(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 172 937**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **84110351.8**

(22) Date of filing: **30.08.84**

(51) Int. Cl.⁴: **B 22 C 11/06**, B 22 C 15/08, B 22 C 15/02, B 22 C 15/14, B 22 C 15/28

(43) Date of publication of application: **05.03.86**
Bulletin 86/10

(84) Designated Contracting States: **CH DE GB LI**

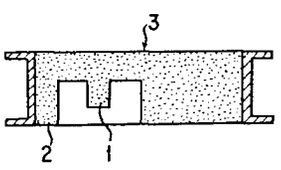
(71) Applicant: **KABUSHIKI KAISHA KOMATSU SEISAKUSHO, 3-6, 2-chome Akasaka, Minato-ku Tokyo 107 (JP)**

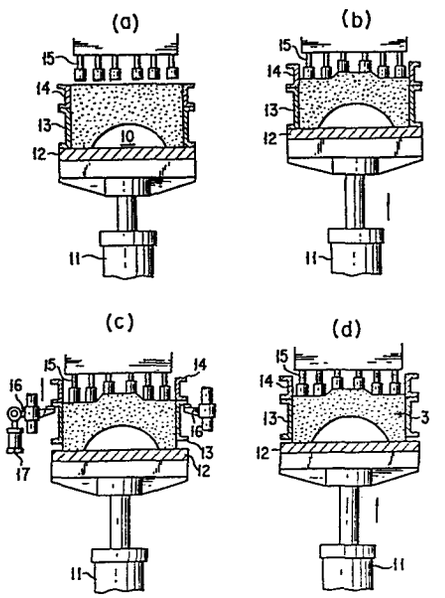
(72) Inventor: **Fuchigami, Masao, No. 5-1, Yawata-yoshinogaito, Yawata-shi Kyoto (JP)**
Inventor: **Matsuo, Yuichi, No. 4-4, Ueno 2-chome, Hirakata-shi Osaka (JP)**

(74) Representative: **Patentanwälte TER MEER - MÜLLER - STEINMEISTER, Mauerkircherstrasse 45, D-8000 München 80 (DE)**

(54) A method for making sand molds.

(57) In a method of preparing a sand mold in which mold sand within a mold frame (2) is squeezed from an upper side opposite to a lower side of the frame at which a pattern is embedded and also from said lower side, the squeezing from the lower side is made only after the squeezing from the upper side has been completed by about or more than 95% of a total squeezing stroke. The sand mold (3) thus prepared comes to have a desired hardness particularly at casting surfaces thereof.





EP 0 172 937 A1

Background of the Invention

This invention relates to a molding method, more specifically it relates to a method of making sand molds having a high hardness particularly at and about pocket areas thereof (pocket areas being those generally located centrally of a sand mold and convexly shaped such as shown by numeral 1 in the accompanying drawing). In order to improve a hardness of casting surfaces particularly of pocket areas in addition to those areas of a sand mold which are located between a mold frame and a pattern and roots of which stand on a pattern plate (hereinafter called as the frame areas), it is known in Japanese preliminary patent publication Sho-No. 55-57353 for example to have mold sand within a mold frame squeezed simultaneously or substantially simultaneously from both vertical sides thereof, viz., a side in which a pattern is bedded down (hereinafter called as the lower or pattern side) and also a side opposite to said lower or pattern side (hereinafter called as the upper or opposite side). In this way of squeezing, it is essential to hold a stroke for squeezing the mold sand from the lower side under strict control, so that joint end surfaces of the frame and the sand shall be brought to a same level. To wit, if the squeezing from the lower side is made until it reaches a pressure sufficient enough to squeeze completely the sand as a whole, it shall be extremely hard to bring the joint end

surfaces of the mold frame and sand to a same level. On the other hand, the control or suppression of a squeezing stroke from the lower side as mentioned above, that is, to such extent that the mold frame and sand is assured of their joint bottom surfaces to be at a same level after squeezing, will afford only such pressure which is insufficient to squeeze the sand, especially pocket areas thereof efficiently hard.

Besides the above problem, a squeezing operation of a sand mold from the lower side is accompanied with the following drawbacks. To wit, when a squeezing stroke from the lower side is made larger so as to increase a squeezing pressure, a gap is produced inevitably between circumferential sides of a pattern and inner circumferential walls of a mold frame, which allows mold sand to fall down thereto. A sealing means has to be provided for the pattern plate in this instance to compensate said gap, whereby the pattern plate becomes expensive . In this instance, an additional lower mold frame is often provided so as to compensate the difference of heights of end surfaces of the mold frame and sand.

In United States patent No. 3,807,483, there is disclosed that a pattern plate is slightly elevated vertically upward after having a cavity of a mold frame filled up with mold sand and having the sand molded therein pneumatically. In this disclosure, its molding is operated statically without any dynamic squeezing, and the vertical movement of the pattern plate is made so as to compensate

stress of mold sand produced thereby within the mold frame cavity by having the sand escaped portionally from the cavity. This is not comparable to this invention which will be described hereinafter.

