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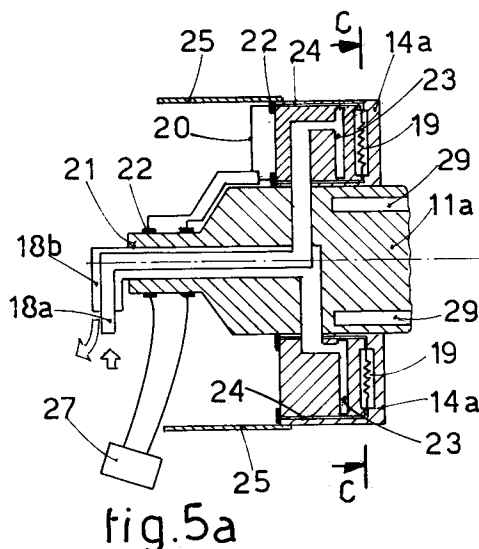
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I-33100 Udine (IT)(54) **Lateral containment device with rings for continuous casting plants with rolls.**

(57) Lateral containment device with rings for continuous casting plants with rolls, in which the rolls (11) are substantially coplanar and parallel, the device comprising automatic means to adjust the distance between centres of the rolls and the rolling pressure, each roll (11) cooperating with a containment ring (14), the rings (14) acting on one end of the other roll (11) and determining the width of strip (13) being continuously cast, the rolls (11) and the rings (14) including means for cooling by circulation of cooling fluid, annular circuit means (23) to cool the rings (14) being capable of being momentarily closed, heating means (19) being included in each ring (14) in cooperation with the wall of the ring (14) in contact with molten metal (12) and being able to be actuated momentarily.

**EP 0 572 795 A1**

This invention concerns a lateral containment device with rings for continuous casting plants with rolls, as set forth in the main claim.

To be more exact, the invention concerns a cooling and/or heating system cooperating with the lateral containment device with rings so as to provide a suitable required temperature of the sidewalls of the containment rings.

So as to produce thin strip from a bath of molten metal in a continuous casting plant comprising two facing, contrarotating rolls, two or more containment rings able to rotate together with the rolls are keyed on the ends of the rolls.

As is disclosed in EP 0138059 for instance, the containment rings can slide along the axis of the rolls and thus enable the width of the cast strip to be adjusted continuously.

The reciprocal displacement of the rings and rolls is performed advantageously with hydraulic means.

The rolls are provided with suitable cooling means consisting of cooling water circulating within the rolls, for instance. This cooling water causes a thermal flow in a direction perpendicular to the surface of the rolls, thus leading to solidification of the strip being formed.

The two half-strips thus created on the surface of each roll are drawn during rotation of the rolls and are connected together in the vicinity of the line connecting the axes of the rolls. The point of meeting of the two half-strips is called in the art the "kissing point".

At the line connecting the axes of the rolls, that is to say, in the zone where there is the minimum distance between the surfaces of the two rolls, the two half-strips are lightly rolled to unite them to each other.

So that the rolling will be strong enough to produce cohesion of the two half-strips, the overall solidified thickness at the kissing point should be slightly greater than the gap existing between the two rolls.

The rolling force is generally measured by load cells fitted to the supports of at least one of the two rolls.

One of the typical shortcomings found in this type of plant of the state of the art consists of the faults in the vicinity of the edges, where the strip is not uniform.

This shortcoming is due most often to undesired solidification of the molten metal caused by the sidewalls of the containment rings, this solidification being due to the heat exchange generated through the containment rings. If the heat exchange is too great, a solid skin generally forms on the sidewalls of the containment rings. This is the case with US-A-2,058,447.

This solid skin is drawn together with the half-strips and is rolled by the rolls; as it is thin and cannot withstand combined bending and compressive stresses, it normally tends to be folded back inwards.

This situation creates a solidified excessive thickness at the edges of the strip, and this thickness is often the cause of mistakes in measuring the rolling force.

