

(19)



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(11)

EP 0 965 402 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
22.12.1999 Bulletin 1999/51

(51) Int. Cl.⁶: **B22D 11/06**

(21) Application number: **99303657.3**

(22) Date of filing: **11.05.1999**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **17.06.1998 AU PP414398**

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(54) Strip casting apparatus

(57) Apparatus for casting metal strip in which molten metal is applied to a casting roll (12) the surface of which is cleaned by a cleaning brush device (21) comprising a main brushing device (22) extending across the roll surface and a sweeper brushing device (23) extending across the roll to engage the roll surface at a location in advance of the main brushing device. Sweeper brushing device (23) comprises an elongate rotary barrel brush mounted for rotation and engageable

with the casting roll (12) so as to be rotatably driven thereby and an elongate scraper blade (29) engaging the bristles (26) of the sweeper brush (23) so as to scrape swept material from the brush (23) and to resist rotation of the brush so as to cause a peripheral speed differential between the sweeper brush (23) and the casting roll.

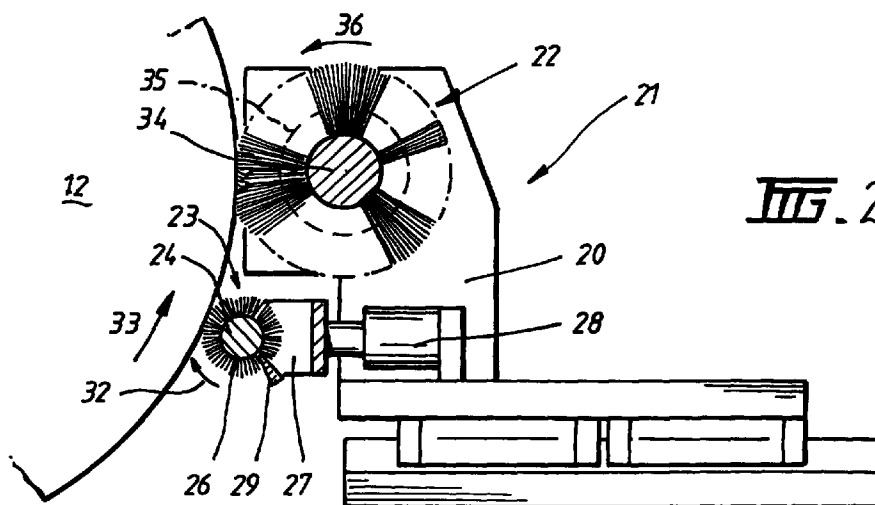


FIG. 2.

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Description

BACKGROUND OF THE INVENTION

[0001] This invention relates to metal strip casting apparatus in which molten metal is brought into contact with a casting roll surface so as to solidify on that surface. More specifically, it is concerned with continuous cleaning of the casting rolls in such casters.

[0002] The casting apparatus may be either a single roll caster or a twin roll caster. In a twin roll caster hot metal is introduced between a pair of contra-rotated horizontal casting rolls which are cooled so that metal shells solidify on the moving roll surfaces and are brought together at the nip between them to produce a solidified strip product at the outlet from the roll nip. The term "nip" is used herein to refer to the general region at which the rolls are closest together. The hot metal may be introduced into the nip between the rolls via a metal delivery nozzle located above the nip to form a casting pool supported on the casting roll surfaces immediately above the nip and confined at the ends of the nip by appropriate confining means such as pool damming side plates.

