(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 529 614 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.05.2005 Bulletin 2005/19

(51) Int Cl.[7]: **B28B 11/04**, B28B 13/02, B41F 15/08

(21) Application number: **04077995.1**

(22) Date of filing: **01.11.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK YU

(30) Priority: **07.11.2003 IT RE20030105**

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(54) Dry decorating device for ceramic tiles

(57) A dry decorating device for ceramic tiles (2), comprising a hopper (9) provided with a lower discharge mouth, or slot, positioned above a band (7) in which powder-permeable regions defining the decoration are provided and which slidably closes the slot, a roller (6) on which the band winds and a roller (5) from which the band unwinds, a conveyor (1) feeding the tiles into a position below said slot and in a direction perpendicular thereto, and means for driving the band winding and unwinding rollers in synchronism with the conveyor advancement speed, said band winding and unwinding rollers being each associated with a respective electric motor, for the two motors there being provided a single control circuit arranged to operate them in both directions of rotation but both in the same sense, said control circuit being governed by signals from speed measurement means which measure the speed of the band carrying the decoration and the speed of the tile conveyor.

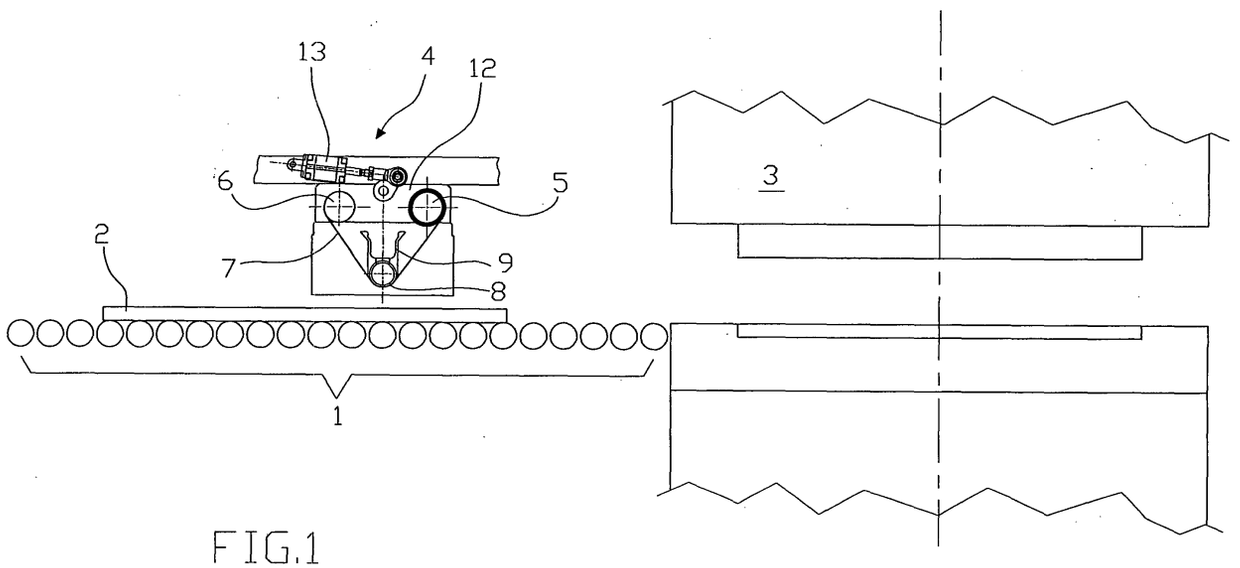

FIG.1

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Description

[0001] The present invention relates to a device for dry-decorating ceramic tiles, of the type described in Italian Patent Application MO99A000141 and in European Patent Applications EP 1247629 and EP 1302289 in the name of TECNO-EUROPA.

[0002] The tile forming plants described in said documents relate to tile double pressing processes and comprise a device for dry decorating by the application of coloured powders.

[0003] The present invention specifically regards the system described in said documents for applying the dry decorations.

[0004] Said system provides for powder deposition through an acetate band in which powder-permeable regions with solid backgrounds or miscellaneous graphics are provided.

[0005] The acetate band is wound about two parallel rollers and slides against the base of a hopper having a curved, preferably semi-cylindrical shape. The hopper contains the powder of the decoration to be applied to the tile, the bottom of the hopper presenting a transverse lower slot against which said band is made to slide.