These measurement mistakes may cause a failure to bond the two half-strips together in their central zone.

The prevalent faults encountered on the strip are therefore of two types:

- a central air space in the strip owing to incomplete bonding;
- a double skin at the edges of the strip.

FR-A-2.628.993 discloses a heated closure plate which is intended to keep hot an upper zone where a casting chamber is located. This plate exerts a high pressure against the edge of both the rolls but does not prevent formation of a thin solidified skin near the rolls, thus disclosing again what we have already said but in a less prominent form.

The present applicants have designed, tested and embodied this invention so as to overcome the shortcomings of the state of the art and to achieve further advantages.

The invention is set forth and characterized in the main claim, while the dependent claims describe variants of the idea of the main embodiment.

The purpose of the invention is to provide a containment device with rings for continuous casting plants with rolls, whereby the temperature of the sidewalls of the containment rings in contact with the molten metal is suitably controlled and adjusted.

The adjustment is pre-arranged in such a way as to prevent excessive heat exchange between those sidewalls and the metal being cast, and viceversa, since the heat exchange, if it is too great and is directed towards those sidewalls, will lead to the shortcomings described above.

The device according to the invention, therefore, purposes to keep the sidewalls of the rings always at a required controlled temperature during the processing steps and in any casting conditions.

The present applicants have found to their surprise that, if the ring is kept at the desired temperature, the results in the finished product are very good.

During normal working of the plant the heat transmitted by the bath of molten metal, which comes into cyclic contact with the same part of the ring, causes heating of the sidewall of the ring in contact with the molten metal.

When the maximum temperature compatible with the task performed by the ring and with the

type of material composing the ring is reached, the ring has to be cooled to avoid too great overheating.

The rings are therefore equipped with a cooling system that lowers the temperature of their sidewalls and prevents overheating. This cooling system may consist, for instance, of circulation of water fed along the axes of the rolls.

When the casting step is started or the casting speeds are low, the temperature of the wall of the ring in contact with the molten metal may be too low. The present applicants have found to their surprise that it is advantageous to provide a heating system suitable to raise, and to help in keeping, the temperature of the ring at the desired level in the initial phase.

This heating system may be brought about, for instance, by introducing a plurality of electrical heating resistors into the ring. These electrical resistors may be fed, for instance, by means of circumferential brush contacts arranged on the outer wall of the ring; the electrical conductors connecting the electrical resistors are connected to the brush contacts.

The brush contacts may be connected directly to the network of the electricity supply.

According to a variant, so as to ensure greater safety of the electrical connections, the brush contacts arranged on the ring are connected through conductors to analogous circumferential brush contacts arranged on the neck of at least one of the rolls.

According to another variant at least one protective element is included to protect the electrical contacts and conductors.

By means of these contrivances it is therefore possible, by regulating the flow of cooling water or the intensity of the electrical supply current, to keep the sidewalls of the rings at the optimum temperature in all the processing steps irrespective of the casting conditions.

The attached figures are given as a non-restrictive example and show some preferred embodiments of the invention as follows:-

Fig.1a

is a diagrammatical plan view of a continuous casting plant with rolls in a processing step;

Fig.1b

shows the plant of Fig.1a in another processing step;

Fig.2

shows in an enlarged scale a cross-section of the continuous casting plant with rolls along the line A-A of Fig.1a;

Figs.3a and 3b

show, with a section from above, a detail of Figs.1 in two processing steps;

Fig.3c

is a diagrammatic plan view of the strip produced by the plant of Figs.1;

Fig.4a

shows, with a section along the line B-B, a detail of Figs.1;

Fig.4b

shows a detail of Fig.4a in an enlarged scale;

Fig.5a

is a partial lengthwise section of the containment device with rings according to the invention;

Fig.5b

is a cross-section of the device of Fig.5a along the line C-C;

Fig.6

is a cross-section of a variant of the device of Fig.5a.