Brief Summary of the Invention

In view of the above problems and drawbacks accompanied to the squeezing of sand from the upper and lower sides, particulary squeezing from the lower side, this invention is to provide a novel method of producing sand molds, in which a squeezing operation even of a small stroke from the lower side can afford to casting surfaces of molds, particularly those of pocket areas a desired hardness.

More in concrete, this invention is to provide a method of making a sand mold in which mold sand within mold frame means is squeezed vertically from both sides thereof, viz., a pattern side at which a pattern is embedded and a side opposite to the pattern side, characterized in that squeezing of the mold sand from the pattern side is made after first squeezing from the opposite side has been completed at a distance near or of a full stroke of the entire squeezing operation.

Brief Description of the Drawings

Fig. 1 is a sectional view of a sand mold to be pre pared in accordance with this invention,

Fig. 2 is a graph showing hardness of pocket areas of

molds prepared in accordance with this invention, in comparison with their hardness made by the conventional method,

Fig. 3 is a graph same as Fig. 2 but showing hardness of frame areas adjacent to a mold frame, and

Figs. 4 to 8 are explanatory side views partly in section, showing embodiments of this invention method.

Detailed Description of the Preferred Embodiments

In this invention method briefly explained above, even through the squeezing from the lower side made under a small stroke, sand molds can have even hardness at casting surfaces, especially at pocket areas thereof. Effectiveness of this invention for affording to the casting surfaces including those of pocket areas of sand molds is explained hereunder with reference to Fig. 1. In preparing a sand mold 3 having an pocket area 1 and a frame area 2 adjacent to a mold frame, the sequence of squeezing from the upper side and from the lower side was changed, while ratios of squeezes from the upper and lower sides in respect to a total squeezing stroke were variously selected. Resulting hardness at the pocket area 1 and frame sided area 2 are measured. In Fig. 2, there are shown resulting hardnesses at the area 1, and in Fig. 3 hardnesses at the area 2. In these figures, ordinates show hardness by AFS unit, and abscissas stroke ratios. Positive numerals on the abscissas show molding operations by squeezing from the upper side, followed by squeezing from the lower side, while negative numerals show those molding in which the squeezing from the

lower side preceded the one from the upper side. For example, in case of the stroke ratio being expressed as 60, it is shown that 60% of a total squeezing stroke was made first from the upper side, followed by squeezing from the lower side of the remnant total stroke of 40%. And, in case of -80,it is shown that 80% of the total stroke was borne first by squeezing from the lowers side, followed by squeezing from the upper side of the remnant stroke of 20%. As shown in Figs. 2 and 3, when a stroke ratio is more than 95 that is, first squeezing from the upper side of more than 95% of the total squeezing stroke which is followed by squeezing from the lower side of the remnant stroke of less than 5%, hardness of molds, especially at casting surfaces of pocket areas, was remarkably improved. The total squeezing stroke in the above was about 120-126mm, while the amount of stroke of squeezing from the lower side was about 3 - 6mm. It shall be apparent from the above that in this invention method, squeezing from the lower side of an extremely small amount of stroke compared to that from the upper side, can bring about even hardness of sand molds.

In Fig. 4, which shows the first embodiment of this invention method, upon a squeeze cylinder 11, there are mounted a pattern plate 12 with a pattern 10 on one side thereof, a main mold frame 13, and an upper supplementary or additional frame 14. Mold sand is introduced within the frames 13 and 14 [Fig. 4 (a)]. Then, the squeezing cylinder 11 is moved vertically upward by about 120mm, whereby squeezing from the upper side is made first by means of segment

squeeze heads 15 [Fig. 4 (b)]. When this squeezing from the upper side has completed, the mold frame 13 together with the upper supplementary frame 14 is elevatated about 5mm by means of lifters 16, leaving the mold sand as it is on the pattern plate [Fig. 4 (c)]. The lifters 16 are operated by cylinders 17 which move vertically upward and downward. The squeeze cylinder 11 is again lifted about 3mm, whereby squeezing from the lower side is performed and molding is completed.

In Fig. 5, there is shown another embodiment of the lifters 16. Here, cylinders 18 which operate horizontally are employed. The cylinders 18 actuate brackets 19 so as to rotate, forward ends of which brackets work to elevate the mold frame 13.

In Fig. 6, there is shown the second embodiment of this invention method. The mold frame 13 is mounted on the pattern plate 12 with a spacer plate 20 of about 5mm in thickness therebetween [Fig. 6 (a)]. When squeezing from the upper side of about 120mm stroke by means of the segment squeeze heads 15 is finished, the spacer 20 are withdrown [Fig. 6 (c)]. And, then, squeezing from the lower side of about 3mm stroke is effected [Fig. 6 (d)].

