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(11)

EP 0 692 320 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

17.01.1996 Bulletin 1996/03(51) Int Cl.⁶: **B21B 13/20, B21B 13/10**(21) Application number: **95110406.6**(22) Date of filing: **04.07.1995**(84) Designated Contracting States:
BE DE ES FR GB SE(72) Inventor: **Dorigo, Alessandro**
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I-33017 Tarcento (Udine) (IT)(54) **Rolling group for high reductions**

(57) Universal rolling-mill of the type with rolling rollers on planetary system, involving four opposite planetary wheels (1,2,3,4), identical and symmetric, each comprising a solar wheel that bears satellites rolling-mill rollers (r), characterized in that:

- two planetary couples of opposite rolling are used which rotation axis lie on the same orthogonal plane as or substantially adjacent to the laminate to be reduced;
- said satellites rolling-mill rollers of each planetary system, are spaced out with a value such to allow the orthogonal rolling-mill interference to not be in the same plane as satellites rolling-mill rollers of the other couple;
- a planetary couple is in staggered synchronism in the rotation for the rolling;
- in such a way that in a single rolling phase one has the rolling alternation of the respective satellites rolling-mill rollers of the opposite couples as in a gear, causing the laminate to undergo some progressive reductions of orthogonal section in an orthogonal way also alternating, during the contemporary, but staggered, rotation of said opposite planetary couples.

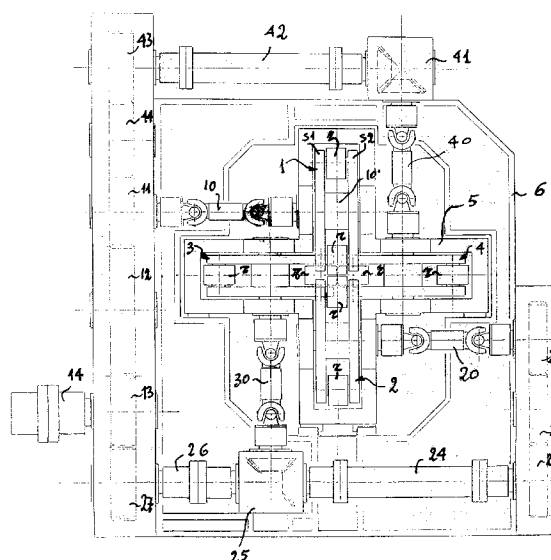


Fig. 1

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Description

This invention has for object a rolling-mill for high reductions.

At the present state of technology planetary rolling-mills which have been essentially devised for high reduction (rolling-mills with high reduction ratio) are known.

Amongst these the "SENDZIMIR PLANETARY MILL" and the "PLATZER PLANETARY MILL" are distinguished, both substantially involving a series of idle rolling rollers mounting wheels of opposite loadbearing so-lars, with the difference that the second solution utilizes intermediate counter-thrust rollers.

These rolling-mills base their conception on the fact that in just one pass they can even reach a section reduction in hot-rolling that nears 98%.

These types of rolling-mills, given their structure, are substantially utilized for unidirectional rolling or for flat rolling, and therefore particularly suitable for the production of flat-plates, tapes or plates.

Wanting to obtain variously profiled wire or rods, is only possible with the use of at least two rolling-mills, a horizontal and a vertical one.

However it is noted that in such a case it is not possible to obtain optimal results, substantially for the fact that a desired section in only two passes, horizontal and vertical cannot be done, because the second pass would find it hard to roll the rim with a too thin flat-plate.

For these reasons the planetary mills, notwithstanding the above mentioned advantages, have found a practical application only in the rolling of products such as tapes and plates.

The scope of the present invention is to render possible and advantageous the planetary rolling in the mills for long products, that require the rolling both with horizontal and vertical axis.