[0006] The slot is opened and closed by pneumatic pistons positioned at the top of the structure.

[0007] The acetate band slides in contact with the tiles or at a short distance from them, its speed being perfectly synchronized with that of the tiles advancing on a roller conveyor, to ensure perfect execution of the decoration.

[0008] The acetate band winds about the front roller positioned downstream of the tile advancement direction, and unwinds from that positioned upstream.

[0009] The acetate band comprises various decorations, generally from two to six, depending on the tile formats.

[0010] After all the decorations have come into contact in succession with a like number of tiles advancing along the roller conveyor, the system rewinds the acetate band about the rear roller to then repeat the cycle.

[0011] The band is driven by a single electric motor connected to the front roller by a rigid transmission.

[0012] In contrast, the electric motor is connected to the rear roller by elastic means forming a flexible coupling, the task of which is to absorb the difference in r. p.m. between the two rollers consequent on the band winding diameters during decoration, and to maintain the acetate band at a constant tension to prevent deformation of the decoration graphics. Decoration is correctly achieved only if the acetate band remains perfectly in contact with the lower roller both during working and during rewinding.

[0013] If this does not happen, the band slackens or stretches, and instead of falling on the tile the powder scatters between the band and the hopper base, with consequent poor decoration definition and the production of rejects.

[0014] A further drawback of the known art derives from the short life of the elastic means, the frequent breakages of which slow down production. This drawback cannot be overcome by changing the type of elastic means.

[0015] Finally, the elastic means of known devices do not allow high rewinding speeds as they are unable to maintain a constant acetate band tension, hence the line has to be slowed down to the detriment of production, or the tile flow has to be halted until the acetate band has been completely rewound.

[0016] The object of the present patent is to remedy the stated drawbacks and problems within the framework of a simple and reliable solution.

[0017] This object is attained by a device having the characteristics defined in claims from 1 to 9.

[0018] According to the invention, each of the acetate band winding rollers is driven by its own motor.

[0019] The motor is keyed directly onto a reduction unit carrying a pinion which engages a gearwheel keyed onto the roller.

[0020] Each of the two motors is of brushless type operating in both directions of rotation, and is associated with its own regulator circuit which in one motor rotation direction is sensitive to motor operating speed, while in the opposite direction it is sensitive to the torque transmitted by the motor. The two motors are regulated such that when the motor of one roller is controlled by speed, the motor of the other roller is controlled by torque, and vice versa.

[0021] The device of the invention operates by the improved method of operation defined in claims from 10 to 13.

[0022] The operational and constructional characteristics and merits of the invention will be more apparent from the ensuing detailed description given with reference to the figures of the accompanying drawings, which illustrate a preferred embodiment thereof by way of non-limiting example.

[0023] Figure 1 is a schematic side view of the invention.

[0024] Figure 2 is a partial enlarged plan view of Figure 1.

[0025] Figure 3 is an enlarged detail of Figure 1.

[0026] The figures show schematically a roller conveyor 1, or motorized roller table, on which the partly compacted tiles 2 are advanced towards the press 3 for their final pressing.

[0027] The decorating device 4 of the present invention is positioned upstream of the press 3.

[0028] Said device comprises a front roller 5 and a rear roller 6, about which the band 7 carrying the powder-permeable regions defining the decorations is wound.

[0029] In the present embodiment said band 7 is an acetate band, but can be of different type and/or nature provided it is suitable for the purpose.

[0030] The band 7 is stretched below the semi-cylin-

drical base 8 of a hopper 9 for the decorating powder, said hopper being provided with a lower mouth 90, or slot, for passage of the powder.

[0031] In proximity to its edges, the band presents a plurality of equidistant holes in which engage the teeth 10 (Figure 3) of two gearwheels 11 positioned to the sides of the band, and having the same diameter as the semi-cylindrical bottom of the hopper.

[0032] The whole assembly is supported by a frame 12 associated with means, such as the cylinder-piston unit 13, which position the bottom of the hopper either very close to or distant from the tiles 2 transiting on the roller conveyor 1.

[0033] With reference to Figure 2, this shows the scheme of the device control and operating circuit, comprising a photoelectric cell 14 for sensing the arrival of a tile 2, and means for measuring the roller table speed and the band advancement speed respectively. In the illustrated embodiment, said speed measurement means comprise a first encoder 15 connected to the roller table 1, and a second encoder 16 connected to the gearwheels 11 on which the band 7 winds.

