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(71) Applicant: **INNSE INNOCENTI SANTEUSTACCHIO S.p.A.**
20, Via A. Franchi
I-25100 Brescia(IT)

(72) Inventor: **Galletti, Cesare**
8 Strada, 6
I-20090 S. Felice di Segrate (Milan)(IT)

(74) Representative: **Vannini, Torquato et al,**
JACOBACCI-CASETTA & PERANI S.p.A. 7 Via Visconti di Modrone
I-20122 Milan(IT)

(54) Roll for strip rolling mill stands.

(57) A roll (1) for a strip-metal rolling mill stand, in particular a backing roll for a four-high stand, comprises a cylindrical shell (8a)covering a central zone (9) of the core (8) of thr roll, and at least one pair of expansion rings (12) which have outer cylindrical walls. The expansion rings (12) are mounted coaxially on the core (8) at opposite ends of the shell (8a) and lie substantially in contact with the shell (8a) in an axial sense. Each ring (12) can be expanded to the diameter of the shell (8a) by supplying pressurised fluid into an annular chamber (13) formed between each ring (12) and the core (8). By selective expansion of the rings (12) the operative width of the roll (1) can be adapted to the width of strip being rolled.

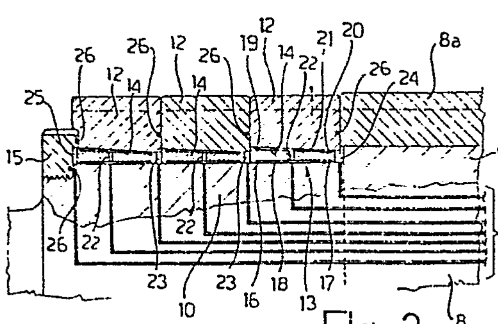

Fig-2

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Roll for strip rolling mill stands

The present invention relates to a roll for strip rolling mill stands, in particular but not exclusively for a backing roll in a four-high or six-high stand and possibly also as an intermediate roll in six-high stands.

In strip rolling mills it is frequently necessary to roll sheet-metal strips of different widths. The rolling mills presently used for producing strips are of the so-called four-high stand type (or four-high rolling mills) in which the rolling mill stands include four rolls, two working rolls in contact with the strip to be rolled and two backing rolls which bear on the working cylinders transmitting their rolling forces.

Generally a rolling mill of the said type is designed to produce good results when working strips of a predetermined width; when used to roll strips of different widths the resultant product is of notably inferior quality.

Indeed, as is well known, reaction forces are applied to the necks of the backing rolls to withstand and counter the pressure which the strip of sheet metal exerts on the rolls during rolling. The backing rolls are thus forced to bend, their fibres being compressed by the strip, with resulting curving. The working rolls follow the deformation of the backing rolls and, as a result, the rolled strip has a transverse section which, instead of being rectangular, tends to take on a form substantially like a biconvex lens, that is, with a greater thickness in the middle.

There thus exists a problem of devising a rolling mill which allows strips of different widths to be rolled while always producing strips with a flat rectangular cross section.

The most obvious solution - that is, the use of rolls appropriate for the width of the strip to be rolled - cannot be adopted in practice due to the very high costs both of the apparatus (the need to have a store of rolls with different dimensions) and particularly of operation (extremely long setting up times for the rolling mill).

One attempt to resolve this problem has been to apply to the working rolls, corrective loads tending to force the facing ends of the two working rolls apart and induce a bending force in the opposite sense to that caused by the rolling force. The effectiveness of this solution is not however sufficient and the precision obtained is again often poor.

In order to solve the said problem it has also been proposed to interpose axially - movable intermediate rolls between the working rolls and the backing rolls. During the rolling of strips of a maximum width, these intermediate rolls are located symmetrically relative to the rolling axis. When it is necessary to roll narrower strips, the intermediate rolls are moved along their axes in opposite directions by a distance substantially equal to the difference between the half-width of the strip to be rolled and that of the widest strip rollable. In this manner the intermediate rolls cause the action of the backing rolls to be distributed only over a central part of the working rolls that is as wide as the strip ; the working rolls are thus subject to smaller forces and curve less.