The problem is solved as claimed by means of a universal mill of the type with rolling rollers on a planetary system, involving four opposite solar wheels, identical and symmetric, that bear satellites rolling-mill rollers, characterized in that:

- two planetary couples of opposite rolling are used which rotation axis lie on the same orthogonal plane as or substantially adjacent to the laminate to be reduced;
- a planetary couple is in staggered synchronism in the rotation for the rolling, preferably half of the angular pass of spacing between said satellites rolling rollers in each solar wheel of the other planetary couple or between these;
- said satellites rolling-mill rollers of each planetary system, are spaced out with a value such to allow the orthogonal rolling-mill interference to not be in the same plane as rolling-mill rollers of the other cou-

ple,

- in such a way that in a single rolling phase one has the rolling alternation of the respective satellites rolling-mill rollers of the opposite couple as in a gear, causing the laminate to undergo some progressive reductions of section in orthogonal direction as well as alternating, during the contemporary, but staggered, rotation of said opposite planetary couples.

In this way it is possible to obtain a finished roll with fewer number of passes and however it will be possible to obtain very high reductions of section with much reduced encumber of the rolling system, not needing a large quantity of subsequent rolling-mills holsters for the progressive reductions.

More in detail this type of plant can substantially be called star mill for the specific star conformation of the support structure of the respective peripheral rolling-mill rollers (satellites rolling-mill rollers in a loadbearing solar wheel conformed substantially in a star shape).

The machine consists therefore of four rolling-mill groups (four solar wheels in opposite couples identical and symmetric) which peripheral satellite rollers of each torque act alternatively according to the vertical axis and horizontal axis.

Every solar wheel therefore supports a series of rolling-mill rollers mounted planetarily on an structure put into rotation that is said solar wheel (star structure).

The minimum number of rolling-mill rollers (known also with the definition cylinders) mounted on every structure is one, but advantageously there can be more (for example four or more).

The rotation of the planetary wheels is ensured by known means (motors/reducers) and can rotate in both directions in discordance or in agreement with the advancement of the material being rolled.

Satellites rolling-mill rollers will rotate in both directions in discordance or in agreement.

A better comprehension of the successive description of a preferential realization solution is given with the help of included drawings which particulars of execution are not to be considered limitative but only supplied for example.

Figure 1 is a frontal schematic view of a universal rolling holster with two couples of opposite planetary rolling wheels, each conformed in a star shape and bearing four rolling-mill rollers with perfectly synchronized and staggered rotation of half pitch.

Figure 2 represents, a schematic side section view.

Figures 3, 4, 5, 6, represent in respective side views and in section AA, BB, CC, DD the progressive reduction form of the laminate to obtain, square, round, "L", and double "T".

The rotation of the planetary wheels is perfectly synchronized by means of mechanical transmission.

The machine represented illustrates a functioning with four planetary wheels put into rotation in agreement

with the laminate.

The planetary wheels are indicated respectively with 1,2,3,4.

Each planetary wheel includes a solar wheel made from two star plates S1-S2, and between these star plates four idle satellites rolling-mill rollers "r" are supported.

The four planetary wheels 1,2,3,4 lie with the coplanar rotation axis on orthogonal plane to the advancement line of the laminate "L".

Towards the top of the rolling-mill holster can be provided either a towing system "T", or a prelamination system, or a straightening system, as from known technique.

The four planetary wheels 1,2,3,4 are contained in a case 5 and everything is supported by a loadbearing structure 6.

The rotation of the four planetary wheels is performed by a single motor axis 14, the tractor gear 13 of which transmits the motion to two opposite gears 12 and 27.

The gear 12, transmits the motion via 11, and cardanic articulation 10 transmits the rotary motion to the planetary wheel 1 of which the star plates holding the satellites s1, s2 are distanced by an axial spacer 10'.

Similarly the opposite planetary wheel 2 is commanded at the same speed and same angular value, by wheel 27 via joint 26, joint 24, gears 23-22-21 and cardanic articulation 20, in order that the opposite rollers "r" coincide perfectly with each other in the respective opposite symmetric movement.

In a similar way the transmission of the motion for the other two opposite horizontal planetary wheels 3 and 4 takes place, but with staggered synchronization as claimed, in order that the respective rollers "r" penetrate in the laminate, the horizontal couple alternatively with the vertical couple.

Planetary wheel 3 receives the motion from cardanic articulation 30 that connects to the conic group 25 from one side and the planetary wheel 4 receives the motion from the articulation 40 via conic couple 41, joint 42 and gears 43-44, this last one geared to 11 of the first transmission.