[0034] The encoders 15 and 16 are set to measure the peripheral speed of the band 7 and of the rollers of the roller table. The signals from the photoelectric cell 14 and encoders 15 and 16 are fed to the device control circuit controlling the operation of the motor 55 which is rigidly connected to the roller 5 and of the motor 66 which is rigidly connected to the roller 6. Each of said motors is controlled by a card 50 and 60 which comprises a switch for switching between two operating and control modes.

[0035] A first operating mode of the motor 55 relates to a determined direction of rotation (anticlockwise direction in Figure 1), and provides for regulating the motor speed on the basis of the signals fed by the encoders 15 and 16 to the circuit 17.

[0036] In contrast. the operating mode of the motor 66, which is made to rotate in the same direction of rotation as the motor 55, provides for regulating its torque to a constant value predetermined by the operator.

[0037] Said operating modes relate to the tile decoration stage.

[0038] When the band has been totally wound on the roller 5, it must be rewound onto the roller 6, with the direction of rotation, the function and the mode of motor operation being inverted in the sense that the motor 66 now operates at a constant speed predetermined by the operator and independent of the signals from the encoder 15 while the motor 55 operates at constant torque.

[0039] In the block circuit diagram of Figure 3 the reference numerals 18, 19 and 18', 19' indicate the electrical connections by which the signals are fed to the motor cards 50 and 60, to control these latter in one operating mode or the other.

[0040] The invention operates in the following manner.

[0041] The control circuit senses the arrival of the tile 2 on the roller table 1 by means of the photoelectric cell 14.

[0042] After a certain time set by the operator (on the basis of the distance of the tile 2 from the decorating device and the speed of the roller table), the control circuit starts the band 7.

[0043] Said band is made to move in the following manner:

[0044] The motor 55 drives the roller 5, winding said band such that its speed is equal to that of the tile 2 to decorate.

[0045] The speed of the motor 55 is controlled on the basis of the signals fed to the circuit 17 by the encoders 15 and 16.

[0046] The control circuit 17 coordinates the system synchronization (closed loop with feedback) such that the two speeds are identical, and that the decoration is perfectly in step with the tile 2.

[0047] In this first stage the motor 55 maintains the band speed equal to that of the roller table 1, while the motor 66 maintains a constant torque (as set by the operator) to maintain the band 7 properly tensioned.

[0048] This stage is repeated identically for a certain number of cycles equal to the number of decorations present on the band 7, until winding is complete.

[0049] Rewinding takes place in the following manner: the control circuit 17 reverses the direction of rotation of the motors 55 and 66 and switches the speed and torque functions by feeding a suitable signal to the motor operating cards.

[0050] The motor 66, which initially operated by maintaining a constant torque, is now controlled only by speed, hence enabling full utilization of the potentiality of the motor to rewind the band 7 as quickly as possible.

[0051] The rewinding speed is no longer controlled under feedback with the speed of the roller table 1, but is based on the overall settings by the operator.

[0052] During rewinding, the motor 55 operates at constant torque to always maintain correct tension of the band 7.

[0053] On conclusion of rewinding, the cycle can recommence.

Claims

1. A dry decorating device for ceramic tiles, comprising a hopper provided with a lower discharge mouth, or slot, positioned above a band in which powder-permeable regions defining the decoration are provided and which slidably closes the slot, a roller on which the band winds and a roller from which the band unwinds, a conveyor feeding the tiles into a position below said slot and in a direction perpendicular thereto, and means for driving said band winding and unwinding rollers in synchronism with the conveyor advancement speed, **characterised in that** said band winding and unwinding roll-

ers are each associated with a respective electric motor, for the two motors there being provided a single control circuit arranged to operate them in both directions of rotation but both in the same sense, said control circuit being governed by signals from speed measurement means which measure the speed of the band carrying the decoration and the speed of the tile conveyor.

2. A device as claimed in claim 1, **characterised in that** each motor is controlled by a card arranged to operate the motor alternately at a speed based on the speed measured by the measurement means and, respectively, at constant torque.

3. A device as claimed in claim 1, **characterised in that** said speed measurement means comprise two encoders.

4. A device as claimed in claim 1, **characterised in that** said electric motors driving the rollers carrying the band are brushless.