[0003] In order to prevent accumulation of metal oxides and slags or other contaminants on the roll surfaces, cleaning devices such as brushes or cleaning belts may be applied to the outer longitudinal sides of the rolls so that the roll surfaces are continuously cleaned before moving into contact with the molten metal in advance of the nip. One apparatus of this kind is disclosed in Japanese Patent Publication JO3230849-A of Nippon Steel Corporation and Mitsubishi Heavy Industries KK. In this apparatus two sets of divided roller brushes are applied to the peripheral surface of each chilled casting roll with the brushes of one set being staggered with respect to those of the other set to provide a brushing action across the complete width of the casting roll. Japanese Patent Publication J01-083341-A also of Nippon Steel Corporation and Mitsubishi Heavy Industries KK also discloses a twin roll caster in which the casting rolls are cleaned by brushes. Japanese Patent Application 29393/97 and 29394/97 of Nippon Steel Corporation disclose roll cleaning arrangements in which two cylindrical cleaning brushes are brought successively into contact with a casting roll at different stages of a casting run. United States Patent 4,793,400 discloses a casting drum cleaner in which a pair of similar rotating brushes are applied to tandem to the drum, both brushes being driven in opposite directions to the rotation of the drum. Other roll brushing arrangements are disclosed in our United States Patents 5,307,861 and 5,575,327.

[0004] No matter what kind of brushing arrangement is used to clean the roll casting surface, it has been found desirable to provide an auxiliary sweeper brush to clean off major accretions of contaminants from the roll surface before it reaches the main cleaning brush instal-

lation which can then perform a fine cleaning function. The sweeper brush can be in the form of an elongate fixed head brush having an elongate array of wire bristles and which can be advanced and retracted so that the brush loading against the roll can be varied. Simple fixed head sweeper brushes of this kind have poor life and can be easily damaged. The number of bristles which can be brought into contact with the roll surface is limited by the narrow width of the brush and accretions on the casting surface can sometimes pass through these bristles. The present invention provides an improved sweeper brush in the form of a barrel brush which enables more effective brushing and longer brush life to be achieved and an arrangement in which the barrel brush need not be driven to perform an effective sweeping function.

SUMMARY OF THE INVENTION

[0005] According to the invention there is provided apparatus for casting metal strip, comprising a casting roll, metal delivery means to deliver molten metal onto the surface of the casting roll and roll cleaning brush means to clean the roll surface, the brushing means comprising a main brushing device extending across the roll to engage the roll at one location and a second sweeper brushing device extending across the roll to engage the roll surface at a location in advance of the main brushing device, wherein the sweeper brushing device comprises an elongate rotary barrel brush extending across the width of the casting roll and mounted for rotation about its longitudinal axis and engagable with the casting roll so as to be rotatably driven thereby, an elongate scraper extending along the barrel brush and engaging the barrel brush so as to scrape swept material from the barrel brush and to resist rotation of the barrel brush so that the barrel brush rotates at a peripheral speed less than that of the casting roll surface and in the same peripheral direction as the casting roll surface at the region of its engagement with the casting roll surface.

[0006] The arrangement provided in accordance with the present invention enables use of a barrel brush for the sweeping function. A barrel brush can have much higher bristle density than an equivalent elongate fixed head brush and the bristles can be much shorter than those of the conventional sweeper brushes. The invention enables the barrel brush to be effectively rotated relative to the casting drum without the need for a complex brush drive while simultaneously ensuring that the barrel brush is continuously cleaned so as to maintain an effective sweeping action.

[0007] Preferably, the apparatus further comprises means to move the barrel brush toward and away from the casting roll.

[0008] The barrel brush may be rotatably mounted on a brush mounting structure connected to a fluid cylinder device actuable to move the brush mounting structure

toward and away from the casting roll. In that case the scraper may be mounted on the brush mounting structure to move in and out with the barrel brush.

[0009] The scraper may comprise an elongate scraper blade projecting into the bristle canopy of the barrel brush.

BRIEF DESCRIPTION OF DRAWINGS

[0010] In order that the invention may be more fully explained one particular embodiment will be described in detail with reference to the accompanying drawings in which:

Figure 1 illustrates a twin roll caster incorporating a pair of brushing devices in accordance with the invention;

Figure 2 illustrates one of the brushing devices; and
Figure 3 is a front elevation of a barrel brush of the brushing device.

