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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 3 :		(11) International Publication Number:
B22C 9/02	A1	WO 82/ 03580
		(43) International Publication Date: 28 October 1982 (28.10.82)

(21) International Application Number: PCT/DK82/00027

(22) International Filing Date: 7 April 1982 (07.04.82)

(31) Priority Application Number: 1663/81

(32) Priority Date: 13 April 1981 (13.04.81)

(33) Priority Country: DK

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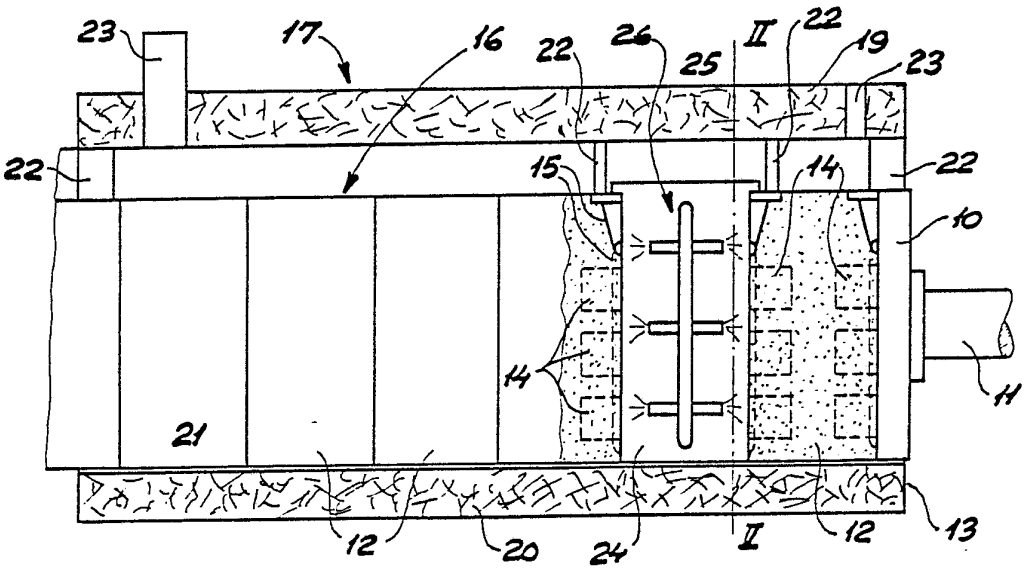
(81) Designated States: BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB (European patent), JP, NL (European patent), NO, SE (European patent), SU, US.

Published
With international search report.
In English translation (filed in Danish).

(54) Title: A METHOD IN THE PRODUCTION OF FROZEN MOULD BODIES AND A PLANT FOR USE IN THE CARRYING OUT OF THE METHOD



(57) Abstract

In the production of frozen moulds (12) or cores the freezing process is accelerated by drawing the liquefied freezing agent, such as nitrogen, used for freezing the water in the mould bodies, into or through the bodies by the application of a vacuum.

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A method in the production of frozen mould bodies and a plant for use in the carrying out of the method

The invention relates to a method of the type defined in the introductory portion of claim 1.

The use of a neutral binder, such as water, and a neutral coolant, such as liquefied nitrogen for freezing the water, totally obviates the environmental pollution which the use of conventional binders and catalysts has in its wake. It moreover reduces the manufacturing costs and allows the sand to be reused without subsequent treatment.

The known embodiments of the present method, by which the coolant is sprayed or poured into or on the mould body, suffer from the drawback that it takes a relatively long time to freeze the water to a sufficient depth; the object of the invention is to eliminate or significantly reduce this drawback.

This object is achieved by carrying out the method as stated in the characterizing portion of claim 1, as the suction through the porous sand mass highly increases the rate at which the freezing agent can be caused to contact the binder in the mould body, resulting in a corresponding reduction in the time required for freezing and additional cooling to the necessary depth.

Claims 2 and 3 define embodiments of the method for use in the production of moulds, and claims 4 and 5 define embodiments for use in the production of solid and hollow cores, respectively.