The solution described immediately above, even though satisfactory from a technical point of view is unsatisfactory from an economic viewpoint. Indeed, not only does it involve the use of a six-high stand which has a more complicated structure than the conventional four-high stands, but it is also heavier and more bulky as well as being further complicated structurally and functionally by the fact that the intermediate rolls must be axially movable in a registerable manner.

A further disadvantage is that, taking account of the relatively long lifetime of the rolls, which is of the order of several tens of years, there is often a problem of refurbishing existing installations in which the introduction of the new technology would involve, at very high cost, the replacement of complete stands by the above-said special six-high stands.

Consequently and more precicely the technical problem underlying this invention is that of making it possible to roll sheet metal strips of different widths accurately without the need to replace existing structures of rolling plants. In other words, the conventional four-high stands already operating in the plant under consideration must, above all else, still be usable.

The concept providing a solution to this problem is that of providing a backing roll the active length of which is variable.

On the basis of this concept, the problem set out above is resolved in accordance with the present invention by a roll comprising a cylindrical core and characterised in that it includes:

- a cylindrical shell covering a central zone of the core,
- at least one pair of expansion rings with cylindrical exteriors that are mounted coaxially on the core at opposite ends of the shell and substantially in contact in an axial sense with the shell itself,
- at least one annular chamber formed between each expansion ring and the core,
- means for passing a pressurised fluid into each of the said chambers to expand the corresponding expansion ring isotropically, the ring having, in a contracted condition, an outer diameter less than the diameter of the shell and, in an expanded condition, an outer diameter equal to that of the shell,
- means for mechanically locking each expansion ring on the core in its contracted and expanded conditions.

Further characteristics and advantages of the invention will become more apparent from one embodiment of a roll for strip rolling mill stands, described below with reference to the appended drawings, given purely by way of non-limiting example in which:

Figure 1 is a schematic view of a four-high stand including a roll according to the invention,

Figure 2 is a partially sectioned view of a detail of the roll according to the invention in an operative condition,

Figure 3 is a partial schematic view in section of the same detail of the roll of Figure 2 in a different operative condition of the roll.

With reference to the drawings, a four-high stand is schematically shown at 2 the uprights 6 and 7 whereof support a stiffening cross-beam 2a. The stand 2 includes two backing rolls 1, 3 and two working rolls 4 and 5 each rotatably supported by the uprights 6, 7 of the stand 2 in a conventional manner not shown in detail.

The backing roll 1 includes a cylindrical core 8 constituted by a larger-diameter central portion 9 and two identical portions 10, 11 of smaller diameter than the central portion 9 and extending symmetrically relative thereto. The central portion 9 is encased by a cylindrical shell 8a rigid with the core 8.

In contrast, portions 10, 11 of the core 8 coaxially mount a plurality of expansion rings each indicated 12 (in the example illustrated there are three rings 12 on each of the portions 10, 11). According to a preferred but non-limiting embodiment, the rings 12 are all identical and similarly arranged on their respective portions 10, 11 of the core 8. In particular, the rings 12 touch each other and the shell 8a and are retained in this disposition by annular shoulders 15. Between each of the expansion rings 12 and the corresponding portion 10, 11 of the core 8 is an annular chamber into which pressurised fluid (in particular, oil) can be passed. As will become clearer from the following description, upon an increase in fluid pressure, each expansion ring 12 is isotropically deformed from a contracted (inoperative) condition in which its outer diameter is less than the outer diameter of the shell 8a, to an expanded (operative) condition in which its outer diameter is the same as the outer diameter of the shell 8a.

Solely for the purpose of simplification, the following description relates to only one of the expansion rings 12 and is given with reference to Figure 2 in which the structural details of the other rings are identified by the same reference numerals.

Each expansion ring 12 has an outer cylindrical wall and an internal, conical wall with a taper that extends towards the shell 8a of the backing roll under consideration.

A support ring 14 is coaxially mounted on the corresponding portion 10, 11 of the core 8 and is movable axially within the chamber 13 formed between the ring 12 and the core 8. The support ring 14 has an outer conical wall with the same taper and taper direction as that of the inner wall of the expansion ring 12.