DESCRIPTION OF PREFERRED EMBODIMENT

[0011] The illustrated twin roll caster comprises a main machine frame 11 which supports a pair of parallel casting rolls 12. Molten metal is supplied during a casting operation from a ladle 13 through a refractory ladle outlet shroud 14 to a tundish 15 and thence through a metal delivery nozzle 16 into the nip 17 between the casting rolls 12. Hot metal thus delivered to the nip 17 forms a pool 10 above the nip and this pool is confined at the ends of the rolls by a pair of side closure plates 18 which are held against stepped ends of the rolls by actuation of a pair of hydraulic cylinder units (not shown). The upper surface of the pool 10 (generally referred to as the "meniscus" level) may rise above the lower end of the delivery nozzle so that the lower end of the delivery nozzle is immersed within this pool.

[0012] Casting rolls 12 are water cooled so that shells solidify on the moving roller surfaces and are brought together at the nip 17 between them to produce a solidified strip product 19 at the roll outlet. This product may be fed to a standard coiler (not shown).

[0013] The illustrated twin roll caster as thus far described is of the kind which is illustrated and described in some detail in our Australian Patent 631728 and our United States Patent 5,184,668 and reference may be made to those patents for appropriate constructional details which form no part of the present invention.

[0014] In accordance with the present invention the illustrated twin roll caster is provided with a pair of roll cleaning devices denoted generally as 21 which are disposed on to each side of the pair of casting rolls such that they can be engaged with the outer side extremities of the rolls 12 to opposite sides of nip 17.

[0015] Each cleaning device 21 comprises a frame 20 which carries a main roll cleaning brush 22 and an aux-

iliary sweeping brush 23. The main brush may be in the form of a cylindrical barrel brush with wire bristles and may be rotated by a rotary drive means 35 coupled to the brush shaft 34 so as to rotate the brush counter to the rotation of the casting roll as indicated by the arrow 36 in Figure 2. Although the main brush is shown as a cylindrical barrel brush but it should be understood that this brush may take other forms such as the elongate rectangular brush disclosed in United States Patent 307861, the rotary brushing devices disclosed in 5,575,327 or the pivoting brushes of Australian Patent Application PO7602. The precise form of the main brush is not critical to the present invention.

[0016] In accordance with the present invention the auxiliary sweeper brush 23 is in a form of a cylindrical barrel brush having a central body 24 carried on a shaft 25 and fitted with a cylindrical canopy of wire bristles 26. The barrel brush shaft 25 is rotatably mounted in a brush mounting structure 27 which can be moved back and forth by operation of quick acting hydraulic cylinders 28 to move the barrel brush inwardly against the roll 12 or to retract it away from the roll. The roll mounting structure 27 is in the form of a wide yoke with side wings 30 in which the brush shaft 25 is rotatably mounted in bearings 31. The barrel brush 23, brush mounting structure 27 and actuator 28 are carried on the main frame 20 of the cleaning device 21 so that the barrel brush will always be correctly positioned in advance of the main brush 22. The roll mounting structure 27 carries an elongate scraper blade 29 which extends throughout the width of the barrel brush 23 and projects into the canopy of bristles 26. Blade 29 may be made of hardened steel and have a sharp leading edge. The arrangement is such that when the brush 23 is biased inwardly against the roll 12 by actuation of the cylinder units 28 it is rotatably driven by the frictional engagement between the canopy of bristles 26 and the roll surface so that it is rotated in the same peripheral direction as the roll surface at the region of its engagement with the roll surface, as indicated by the arrows 32, 33 in Figure 2. The rotation of the barrel brush 23 is retarded by its interengagement with the scraper blade 29 so that the barrel brush 23 is driven at a slower peripheral speed than the roll. The relative speed between the roll and the barrel brush 23 causes effective sweeping action and ensures that the bristles engaging the casting roll will change continuously. The scraper blade 29 also effectively cleans the barrel brush 23 of contaminating material swept from the casting surface of the roll so that clean bristles are continuously presented to the casting roll surface.