Another embodiment which provides for rapid penetration of the freezing agent into the mould bodies is defined in claim 6. When this method, used in connection with a mould string, is carried out as stated in claim 7, the freezing medium is passed direct to the mould faces which later contact the molten metal.

The invention also concerns a plant for use in the carrying out of the method, and claim 8 defines such a plant for the production of moulds in which freezing is effected in the mould box.

Claim 9 defines a mould production plant in which the moulds are not frozen until they have left the mould box and have been pushed out on the mould path, and claim 10 teaches how to mount the nozzle assembly so that the vacuum tunnel can be closed by simple means simultaneously with the nozzle assembly being in its operative position between the exposed mould faces.

An embodiment of the plant of the invention will be described more fully below with reference to the drawing, in which

fig. 1 schematically shows the plant, as seen from the side and partly in section, with the nozzle assembly in its operative position,

fig. 2 is a cross-sectional view taken along the line II-II in fig. 1, with the nozzle assembly in its in-operative position, and

fig. 3 is a schematical top view of the plant on a reduced scale.

In the drawing, 10 represents a pattern plate fitted on the piston rod 11 of a hydraulic cylinder (not shown) of a known mould producing machine, which moulds and presses each mould between two vertical pattern plates in a frame (not shown), and then one pattern plate is pivoted to a horizontal position and the other pushes the produced mould 12 out of the frame and forwardly to the position shown in figs. 1 and 3 on a mould path 13 by means of the hydraulic pressing cylinder. The pattern plates produce mould impressions 14 and impressions 15 which upon juxtapositioning of the moulds form mould cavities and ingates and sprues between each pair of adjacent moulds 12. The said position of the newly formed mould 12 provides a space 24 between this mould and the rear mould in the mould row 16 formed by the previously produced moulds on the mould path 13.

The rear end of the mould row 16 and the last-formed mould 12 are surrounded by a vacuum and cooling tunnel 17 defined by two side walls 18, a top wall 19 and a bottom 20 of heat insulating material. The bottom 20 constitutes a part of the mould path 13 and supports a slide plade 21 on which the moulds 12 can rest and slide. Gaskets 22 are provided at the ends of the tunnel 17, and they extend from the side wall 18 and the top wall 19 towards and resiliently and sealingly engage the mould row 16 and edge faces of the pattern plate 10, respectively, in the pattern plate position shown in figs. 1 and 3. Adjacent the front end of the tunnel 17 a through pipe stub 23, which can be connected to a source of vacuum (not shown), is fitted in the top wall 19.

Opposite the space 24 between the last-formed mould 12 and the rear end of the mould row 16 one tunnel side

wall 18 is formed with an opening 25 through which a nozzle assembly generally designated by 26 can be inserted into the space 24. The nozzle assembly 26 is formed by a U-shaped frame 27, between the legs of which there extends a plurality of vertical pipes 28, which each carry a plurality of nozzle pipes 29 disposed end to end in pairs and extending in parallel with the mould path; in the active position of the nozzle assembly shown in figs. 1 and 3 one half of the nozzle pipes 29 are rearwardly directed towards the mould face of the last-formed mould 12, the other half being forwardly directed towards the exposed mould face of the rear mould in the mould row 16.

The nozzle assembly 26 is secured to and extends perpendicularly from a closing plate 30 placed at the end of the piston rod 31 in a hydraulic cylinder (not shown), which is capable of reciprocating it between the position shown in fig. 2, in which the entire nozzle assembly is disposed outside the vacuum and cooling tunnel 17, and the position shown in figs. 1 and 3 with the nozzle assembly disposed in the space 24 between the moulds. In the second position the edge portions of the closing plate sealingly engage a gasket 32 fitted circumferentially in the edge of the opening 25 in the side wall of the tunnel 17.