An annular chamber 18 is formed between the support ring 14, the corresponding portion 10, 11 of the core 8, and two annular seals 16, 17 spaced axially on the portion 10, 11. Similarly, an annular chamber 21 is formed between the support ring 14, the expansion ring 12 and two annular seals 19, 20 concentric with the annular seals 16, 17 mentioned above.

The chambers 18 and 21 are in fluid communication through a passage 22 extending radially through the support ring 14.

The support ring 14 has an axial length less than the axial length of the corresponding expansion ring 12 and hence of the chamber 13 in which it is axially movable.

Consequently, respective annular chambers 23, 24 and 25 are defined between adjacent support rings 14, between one end support ring 14 and the portion 9, and between the other end ring and the annular shoulder 15. The sealing of these annular chambers against pressurised fluid is ensured by seals each schematically indicated 26.

A plurality of ducts generally indicated 27 extend axially through the core 8 of the backing roll under consideration and communicate at one end with a hydraulic control unit, not shown, and at the opposite end with each of the chambers 18-21, 23, 24 and 25.

The operation of the backing roll 1 embodying the invention will now be described starting from an initial situation in which all the support rings 14 have been moved as far towards the annular shoulder 15 as possible. Under these initial conditions, the rings 12 are in their contracted states and their outer cylindrical walls have a smaller diameter than the diameter of the skirt 8a.

In this situation the backing roll 1 is adapted for rolling a strip of a minimum width, and behaves as a backing roll of a width equal to the width of the shell 8a only. The underlying working roll 4 is thus subject to thrust from the backing roll 1 over only its central part just as the opposing forces produced by the strip being rolled act only on this central part. The working roll 4 thus only takes on the deformation of the central portion or shell of the backing roll 1, a deformation which is substantially zero.

When it is necessary to roll strips of a greater width than that considered above, it is necessary to increase the operative width of the backing roll 1 and this is achieved by bringing into operation one or more pairs of expansion rings 12 by transforming them from their contracted condition considered previously to an expanded condition. Under these conditions, the outer diameter of the cylindrical walls of the expansion rings is the same as the diameter of the shell 8a.

In order to expand, for example, the first expansion ring (that is, the ring 12 adjacent the cylindrical shell 8a), pressurised oil is delivered into the corresponding annular chambers 18 and 21 to expand the ring 12, and into the chamber 23 adjacent thereto to move the support ring 14 towards the shell 8a as the ring 12 expands.

Once the expanded condition is reached, the oil pressure is removed and the ring 12 remains locked in the expanded condition due to the action of the support ring 14 which thus behaves as a wedge. The operations of expanding the remaining rings 12 are entirely similar.

In order to return, for example, the first ring 12 to its contracted condition, it is necessary to deliver pressurised oil into the corresponding chambers 18 and 21 and into the chamber 24 to move the support ring 14 into a position opposite to that previously considered, that is towards the annular shoulder 15. After this displacement, the oil pressure is removed and the ring 12 takes up its initial contracted condition again. The same support ring 14 keeps the expansion ring 12 in this position.

A roll according to the invention thus allows the rolling of strips of different widths, with the resultant rolled strips having flat rectangular cross sections.

Furthermore such a backing roll may be used either in an existing four-high stand, or in a conventional six-high stand as an intermediate roll.

Depending on operational requirements, either a single backing roll may be used as described above, acting on only one working roll, or a pair of backing rolls embodying the invention may be used each acting on a respective working roll in this case, naturally the effectiveness of the invention will be increased.

A backing roll according to the invention may be used together with conventional corrective loads further increasing the working precision. It will thus be clear that a backing roll according to the invention solves the technical problem previously explained, ensuring rolling results which are technically consistent, with reasonable production, installation and operating costs.