The ratios of transmission will be, as said, duly calculated to supply the desired synchronism.

The rolling rollers rotate in a discordant way respect to the bar subjected to the rolling "L", but because the speed of the planetary wheel is greater than the advancement speed of the laminate, it results that the couple of rollers "r" (horizontal and vertical) that alternatively come into contact with the material, each produce a small rolling action.

This rolling-mill (horizontal, vertical) allows the contemporary rolling on all the surface of the material, this means that any form of laminate can be laminated (with a high reduction system). Naturally the rolling rollers can be motorized on their own or can also be idle as in the specific case reported in the figures.

Advantageously as said, at the entrance of the group for high reduction, a dragger is placed (traction and/or thrust) to ensure a constant advancement to the laminate "T".

Advantages:

- a very-high reduction possibility is obtained with just one machine, that is, one replaces more traditional rolling groups;
- one has the possibility to produce with one machine, various final forms from products as square (billets), large plates, circular or other forms.
- one has a notable reduction of plant costs.

In the definition of the claims the structure supporting rolling rollers are called planetary wheels 1,2,3,4, each couple of opposite planetary wheels is called planetary couple 1-2 and 3-4; each rolling roller is called planetary rolling roller and the wheel that supports them is called solar wheel.

In the present solutions the satellites rolling rollers are idle but obviously could also be motorized.

Analogously the motorization of the illustrated solar wheels in the Figures performs with a single motor, but it is obvious that one can adopt more motors.

Claims

1. Universal rolling-mill of the type with rolling rollers on planetary system, involving four opposite planetary wheels, identical and symmetric, each comprising a solar wheel that bears satellites rolling-mill rollers, characterized in that:
 - two planetary couples of opposite rolling are used, the rotation axis of which lie on the same orthogonal plane as or substantially adjacent to the laminate to be reduced;
 - said satellites rolling-mill rollers of each planetary system, are spaced out with a value such to allow the orthogonal rolling-mill interference to not be in the same plane as satellites rolling-mill rollers of the other couple;
 - a planetary couple is in staggered synchronism in the rotation for the rolling;
 - in such a way that in a single rolling phase one has the rolling alternation of the respective satellites rolling-mill rollers of the opposite couple as in a gear, causing the laminate to undergo some progressive reductions of orthogonal section in orthogonal direction as well as alternat-

ing, during the contemporary, but staggered, rotation of said opposite planetary couples.

2. Rolling-mill according to claim 1, characterized in that said planetary wheels are with four rays or with four satellites rolling rollers. 5
3. Rolling-mill according to claim 1, characterized in that said satellites rolling rollers are idle. 10
4. Rolling-mill according to claim 1, characterized in that said planetary wheels rotate at a speed peripherically higher than the advancement speed of the laminate. 15
5. Rolling-mill according to claim 1, characterized in that towards the top of the universal rolling holster is installed at least one couple of rollers of traction/thrust "T". 20
6. Rolling-mill according to claim 1, characterized in that towards the top of the rolling holster is installed a preventive rolling system.
7. Rolling-mill according to claim 1, characterized in that the transmission of the rotation to the four planetary wheels is made by means of mechanical gears from a single motor axis (14). 25
8. Rolling-mill according to claim 1, characterized in that the four planetary wheels 1,2,3,4 are encompassed in a central cage 5 and are set up demountable and adjustable by means of cardanic articulation (10,20,30,40). 30