The nozzle assembly 26 is connected to a source of a liquefied freezing agent, e.g. nitrogen, by means (not shown) comprising a non-return valve. In the active position of the nozzle assembly the freezing agent is sprayed on the two mould faces directed towards the nozzle assembly, and the vacuum simultaneously applied on the outer faces of the moulds present in the vacuum and cooling tunnel 17 causes the freezing agent to be

drawn rapidly into the moulding sand and to cool the water in the sand below the freezing point, so that the water will turn into ice which binds the sand grains together. After this freezing process the supply of coolant to the nozzle assembly is interrupted, and the nozzle assembly is withdrawn from the tunnel 17 to the position shown in fig. 2. The drive cylinder for the pattern plate 10 then pushes the last-formed mould 12 into engagement with the mould row 16 and additionally pushes the entire mould row a distance forwards corresponding to the thickness of a mould. This mould row movement can be supported by a generally known advancing mechanism (not shown). After the completion of the advancing movement the pattern plate returns to its operative position in which it can cooperate with the other pattern plate (not shown) to produce a new mould.

Owing to considerations of space it may be expedient in practice to mount the moving cylinder (not shown) for the closing plate 30 and the nozzle assembly 26 above the tunnel 17 instead of at its side, as indicated in fig. 2. The shown and described plant can also be modified in many other ways.

Plants according to the invention may assume many other shapes than the one shown and described in the foregoing. It may e.g. be formed by a closed, heat insulated box in which one or more sand moulds or cores may be placed and which may be evacuated and then be supplied with liquefied coolant, which because of the evacuation penetrates rapidly into the mould bodies and freeze at any rate part of the water in it.

This effect will be greatly enhanced when the mould bodies are formed by a string of juxtaposed moulds like

the one shown in figs. 1 and 3 and the means for supplying freezing agent are adapted to supply this agent direct to the ingates 15 of the moulds.

Patent Claims :

1. A method in the production of frozen mould bodies (12) of granular material and a binder which is a gas or a liquid at positive temperatures in °C, c h a r a c-terized by drawing a freezing agent through or into the mould body or bodies (12) immediately after the formation thereof.

2. A method according to claim 1 in the production of moulds (12) in a mould box, at least one wall of which is a pattern plate, c h a r a c t e r i z e d by the use of a mould box comprising a pattern plate which is porous or formed with small holes or channels and through which a freezing medium is sprayed or pressed, and wall portions which are porous or formed with small holes or channels and to which vacuum is applied.

3. A method according to claim 1 or 2 in the production of frozen moulds (12), by which the moulds are produced between two pattern plates (10) and pushed out on a mould path (13) where they engage each other to form a mould cavity (14) between each pair of adjacent moulds, c h a r a c t e r i z e d in that before a newly formed mould (12) is pushed into engagement with the last mould in the mould row, a freezing agent spraying device (26) is inserted between these two moulds, and a vacuum is applied around at least some of the outer sides of the moulds.

4. A method according to claim 1 in the production of cores in a two-part core box, c h a r a c t e r i z e d by using a core box which is porous or formed with small holes or channels, supplying a freezing agent to at least one side of one core box part, and applying vacuum

to at least one side of the other core box part.

5. A method according to claim 1 in the production of hollow cores in a two-part core box, c h a r a c t e r i z e d by using a core box which is porous or formed with small holes or channels, introducing, during or immediately after the formation of a hollow core on the walls of the mould cavity, a freezing agent into said cavity, and applying vacuum to at least part of the outer face of the core box.

6. A method according to claim 1, c h a r a c t e r i z e d by placing one or more mould bodies (12) in a closed box to be evacuated, and then supplying a freezing agent to the interior of the box.

7. A method according to claim 6, c h a r a c t e r i z e d in that a plurality af mould bodies (12) forms a mould string (16) of juxtaposed moulds, and that the freezing agent is supplied to these moulds through the ingates.