CLAIMS

1. A roll (1) for strip rolling mill stands, comprising a cylindrical core (8) and characterised in that it comprises:

- a cylindrical shell (8a) covering a central zone (9) of the core (8),

- at least one pair of expansion rings (12), with cylindrical exteriors, that are mounted coaxially on the core (8) at opposite ends of the shell (8a) and substantially in contact in an axial sense with the shell itself,

- at least one annular chamber (18, 21) formed between each expansion ring (12) and the core (8),

- means (27) for passing a fluid under pressure into the said at least one chamber (18, 21) to expand the corresponding expansion ring (12) isotropically, the ring having, in a contracted condition, an outer diameter less than the diameter of the shell (8a) and, in an expanded condition, an outer diameter equal to that of the shell (8a), and

- means (14) for mechanically locking each expansion ring (12) on the core (8) in both its contracted and expanded condition.

2. A roll (1) according to Claim 1, characterised in that a support ring (14) is coaxially mounted on the core (8) for axial movement within the said at least one annular chamber (13), the support ring constituting locking means for the corresponding expansion ring (12) in its contracted and expanded conditions.

3. A roll (1) according to Claim 2, characterised in that each expansion ring (12) has an internal conical wall and each associated support ring (14) has an outer conical wall with the same taper and taper direction as the taper of the internal wall of the expansion ring (12), the support ring (14) acting as a locking wedge for the corresponding expansion ring (12).