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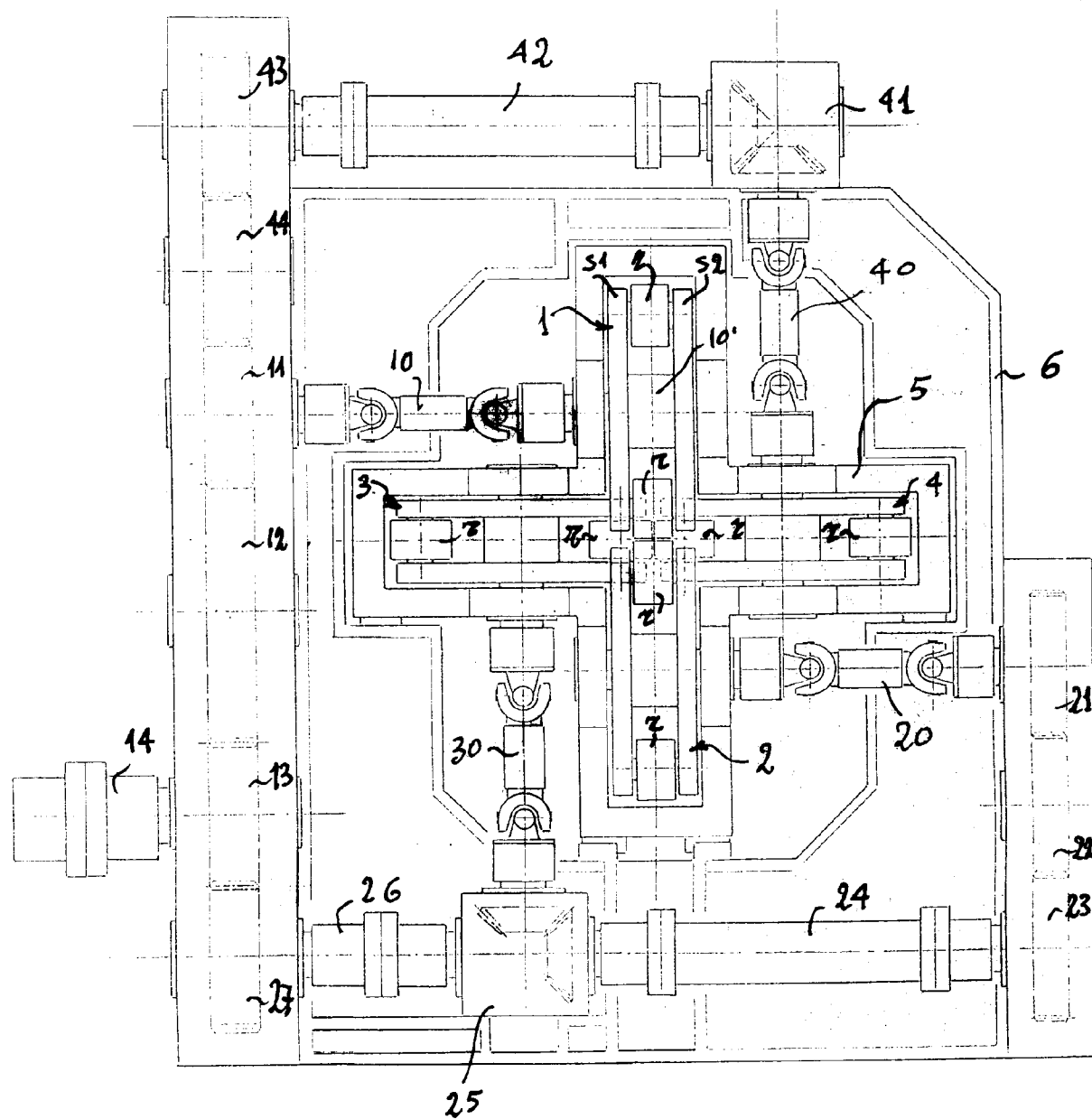