The reference number 10 in the figures indicates a generic continuous casting plant as shown in the diagrammatic plan view of Fig.1.

The plant 10 consists of two facing, contrarotating rolls 11a and 11b, between which molten metal 12 is cast to produce a thin strip 13 at the outlet of the plant.

Two lateral containment rings 14a and 14b which can rotate together with the rolls 11a-11b are keyed at the ends of the rolls 11a-11b. These containment rings 14a-14b can move along the axes of the rolls 11a-11b so as to adjust the width of the emerging strip 13 continuously as required (see Figs.1a and 1b).

The rolls 11a and 11b are provided with cooling means to obtain solidification of the cast metal 12. In this example the rolls 11a-11b include within them a circulation of cooling water 15, which creates a thermal flow in a direction perpendicular to the axes of the rolls 11.

In the example of Figs.5 and 6 the rolls 11 are provided with an annular cooling circuit 29.

This thermal flow causes solidification of the strip 13 or, to be more exact, causes the formation of two half-strips 16a and 16b respectively on the surfaces of the two rolls 11a and 11b.

Rotation of the rolls 11a-11b brings the half-strips 16a-16b into contact at a point 17 called the "kissing point".

The two half-strips 16a-16b are rolled so as to bond them together at the kissing point 17.

The required rolling force is measured by load cells 28 fitted to the supports of one of the rolls 11.

Too great heat exchange between the molten metal 12 and the sidewalls of the containment rings 14a-14b generally leads to shortcomings in the finished strip 13. In fact, too great heat exchange can lead to undesirable solidification of the molten metal 12 on the sidewalls of the ring 14 in contact with the molten metal 12 (see Figs.3a, 3b and 4b), thus causing the formation of a solid skin 12a, which is drawn by the rolls 11a-11b and is rolled

together with the two half-strips 16a-16b.

This solid skin 12a tends to become folded inwards (Fig.3b) and creates a solidified excessive thickness at the edges of the strip 13, thus often causing a failure of the half-strips 16a-16b to be bonded together in their central zone, as can be seen in Fig.3c.

So as to reduce the heat exchange, for instance in the event of overheating of the sidewalls of the rings 14a-14b, the invention provides for the inclusion of an annular circuit 23 for circulation of cooling water within the containment rings 14a-14b.

In this example the cooling water is fed along the axes of the rolls 11 through an inlet conduit 18a and is discharged through an outlet conduit 18b (Fig.5a).

According to a variant shown in Fig.6, so as to convey and direct the cooling water with a view to ensuring an even distribution of the water and therefore an even cooling over the whole sidewall of the ring 14, which is the ring 14a in this case, the annular circuit 23 includes baffle elements 26 to guide the water which cooperate with the inlet and outlet conduits 18a and 18b respectively.

When the casting conditions do not provide a high enough temperature on the sidewalls of the containment rings 14a-14b in contact with the molten metal 12, the invention includes the provision of a heating system, which in this example (Figs.5) consists of electrical heating resistors 19 arranged radially in the rings 14.

Embodiments are possible, but are not shown here, which include electrical resistors 19 arranged in a spiral along the periphery of the rings 14 or else include metallic radiant disks which are coaxial and concentric with the rings 14.

Electric current is fed to the electrical resistors 19, in this case, through brush contacts 22 fitted to the outer surface of the ring 14a and connected to the resistors 19 by connecting conductors 24.