In Fig. 7 which shows the third embodiment of this invention method, when squeezing from the upper side of about 120mm stroke is completed [Fig. 7 (b)], the mold frame 13 and the supplementary frame 14 are held at their positions by mold-locking cylinders 21, and the squeeze cylinder 11 is lowered about 5mm so as to have the mold sand slid in

relation to the stationarily held mold frame 13 [Fig. 7 (c)]. Then, the squeeze cylinder 11 is elevated again about 3mm, whereby squeezing from the lower side is effected [Fig. 7 (d)].

Fig. 8 shows the fourth embodiment of this invention method, in which the mold frame 13 is held by mold frame fixing lifters 22 at an elevated position of a distance of about 5mm from the pattern plate [Fig. 8 (a)]. Squeezing from the upper side is down by having the segment squeeze heads 15 descended about 120mm [Fig. 8 (b)]. Then, squeezing from the lower side is mede by the elevation of tne squeeze cylinder 11 about 3mm.

It shall be noted from the above descrived embodiments that in this invention method, contrarily to certain conventional methods in which patterns are located on a pattern plate while mold frames are sustained by another plate, all the squeezing is performed by mold frames and patterns which are unanimously located on a single pattern plate, whereby a hazardous operation for bringing about the patterns and the mold frames to a same level during molding is eliminated. In addition, since second squeezing from the lower side is made, in this invention, at a small amount of stroke and only after the completion of first squeezing from the upper side which shall have mold sand compacted very tightly before the second squeezing, there is no fear that during the second squeezing, mold sand, bottom part of which is not sustained by a mold frame, shall flow outwardly under the mold frame. Further in addition, since sencond squee-

zing is made only after the completion of first squeezing, casting surfaces which have been tightly compacted outwardly from a pattern by the first squeezing, are further recompacted by the second squeezing inwardly from the pattern so that evenly smooth casting surfaces are obtainable.

Claims

1. A method of making a sand mold in which mold sand within mold frame means is squeezed vertically from both sides thereof, viz., a pattern side at which a pattern is embedded and a side opposite to the pattern side, characterized in that squeezing of the mold sand from the pattern side is made after first squeezing from the opposite side has been completed at a distance near or of a full stroke of the entire squeezing operation.

2. A method as claimed in Claim 1 characterized by having the mold frame means comprised of a main mold frame and a supplementary mold frame, and mounting the supplementary mold frame on the main mold frame.

3. A method as claimed in Claim 2, comprising:

(a) mounting the pattern and the mold frame means on one side of a pattern plate so as to define a sand chamber therebetween, the pattern plate being operatively connected at another side thereof to a squeeze cylinder;

(b) introducing mold sand into the sand chamber;

(c) positioning squeeze head means over the upper surface of the introduced mold sand;

(d) squeezing firstly the mold sand from the opposite side;

(e) moving the mold frame means upwardly to a slight distance, in the meanwhile the first squeezed mold sand and the pattern one the pattern plate, and the squeeze head means being kept in their respective positions where the first squeezing has been carried out; and

(f) squeezing secondly the first squeezed mold sand from the pattern side by a distance slightly less than the upward moved distance of the mold frame means.

4. A method as claimed in Claim 2, comprising:

(a) mounting the pattern and the mold frame means on one side of a pattern plate so as to define a sand chamber therebetween in which mounting a thin spacer plate is inserted between the pattern plate and the mold frame means, the pattern plate being operatively connected at another side thereof to a squeeze cylinder;

(b) introducing mold sand into the sand chamber;

(c) positioning squeeze head means over the upper surface of the introduced mold sand;

(d) squeezing firstly the mold sand from the opposite side;

(e) removing the spacer plate from its position between the pattern plate and the mold frame means after the first squeezing has been completed; and

(f) squeezing secondly the first squeezed mold sand from the pattern side by a distance slightly less than the thickness of the spacer plate.

5. A method as claimed in Claim 2, comprising:

(a) mounting the pattern and the mold frame means on one side of a pattern plate so as to define a sand chamber therebetween, the pattern plate being operatively connected at another side thereof to a squeeze cylinder;

(b) introducing mold sand into the sand chamber;

(c) positioning squeeze head means over the upper

surface of the introduced mold sand;

(d) squeezing firstly the mold sand from the opposite side;

(e) operating the squeeze cylinder to move the pattern plate downwardly by a slight distance together with the pattern on which the first squeezed mold sand is rested, in the meanwhile the mold frame means being kept by mold frame holding means in the position where the first squeezing has been effected; and

(f) squeezing secondly the first squeezed mold sand from the pattern side by a distance slightly less than the downward moved distance of the squeeze cylinder.

6. A method as claimed in Claim 2, comprising:

(a) mounting the pattern and the mold frame means on one side of a pattern plate so as to define a sand chamber therebetween, in which said mold frame means is held by mold frame holding means so as to keep a space of a slight distance between the pattern plate and the mold frame means, the pattern plate being operatively connected at another side thereof to a squeeze cylinder;

(b) introducing mold sand into the sand chamber;

(c) positioning squeeze head means over the upper surface of the introduced mold sand;

(d) squeezing firstly the mold sand from the opposite side; and

(e) squeezing secondly the first squeezed mold sand from the pattern side by a distance slightly less than said space between the pattern plate and the mold frame means.