8. A plant for the production af frozen moulds (12) by the method according to claim 2, comprising a mould box and a pattern plate, c h a r a c t e r i z e d in that both the mould box and the pattern plate are porous or formed with small holes or channels, and by means to supply a freezing agent to the pattern plate and means to apply vacuum to at least part of the outer face of the mould box.

9. A plant for the production of frozen moulds (12) by the method according to claim 3, comprising a mould producing machine with two pattern plates (10) between which the moulds are produced, and a mould path (13)

which the finished moulds are pushed out on to engage each other, c h a r a c t e r i z e d by a nozzle assembly (26) adapted to spray a freezing agent, said nozzle assembly being so mounted as to be movable from a position outside the mould row (16) in between the rear mould in the mould row and the last-produced mould, and by a vacuum tunnel (17) fitted above the mould path (13), one part of said vacuum tunnel enclosing the rear mould or moulds (12) in the mould row (16), another part enclosing the last-formed mould which has not yet been pushed into engagement with the mould row.

10. A plant according to claim 9, c h a r a c t e r i z e d in that one of the walls (18) of the vacuum tunnel (17) is formed with an opening (25) in alignment with the space between the mould row (16) and the last-formed mould (12), and that the nozzle assembly (26) is placed on a closing plate (30) adapted to sealingly engage the wall concerned along the circumference of the opening in the active position of the nozzle assembly.

11. A plant according to claim 9 or 10, c h a r a c t e r i z e d by a cooling tunnel fitted around the vacuum tunnel (17).