Fig. 1

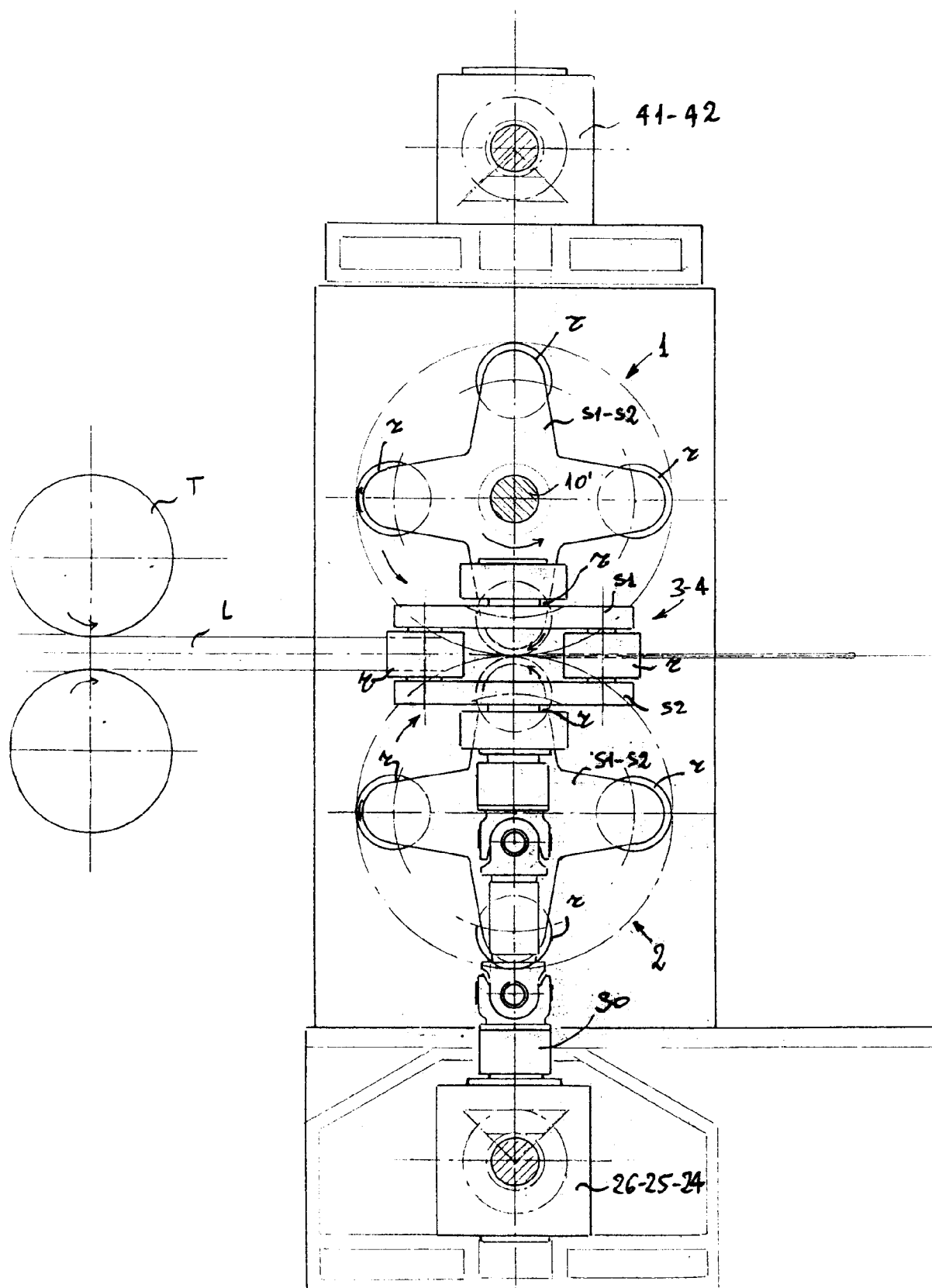
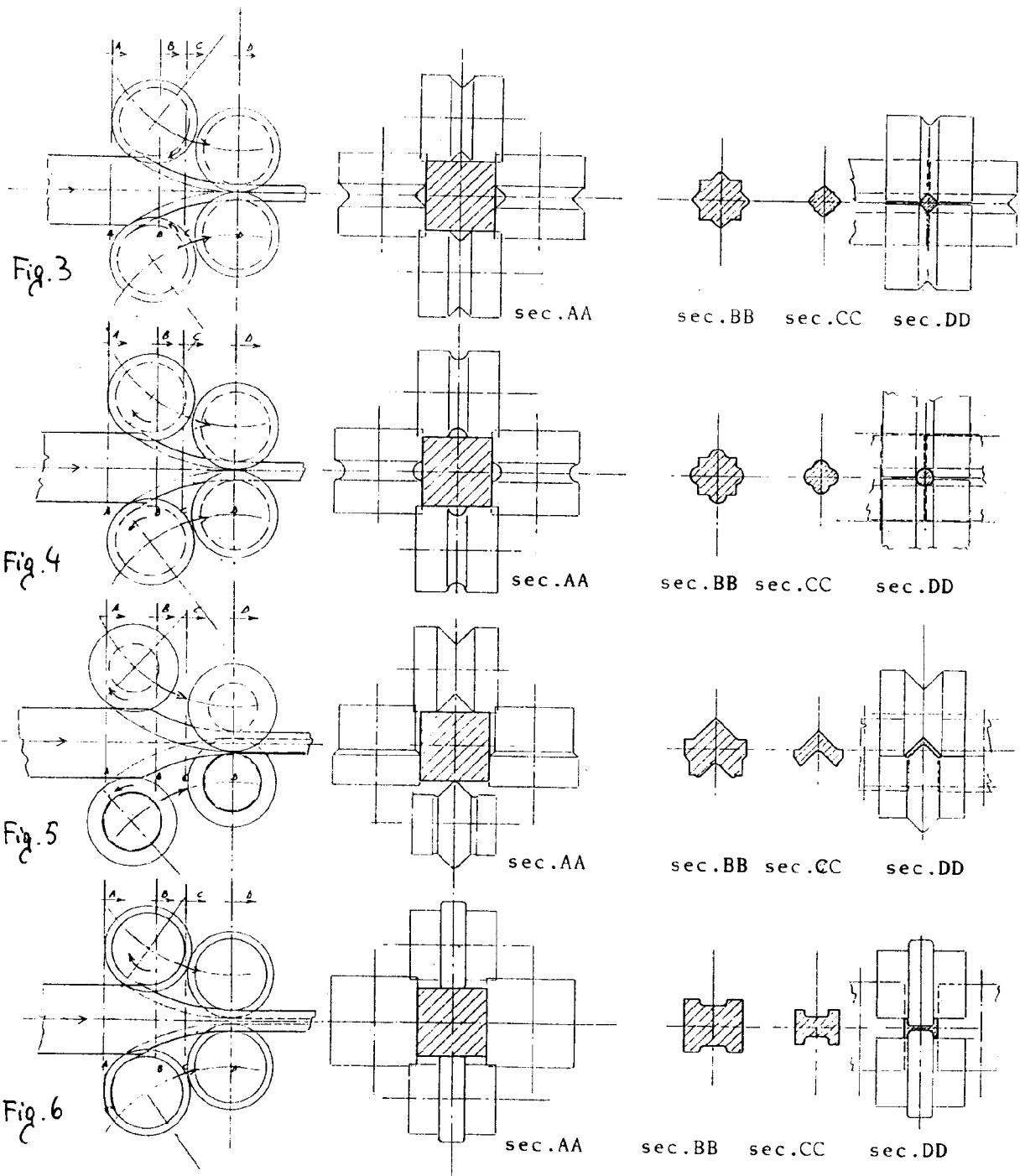