1/6

0172937

FIG. 1

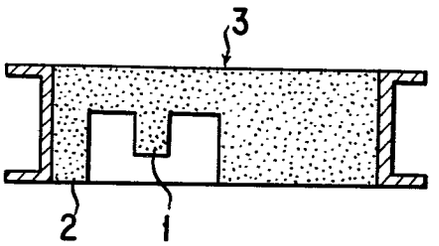


FIG. 2

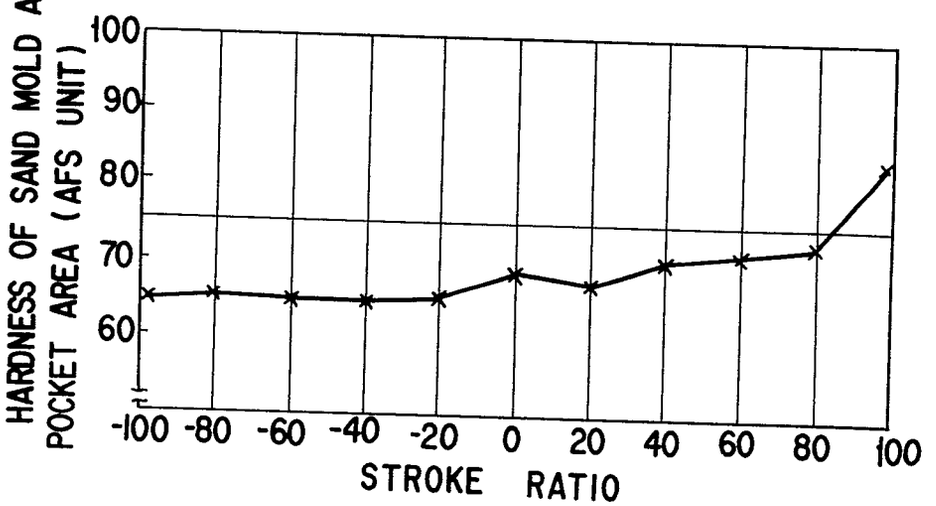