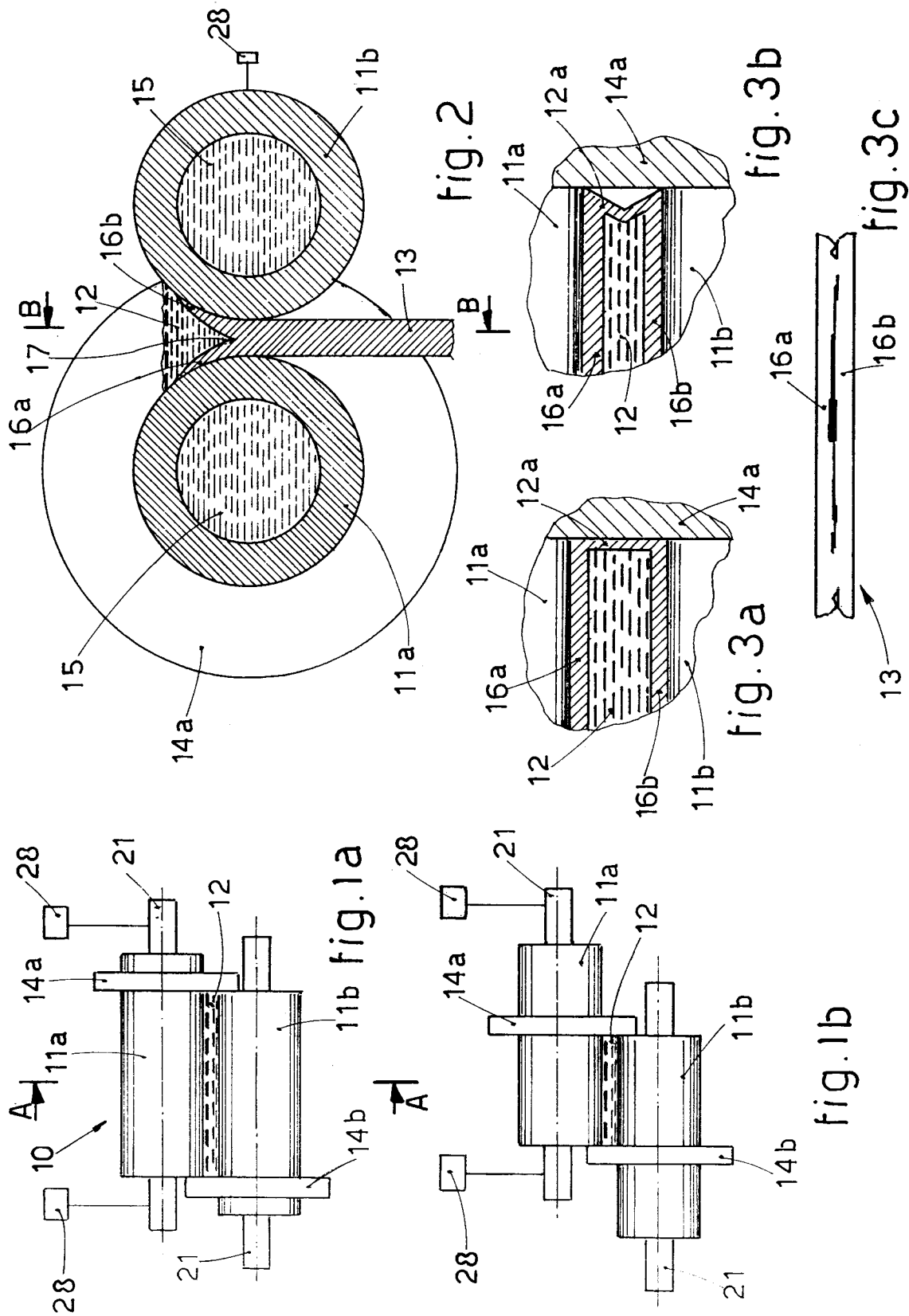
The brush contacts 22 in this case are circumferential and are fitted to a drum 20 connected electrically to the neck 21 of the roll 11, the neck 21 being equipped likewise with circumferential brush contacts 22 connected electrically to the supply network 27.

Coordinated adjustment of the flow of cooling water and of the intensity of the electrical current enables the required and most suitable temperature to be provided on the sidewalls of the containment rings 14a-14b directly in contact with the molten metal 12.