[0017] Barrel brush 23 is moved into engagement with the casting roll prior to the start of casting and is moved away from the roll after casting conditions have stabilised. It is moved back into engagement with the roll just prior to termination of the cast. The barrel brush serves to prevent damage to the main brush and the casting roll due to carry over of debris generated on commence-

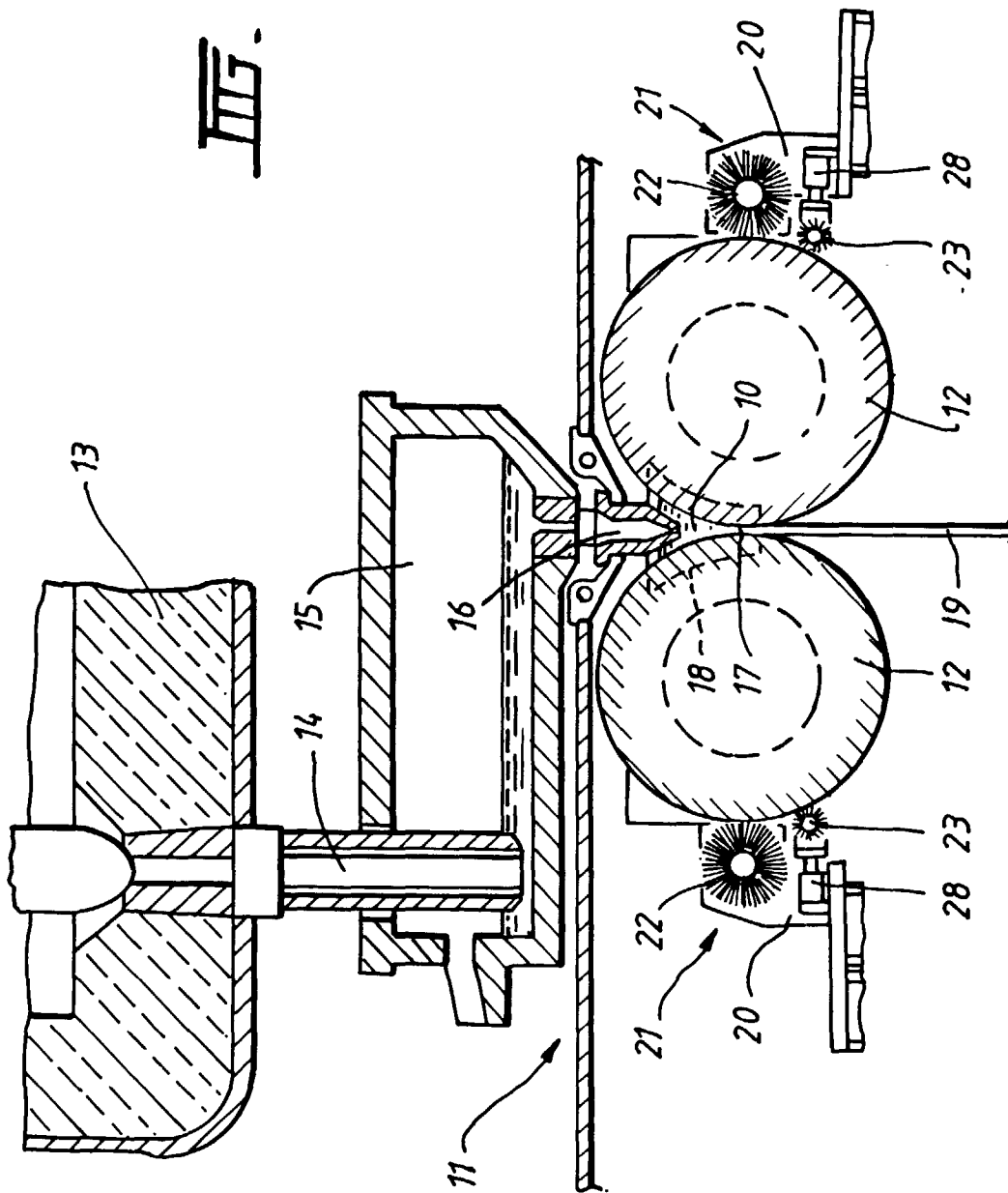
ment and termination of casting.