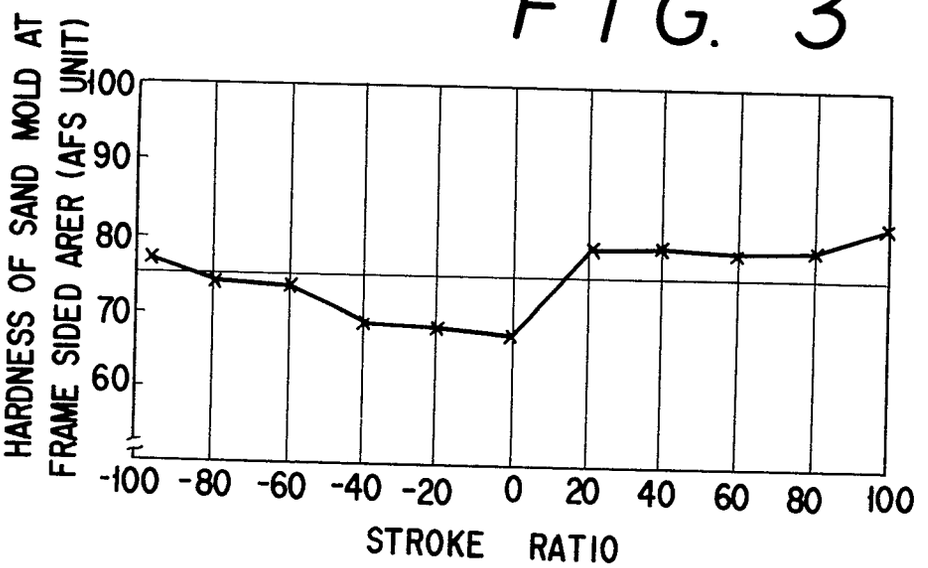
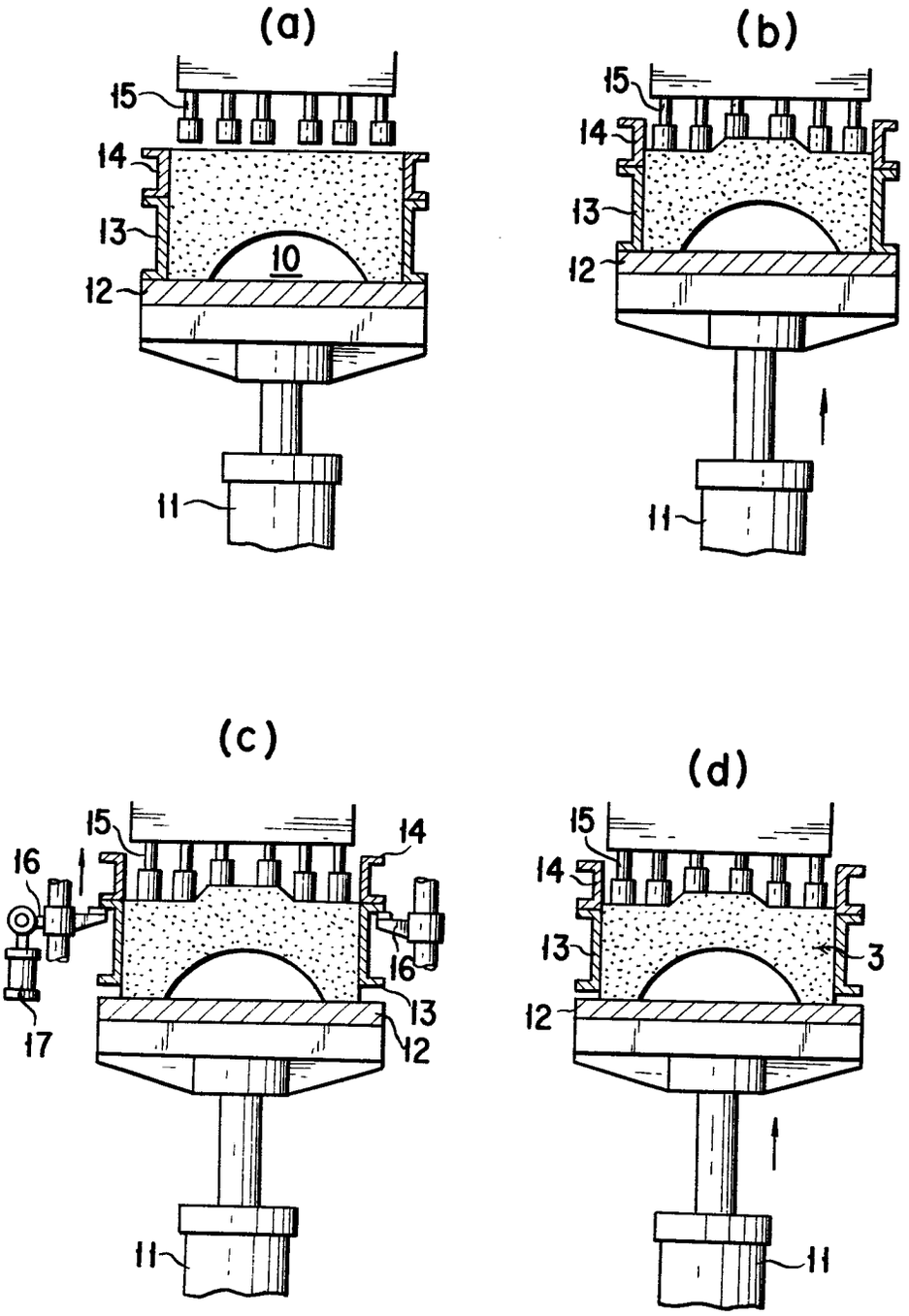