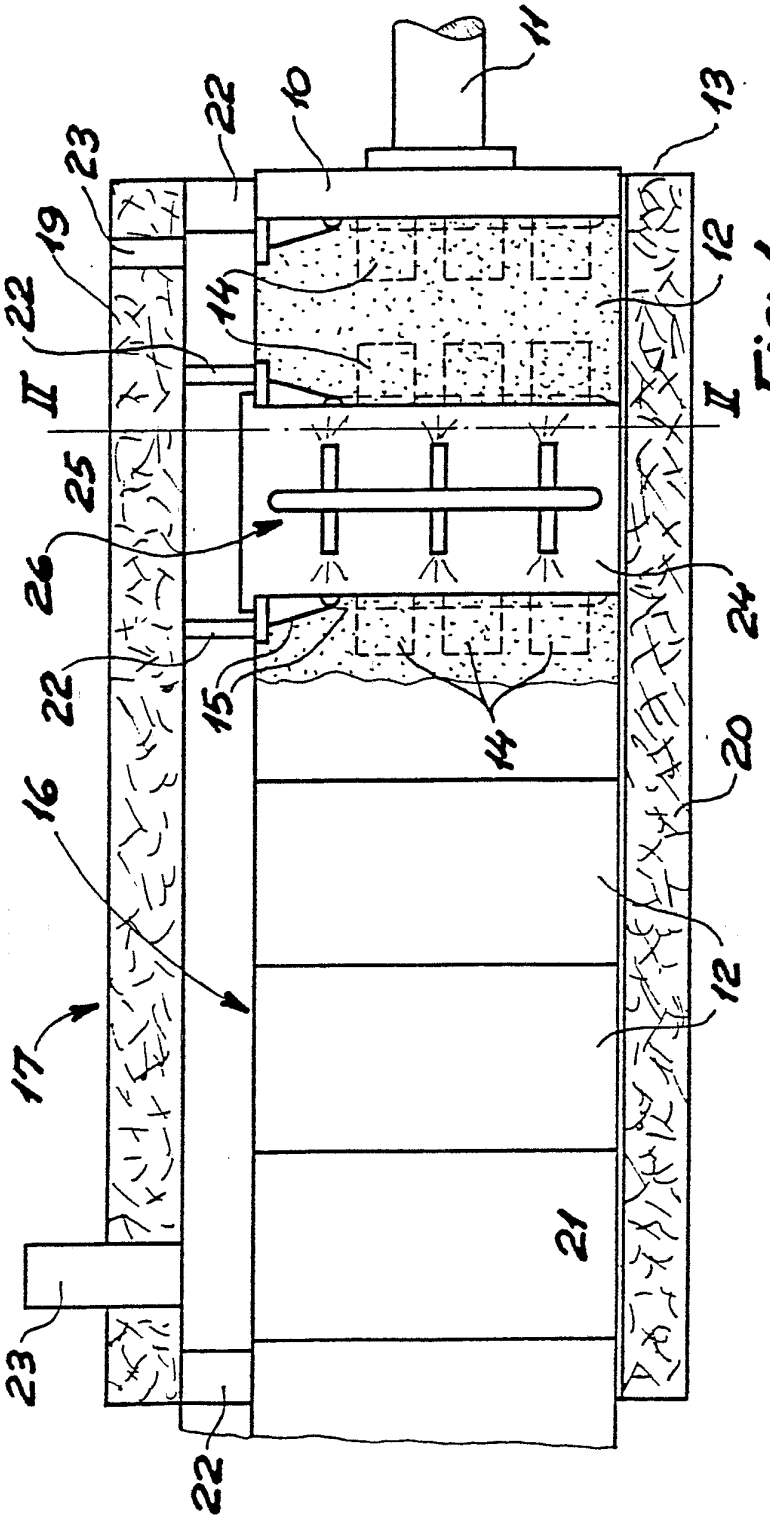

Fig. 1

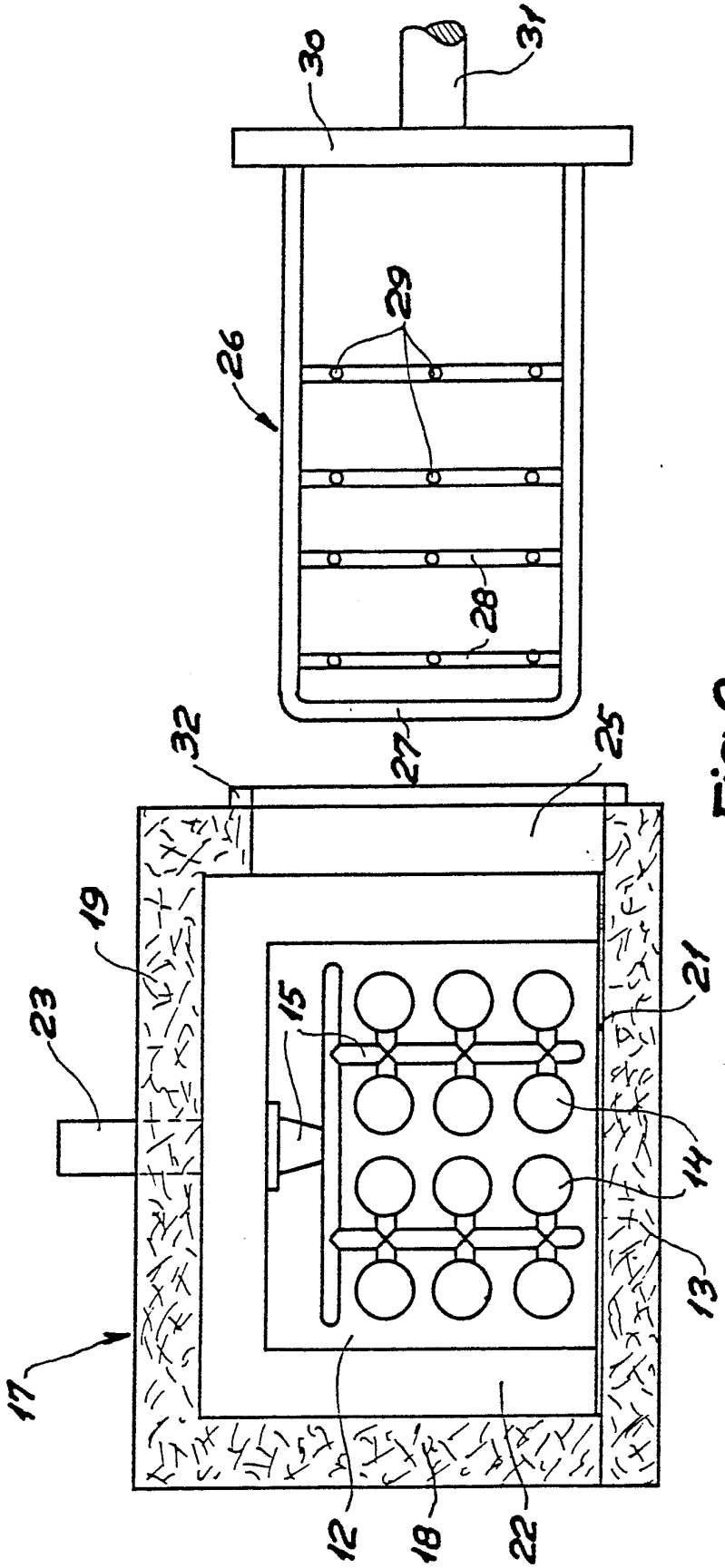

Fig.2

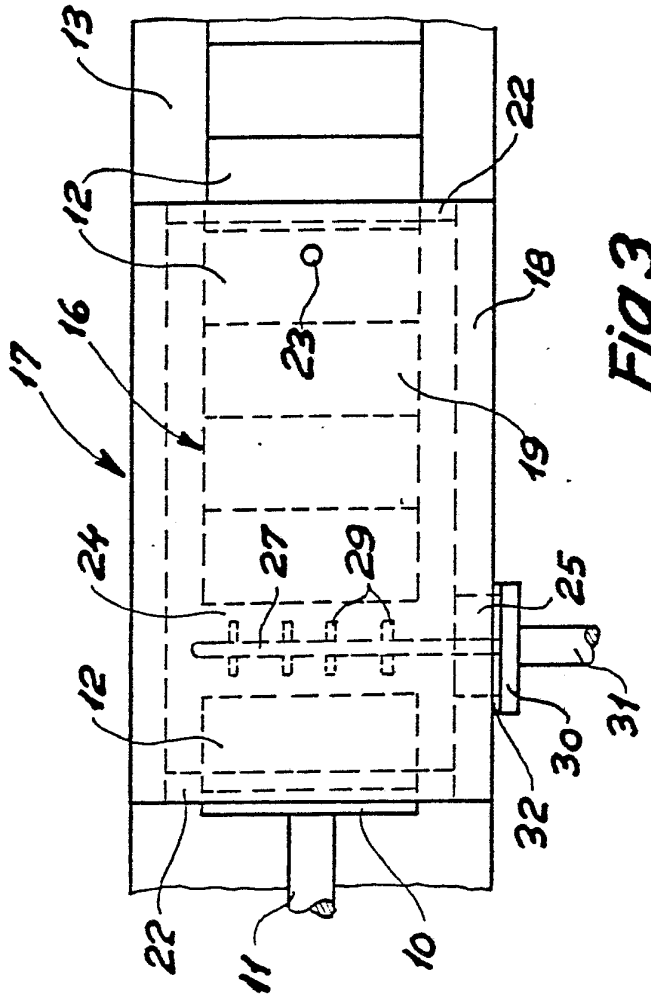

Fig.3

INTERNATIONAL SEARCH REPORT

International Application No PCT/DK82/00027

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC 3

B 22 C 9/02

II FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
IPC 3	B 22 C 9/00, 9/02, 9/12
US Cl	164:6, 7, 12, 16, 41

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
A	SE, B, 356 239 (AMERICAN CAST IRON PIPE COMPANY) 13 October 1969	1
X	NO, B, 142 944 (W H BOOTH & CO) 15 February 1977	1
X	DE, A, 2 738 114 (W H BOOTH & CO) 8 March 1979	1
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IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
1982-06-16	1982 -06- 24
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P	Patent Abstracts of Japan, abstract of JP 56-47240, publ. 1981-04-28	1
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