5. A device as claimed in claim 1, **characterised in that** said tile conveyor is a motorized roller table.

6. A device as claimed in claims 2 and 7, **characterised in that** one of said encoders is associated with one of the roller table rollers.

7. A device as claimed in claim 1, **characterised by** comprising a photoelectric cell to indicate arrival of the tile.

8. A device as claimed in claim 7, **characterised in that** said photoelectric cell is connected to said control circuit.

9. A device as claimed in claim 1, **characterised in that** each motor is connected to the respective roller by a rigid transmission.

10. A method for controlling a device claimed in claim 1, **characterised in that** the motor associated with the band winding roller is caused to rotate at a speed which is a function of the speed measured by the speed measurement means for the band and conveyor, while the motor associated with the band unwinding roller is caused to rotate at a constant torque value sufficient to ensure correct band tensioning.

11. A method as claimed in claim 10, **characterised in that** the value of said torque can be set by the operator.

12. A method as claimed in claim 10, **characterised in that** the rotational speed of said motor associated with the band winding roller is such as to cause the band to wind at the same speed as the table advancement speed.

13. A method as claimed in claim 10, **characterised by** sensing the arrival of a tile below the decorating device.

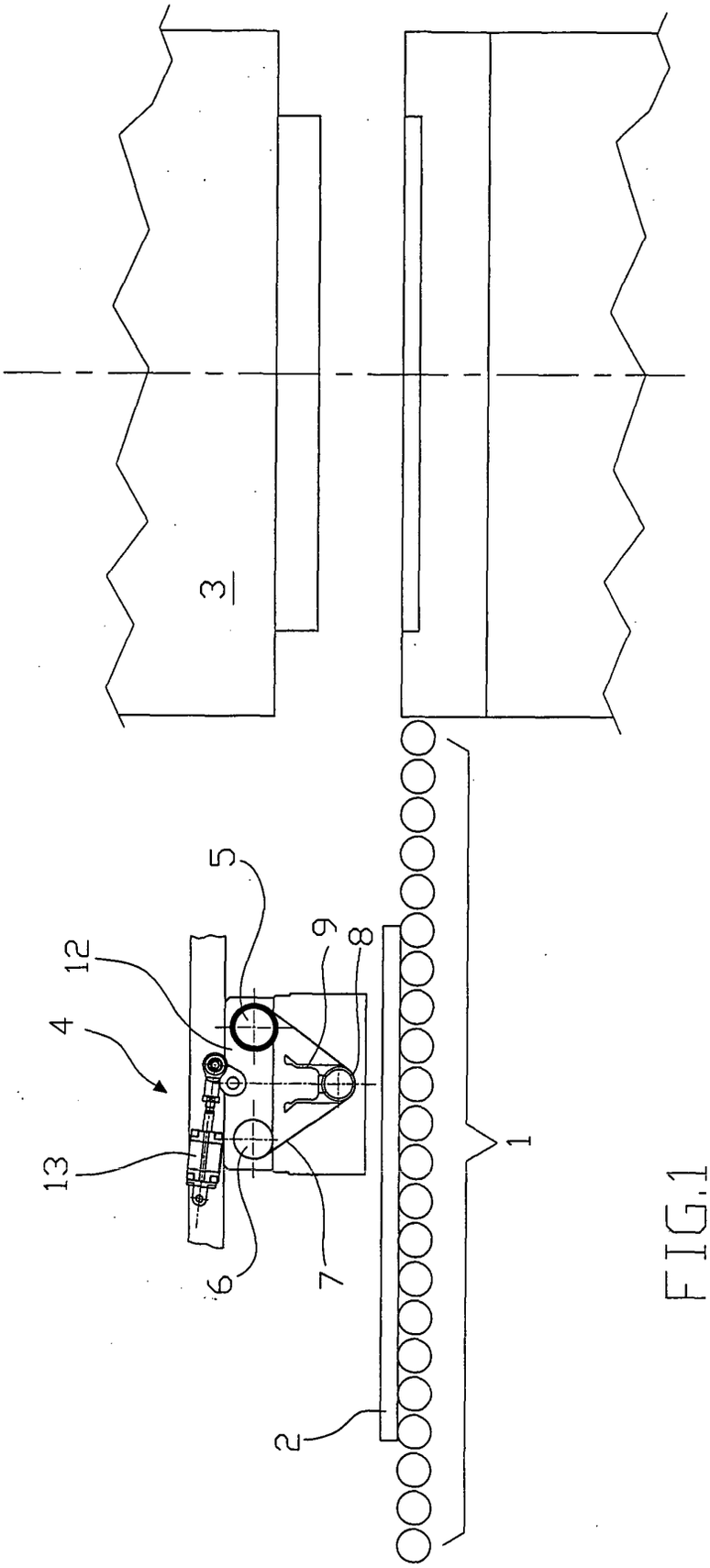

FIG.1