The device according to the invention comprises one or more screening elements 25, secured in this example to the periphery of the ring 14a, so as to ensure protection of the brush contacts 22.

Claims

1. Lateral containment device with rings for continuous casting plants with rolls, in which the rolls (11) are substantially coplanar and parallel, the device comprising automatic means to adjust the distance between centres of the rolls and the rolling pressure, each roll (11) cooperating with a containment ring (14), the rings (14) acting on one end of the other roll (11) and determining the width of strip (13) being continuously cast, the rolls (11) and the rings (14) including means for cooling by circulation of cooling fluid, annular circuit means (23) to cool the rings (14) being capable of being momentarily closed, heating means (19) being included in each ring (14) in cooperation with the wall of the ring (14) in contact with molten metal (12) and being able to be actuated momentarily.
2. Device as in Claim 1, in which the heating means consist of electrical resistors (19) fed with controlled power.
3. Device as in Claim 1 or 2, in which the rings (14) can be positioned along the length of their respective roll (11).
4. Device as in any claim hereinbefore, in which the rolls (11) can be positioned along their own axis.



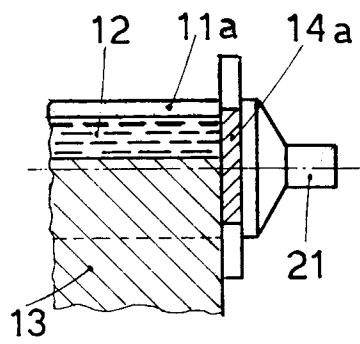


fig.4a

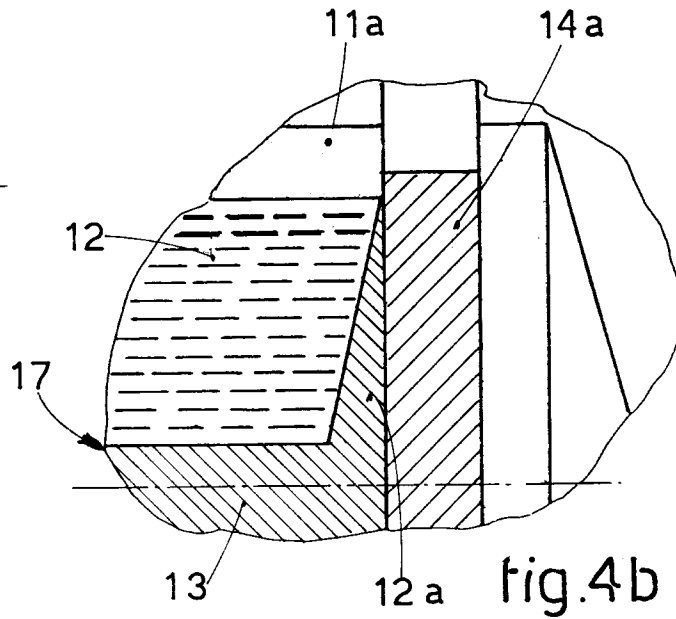


fig.4b

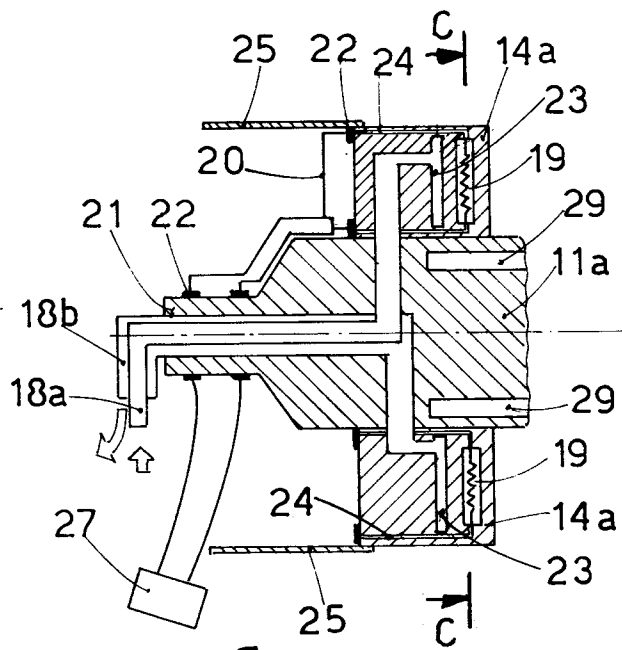


fig.5a

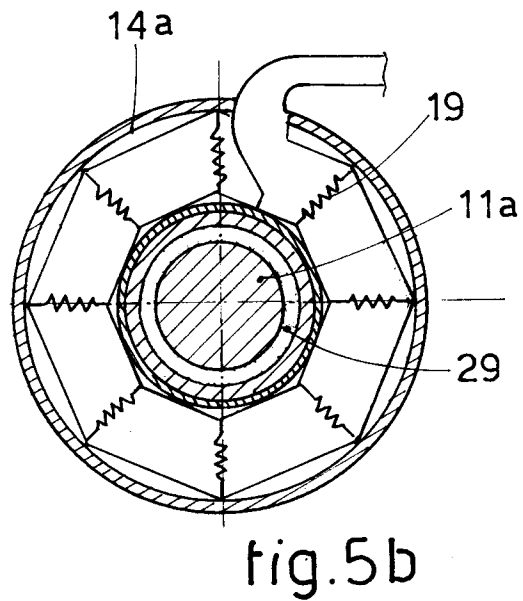


fig.5b

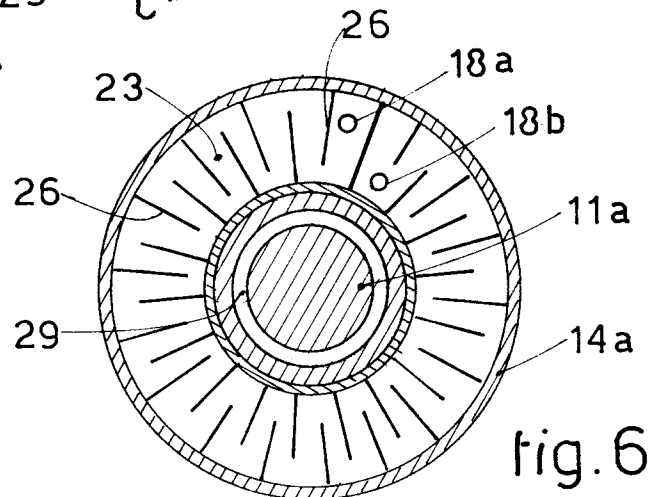


fig.6



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EUROPEAN SEARCH REPORT

Application Number

EP 93 10 6715

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.5)
A	US-A-2 058 447 (C.W.HAZELETT) * page 6, line 1 - line 32; figures 22,23 * ---	1	B22D11/06
D,A	EP-A-0 138 059 (HITACHI LTD) * page 23, line 25 - page 25, line 19; figures 7,8 * ---	1	
A	FR-A-2 628 993 (IRSID) * abstract; figures 1,2 * * page 6, line 21 - line 29 * ---	2	
A	SOVIET INVENTIONS ILLUSTRATED Section Ch, Week 30, Derwent Publications Ltd., London, GB; Class M, AN 83-721790/30 & SU-A-959 903 (AS BELO MOGIL PHYS) 23 September 1982 * abstract * ---	1	
A	PATENT ABSTRACTS OF JAPAN vol. 8, no. 32 (M-275)(1469) 10 February 1984 & JP-A-58 188 549 (NIPPON KOKAN KK) 4 November 1983 * abstract * -----	1	TECHNICAL FIELDS SEARCHED (Int. Cl.5) B22D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 27 AUGUST 1993	Examiner MAILLIARD A.M.
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			