FIG. 3



0172937

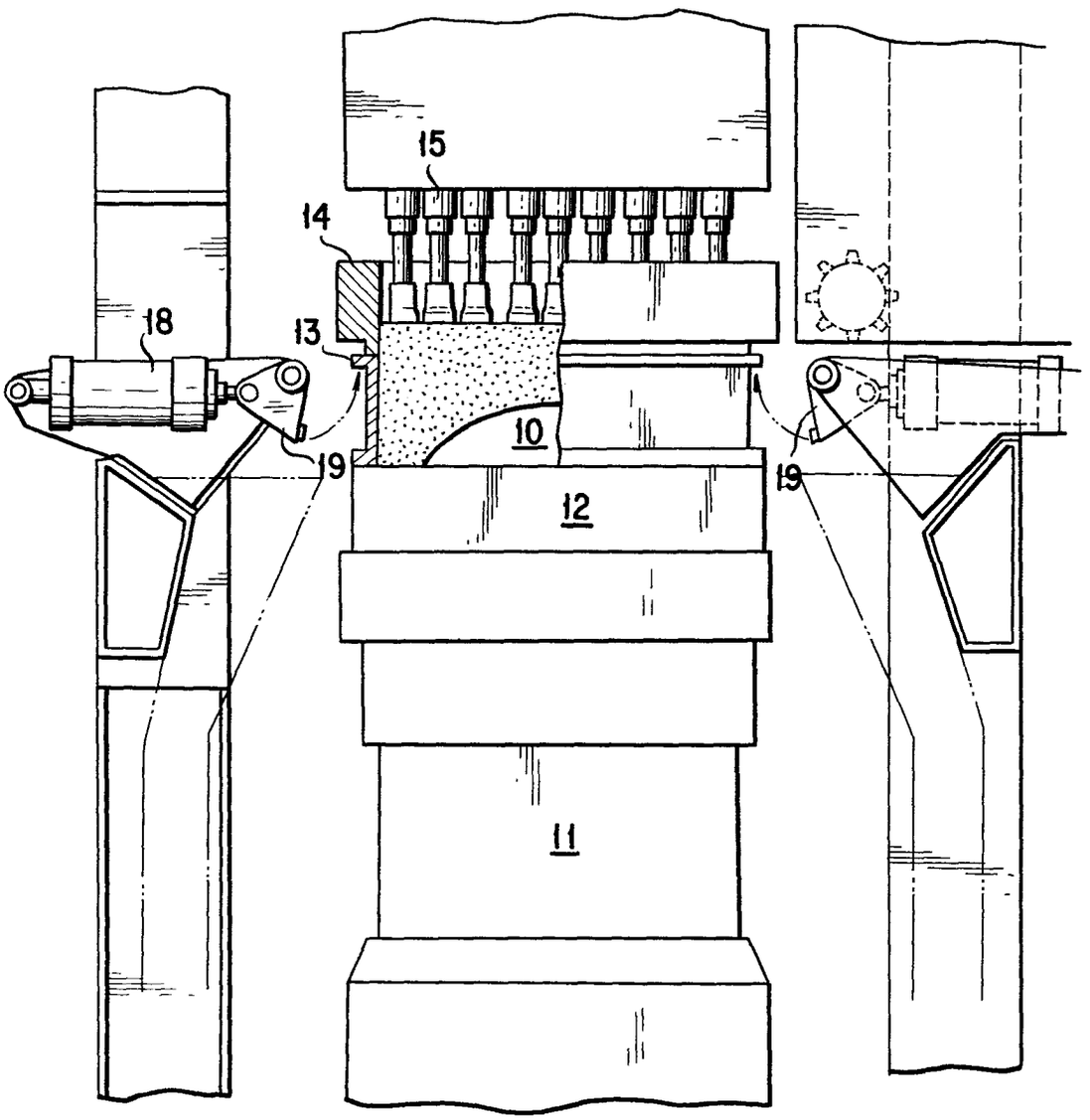
FIG. 4



0172937

3/6

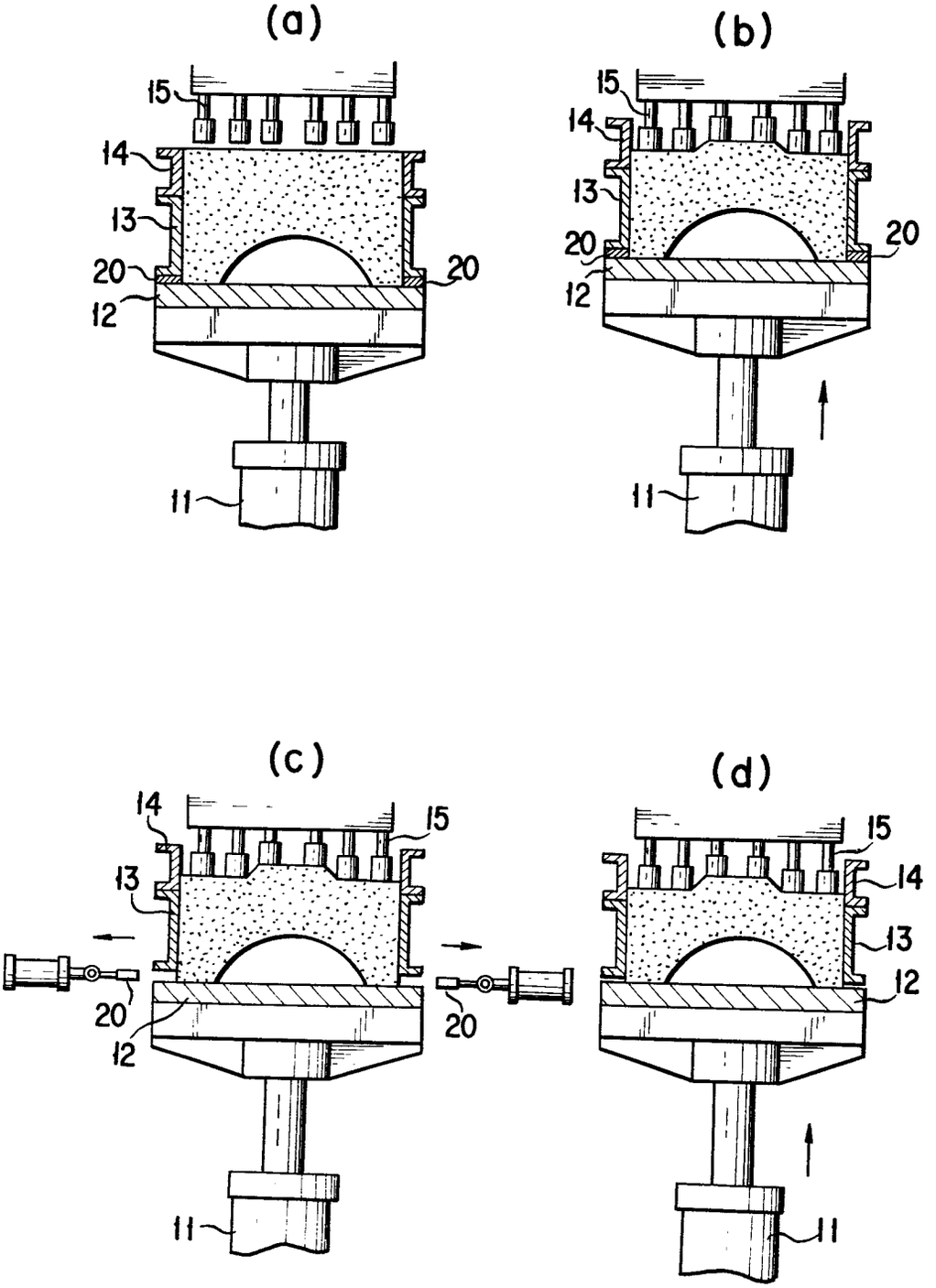
FIG. 5



0172937

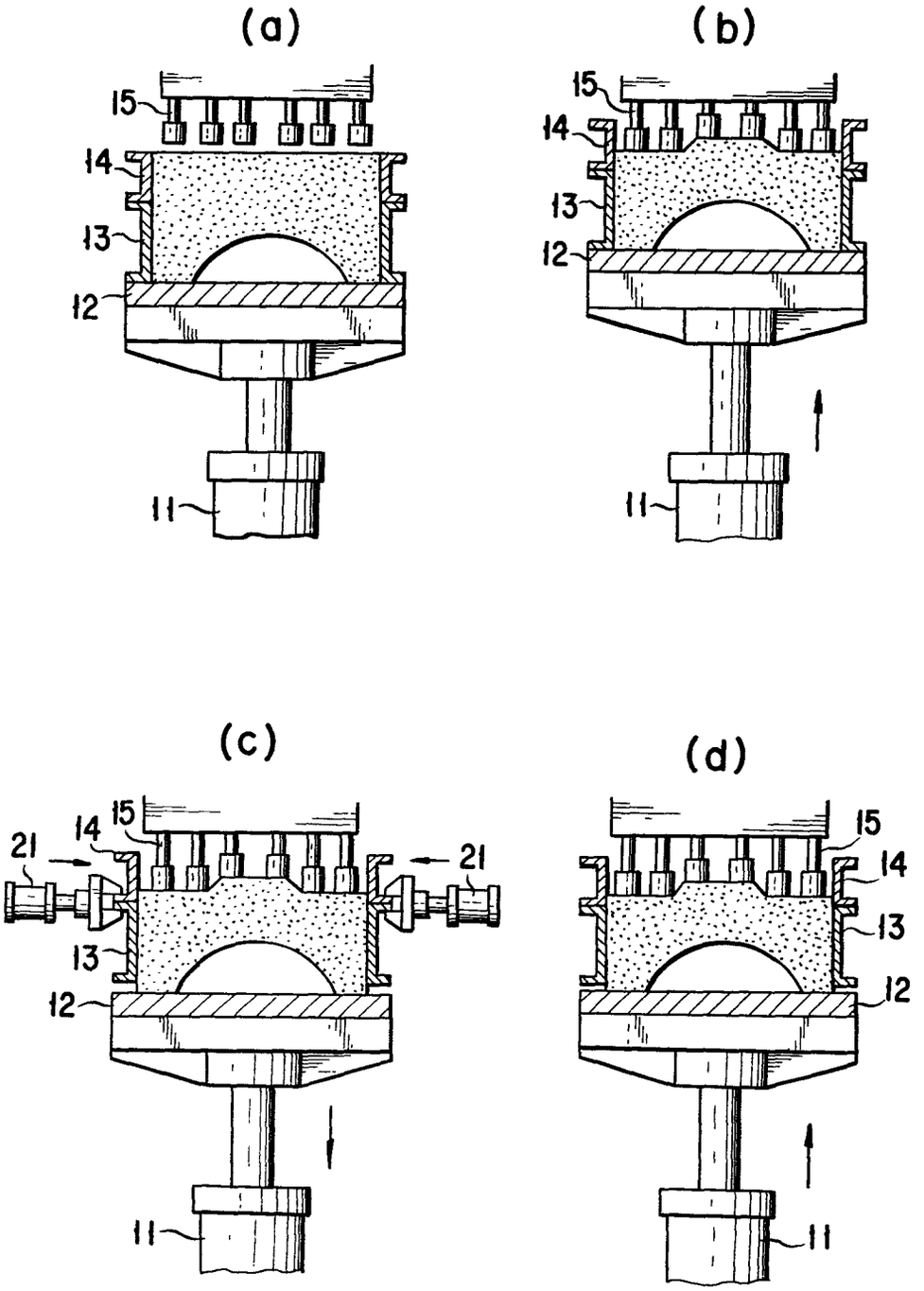
4/6

FIG. 6



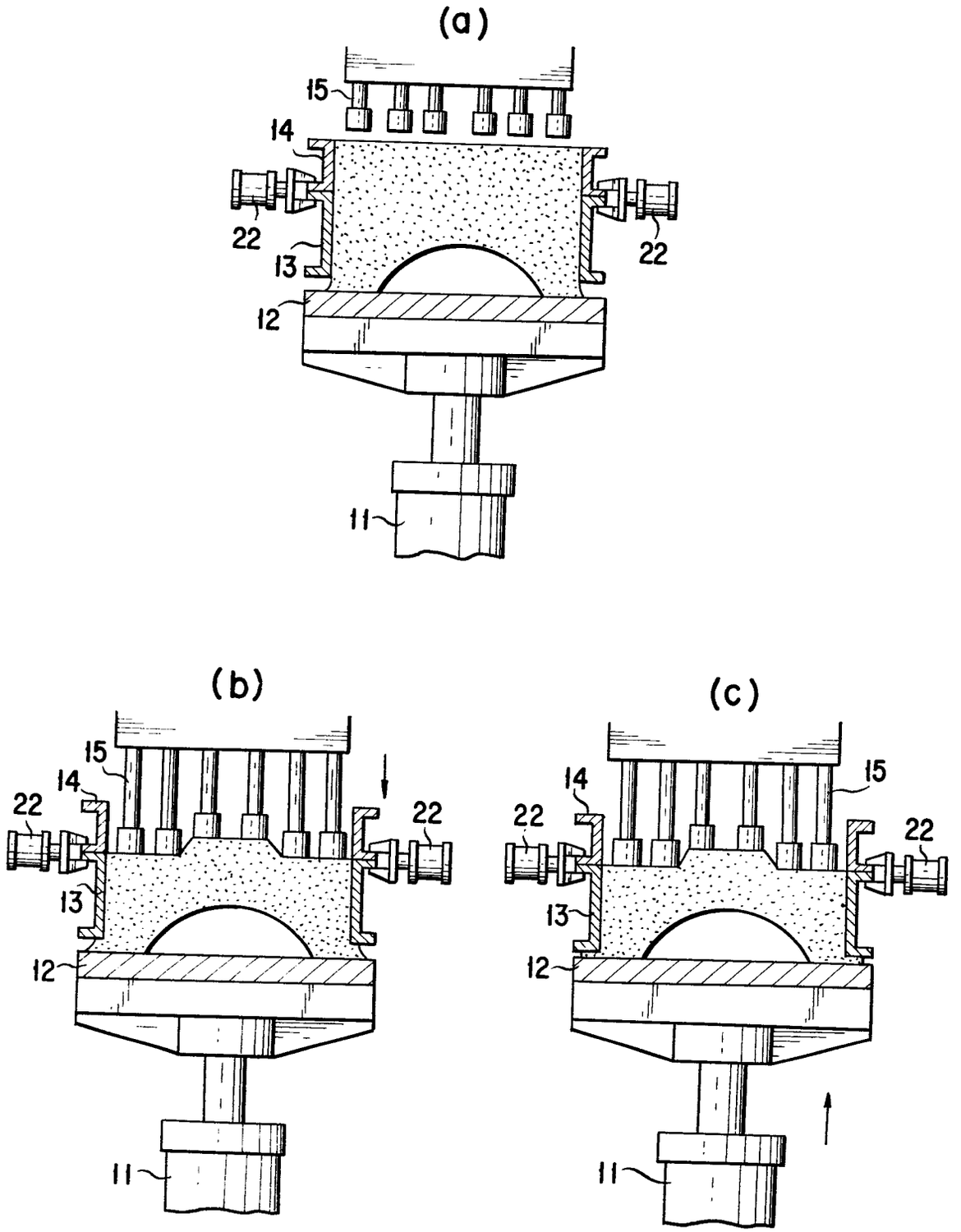
0172937

FIG. 7



0172937

FIG. 8



European Patent Office

EUROPEAN SEARCH REPORT

0172937
Application number

EP 84 11 0351

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	DE-A-1 958 571 (STATNI VYZKUMNY USTAV) * Figure *	1	B 22 C 11/06 B 22 C 15/08 B 22 C 15/02 B 22 C 15/14 B 22 C 15/28
A	DE-A-2 815 951 (H. WAGNER MASCHINENFABRIK) * Claims 1,3 *	1	
A	DE-A-2 936 173 (INVENTIO AG) * Claim 1; figure 1 *	1	
A	DE-A-1 433 977 (OSBORN MANUFACTURING CO.)		
A	DE-B-1 297 818 (OSBORN MANUFACTURING CO.)		TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	DE-B-1 242 802 (OSBORN MANUFACTURING CO.)		B 22 C 11/00 B 22 C 15/00
D,A	US-A-3 807 483 (BUHLER) * Claims 1,19 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	11-03-1985	GOLDSCHMIDT G

CATEGORY OF CITED DOCUMENTS

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

& : member of the same patent family, corresponding document

EPO Form 1503 03.82