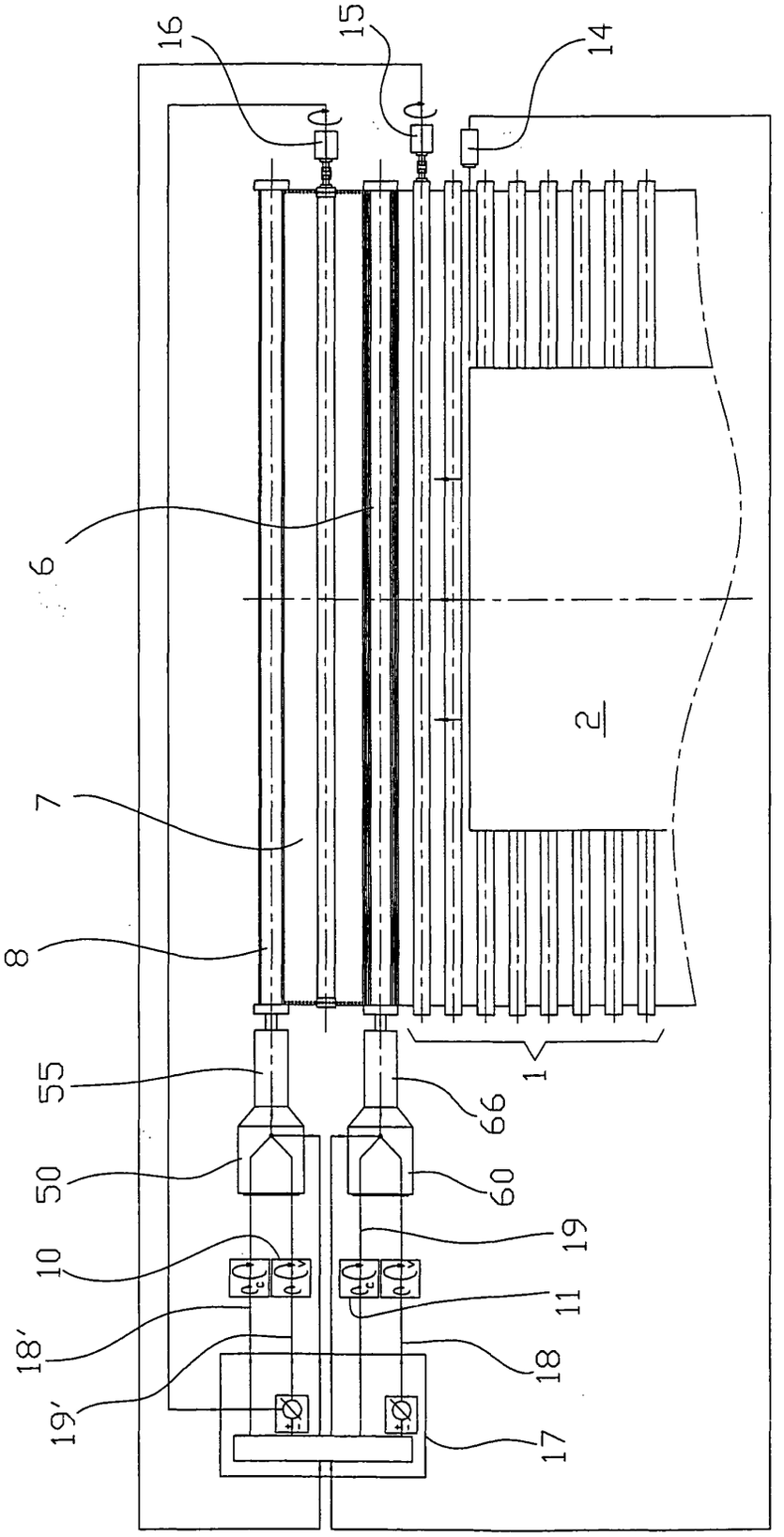

FIG.2

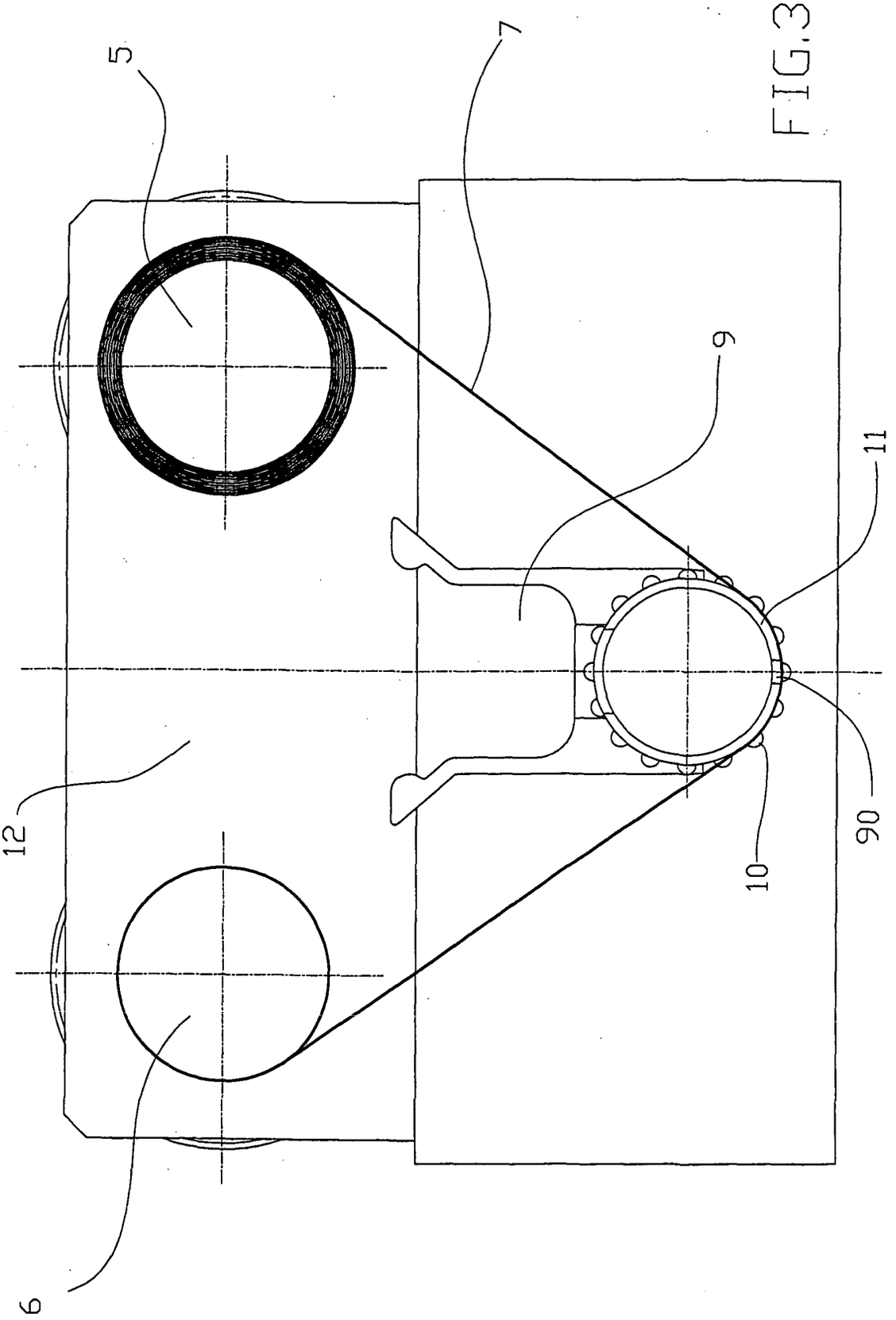

FIG.3

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EUROPEAN SEARCH REPORT

Application Number
EP 04 07 7995

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.7)
A	EP 1 247 629 A (TECNO EUROPA S.R.L) 9 October 2002 (2002-10-09) * the whole document * -----	1,10	B28B11/04 B28B13/02 B41F15/08

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B41F
B28B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 February 2005	Loncke, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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17-02-2005

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		EP 1247629 A2	09-10-2002

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