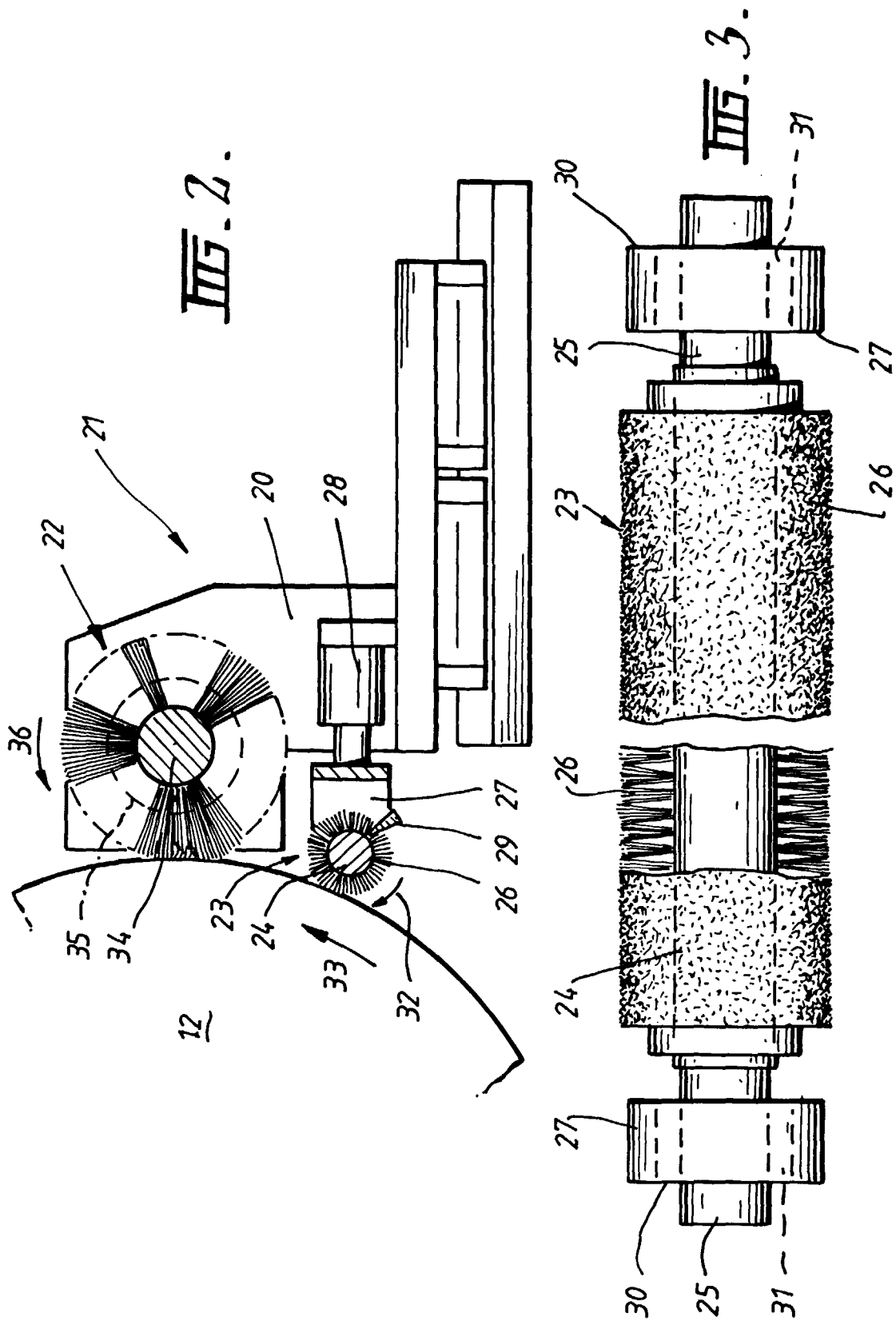
Claims

1. Apparatus for casting metal strip, comprising a casting roll (12), metal delivery means (13, 14, 15) to deliver molten metal onto the surface of the casting roll (12) and roll cleaning brush means (21) to clean the roll surface, the brushing means (21) comprising a main brushing device (23) extending across the roll to engage the roll at one location and a second sweeper brushing device extending across the roll to engage the roll surface at a location in advance of the main brushing device (22), characterised in that the sweeper brushing device (23) comprises an elongate rotary barrel brush extending across the width of the casting roll (12) and mounted for rotation about its longitudinal axis and engagable with the casting roll so as to be rotatably driven thereby, an elongate scraper (29) extending along the barrel brush (23) and engaging the barrel brush so as to scrape swept material from the barrel brush and to resist rotation of the barrel brush (23) so that the barrel brush rotates at a peripheral speed less than that of the casting roll surface (12) and in the same peripheral direction as the casting roll surface at the region of its engagement with the casting roll surface. 5 10 15 20 25
2. Apparatus as claimed in claim 1, further characterised by comprising means (28) to move the barrel brush (23) toward and away from the casting roll (12). 30
3. Apparatus as claimed in claim 2, further characterised in that the barrel brush (23) is rotatably mounted on a brush mounting structure (27) connected to a brush actuator (28) actuable to move the brush mounting structure (27) toward and away from the casting roll (12). 35 40
4. Apparatus as claimed in claim 3, further characterised in that the brush actuator (28) comprises a fluid actuable cylinder device. 45
5. Apparatus as claimed in claim 3 or claim 4, further characterised in that the scraper (29) is mounted on the brush mounting structure (27) to move in and out with the barrel brush (23). 50
6. Apparatus as claimed in any one of claims 3 to 5, further characterised in that the scraper (29) is fixed to the brush mounting structure (27). 55
