (BADISCHE MASCHINENFABRIK) * Claims 1,2; figures *	1,9	
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A	<u>DE - A - 2 304 992</u> (HOFSTETTER)		
A	<u>US - A - 3 512 756</u> (E.K. CLELAND)		CATEGORY OF CITED DOCUMENTS
A	<u>GB - A - 162 262</u> (L. CUCURNY)		X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons
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X	<u>DE - A - 2 643 357</u> (VOEST) * Figures 1,2,3; page 8, lines 33-34; page 9, lines 1-14 *	1-5,9,11,12,14,15	

The present search report has been drawn up for all claims			&: member of the same patent family, corresponding document
Place of search The Hague		Date of completion of the search 28-01-1982	Examiner MAILLIARD