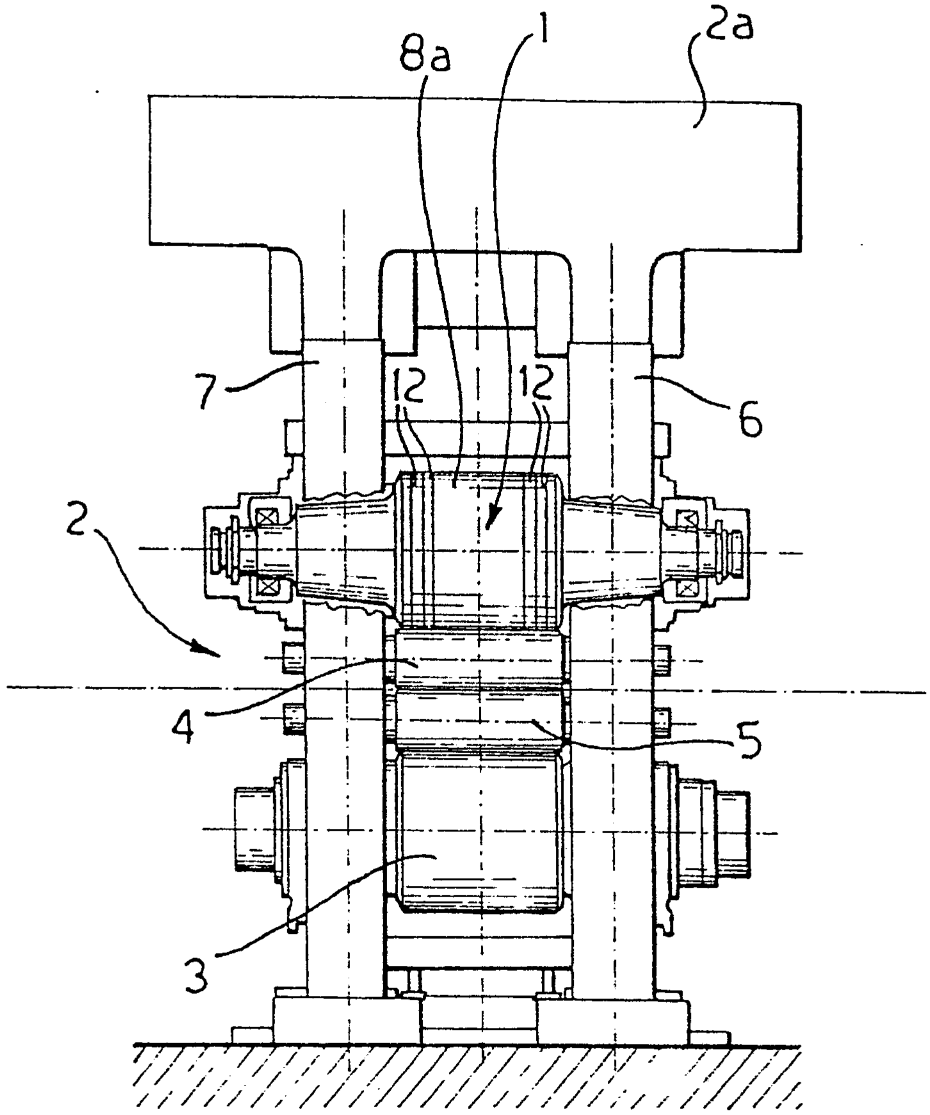

Fig-1

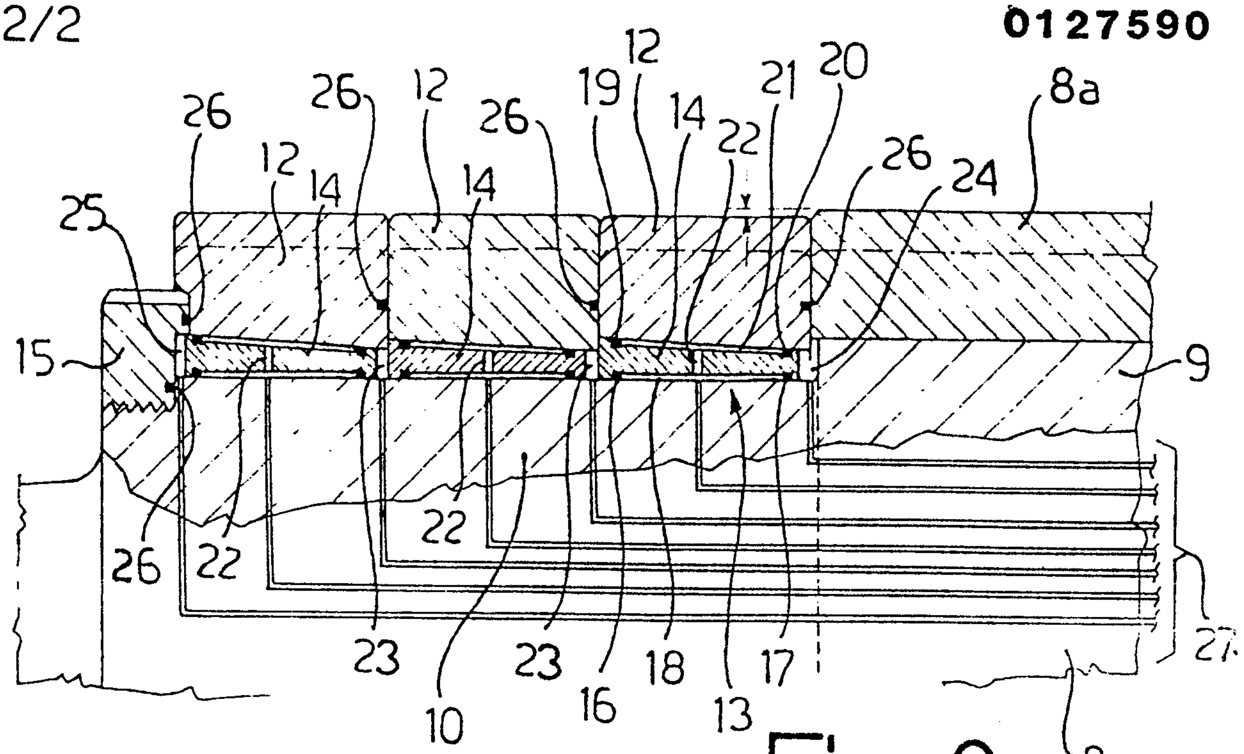
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Fig-2