Fig. 2





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EUROPEAN SEARCH REPORT

Application Number
EP 95 11 0406

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)
X	DE-A-18 13 331 (SIEMAG SIEGENER MASCHINENBAU GMBH)	1,3,4,7,8	B21B13/20
Y	* the whole document *	2,5,6	B21B13/10

X	US-A-4 193 282 (WILSON)	1,7	
Y	* the whole document *	2	

X	LA TECHNIQUE MODERNE, vol. 46, no. 11, November 1964 pages 433-438, 'Les Laminaires Planétaires Sendzimir'	1,3,7	
Y	* page 434, left column, line 34 - right column, line 11; figure 2 *	5,6	
	* figures 1,5 *		

X	DE-A-14 52 143 (WISSENSCHAFT.-TECHN. ZENTRUM AUSRÜSTUNGEN FÜR DIE SCHWERINDUSTRIE ...)	1,3,7	
A	* the whole document *	2,8	

X	EP-A-0 156 151 (IRSID)	1,3	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	* claims; figures *	2,7,8	B21B
	* page 1, line 3 - page 2, line 33 *		
	* page 9, line 17 - line 21 *		
	* page 11, line 3 - line 9 *		

A	PATENT ABSTRACTS OF JAPAN vol. 9 no. 14 (M-352), 22 January 1985 & JP-A-59 163005 (SUMITOMO) 14 September 1984, * abstract *	4	

The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 25 October 1995	Examiner Plastiras, D
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 03.92 (P4/C01)