7. Apparatus as claimed in any one of claims 3 to 6, further characterised in that the barrel brush (23), the brush mounting structure (27) and the brush actuator (28) are carried on a frame (20) which sup-

ports the main brushing device (22).

8. Apparatus as claimed in any one of claims 1 to 7, further characterised in that the barrel brush (23) comprises a central brush body (24) and a cylindrical canopy of bristles (26) projecting radially outwardly from the central body (24).
9. Apparatus as claimed in claim 8, further characterised in that the bristles (26) are formed of steel wire.
10. Apparatus as claimed in claim 8 or claim 9, further characterised in that the scraper (29) comprises an elongate scraper blade projecting into the bristle canopy of the barrel brush (23).
11. Apparatus as claimed in claim 10, further characterised in that the scraper blade (29) has a sharp leading edge.
12. Apparatus as claimed in claim 10 or claim 11, further characterised in that the scraper blade (29) is made of hardened steel.







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EUROPEAN SEARCH REPORT

Application Number
EP 99 30 3657

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.6)
A,D	US 5 575 327 A (KATO HEIJI) 19 November 1996 (1996-11-19) * column 3, line 32 - column 5, line 15; figures 1-5 *	1-12	B22D11/06
A,D	PATENT ABSTRACTS OF JAPAN vol. 097, no. 006, 30 June 1997 (1997-06-30) & JP 09 029393 A (NIPPON STEEL CORP), 4 February 1997 (1997-02-04) * abstract *	1-12	
A,D	PATENT ABSTRACTS OF JAPAN vol. 097, no. 006, 30 June 1997 (1997-06-30) & JP 09 029394 A (NIPPON STEEL CORP), 4 February 1997 (1997-02-04) * abstract *	1-12	
A,D	US 4 793 400 A (WOOD RICHARD A) 27 December 1988 (1988-12-27) * abstract; figure 1 *	1-12	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
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Place of search		Date of completion of the search	Examiner
THE HAGUE		2 August 1999	Mailliard, A
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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 99 30 3657

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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