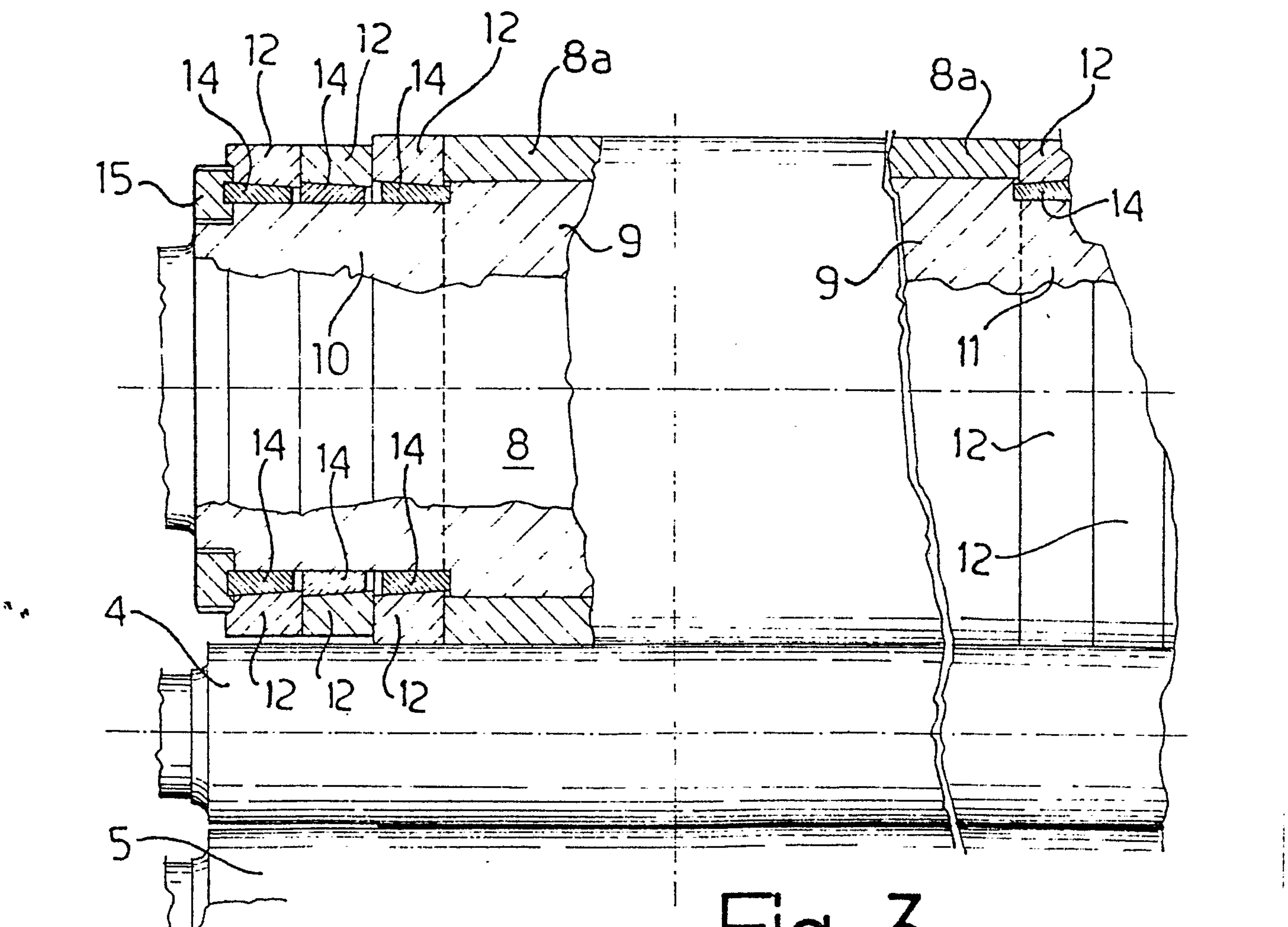
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Fig-3

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EUROPEAN SEARCH REPORT

Application number

EP 84830148.7

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. 3)
Y	FR - A - 2 083 867 (DEMAG AKTIENGESELLSCHAFT) * Page 6, line 5 - page 7, line 35; fig. 1,2 *	1-3	B 21 B 27/02
Y	GB - A - 2 094 687 (DAVY-LOEWY LIMITED) * Page 1, line 125 - page 2, line 31; fig. 3; claims 1-4 *	1-3	
Y	US - A - 4 026 491 (BOSTROEM) * Column 7, lines 10-31; fig. 11,12 *	1-3	

TECHNICAL FIELDS SEARCHED (Int. Cl. 3)

B 21 B 13/00
B 21 B 27/00
B 21 B 29/00
B 21 B 31/00
B 21 B 37/00
B 21 C 47/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	30-08-1984	TROJAN

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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