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

(11) **EP 3 639 973 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
22.04.2020 Bulletin 2020/17

(21) Application number: **19204175.4**

(22) Date of filing: **18.10.2019**

(51) Int Cl.:
B24B 7/06 *(2006.01)* ***B24B 9/10*** *(2006.01)*
B24B 27/00 *(2006.01)* ***B24B 9/00*** *(2006.01)*
B24B 49/18 *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **19.10.2018 IT 201800009638**

(71) Applicant: **Bottero S.p.A.**
12100 Cuneo (IT)

(72) Inventors:
- **FACCENDA, Aldo**
  12100 CUNEO (IT)
- **MARGARIA, Pierfranco**
  12100 CUNEO (IT)

(74) Representative: **Bergadano, Mirko et al**
Studio Torta S.p.A.
Via Viotti, 9
10121 Torino (IT)

(54) METHOD FOR GRINDING GLASS SHEETS

(57) A succession (7) of glass sheets (2) arranged at a predetermined distance (D) from each other is fed along a longitudinal direction (12) and through a grinding station (13), in which a peripheral surface (5) of the glass sheets (2) is progressively ground through a row (A) of grinding wheels (22) arranged side-by-side in a direction parallel to the longitudinal direction (12); during the grinding of the sheets (2) the wear of at least one first grinding wheel (22') is detected and the same first grinding wheel (22') is repositioned, keeping the succession (7) of sheets moving through the grinding station (13) and in a time period ranging between the moment in which a tail of a sheet (2') being ground on the first grinding wheel (22') has left the first grinding wheel (22') and before a head of a consecutive sheet (2') to be ground reaches the first grinding wheel (22').

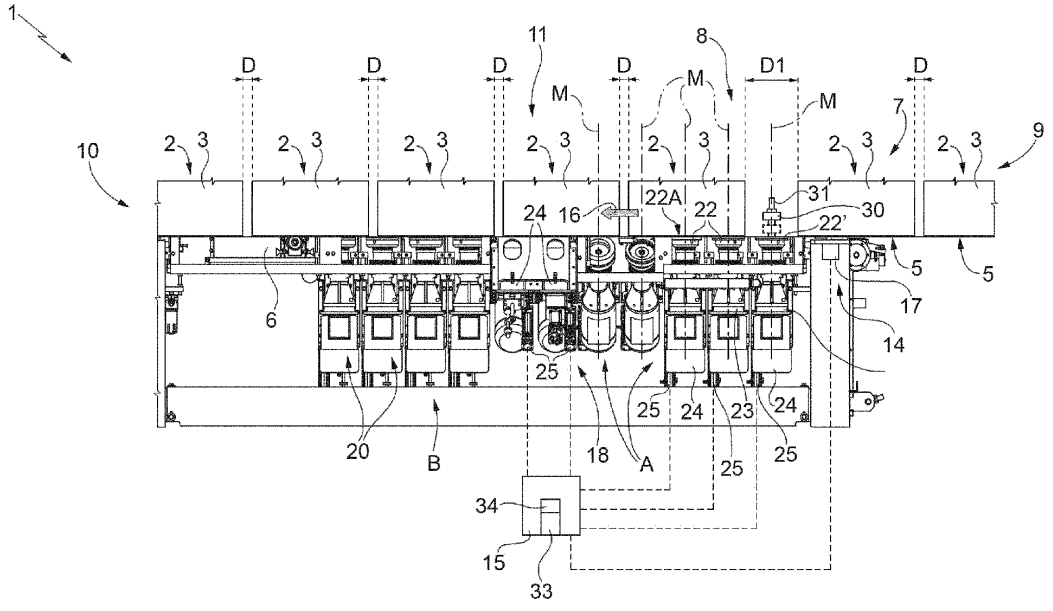

FIG. 1

EP 3 639 973 A1

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims priority from Italian patent application no. 102018000009638 filed on 19/10/2018.

TECHNICAL FIELD

[0002] The present invention relates to a method for grinding glass sheets.

[0003] In particular, the present invention relates to a method for grinding peripheral or side surfaces of a glass sheet, i.e. those surfaces, which extend orthogonally to the extended surfaces of the same glass sheet.

BACKGROUND ART

[0004] As is known, two types of machines are known and used for grinding peripheral surfaces. On the one hand, the so-called "bilateral" grinding machines belong to a first type. With these, the sheets are fed sideways and the opposite peripheral surfaces thereof are ground simultaneously by two rows of grinding wheels, which face each other and are arranged in a grinding station of the machine.

[0005] The so-called "rectilinear" grinding machines, on the other hand, belong to a second type, wherein the sheets are fed edgeways and they are ground by feeding the peripheral surfaces onto an underlying row of grinding wheels, which are also arranged in a grinding station of the machine.

[0006] Regardless of the type of machine used, each row of grinding wheels comprises a plurality of grinding wheels and a plurality of polishing wheels arranged downstream of the grinding wheels for polishing the surfaces ground by the grinding wheels; the grinding wheels differ from one another both as regards their abrasive capacity and the abrasive material and/or the matrix in which such abrasive material is dispersed. Some grinding wheels have rotation axes thereof orthogonal to the surface to be ground, others have inclined rotation axes thereof for processing a longitudinal edge of the sheet.

[0007] Each grinding wheel removes a predetermined quantity of material according to a predetermined grinding programme or cycle.

[0008] During the processing of the sheet, each grinding wheel inevitably wears out. The wear of the grinding wheels must be monitored constantly and the relative wear recuperated to guarantee that each grinding wheel works in the condition of removal specified by the grinding programme, i.e. that it has an abrasive surface thereof always arranged on a predetermined fixed grinding or zero plane thereof so that the grinding wheel removes the specified quantity of material from the glass sheet. The recuperation of the wear of a grinding wheel is universally indicated as "zeroing or grinding wheel repositioning", and consists of detecting the wear of the grinding wheel and advancing the grinding wheel by a quantity equal to the wear, so as to bring the abrasive surface of the grinding wheel back to the above-mentioned zero plane.

[0009] To date, after detecting the need to zero one or more grinding wheels, the grinding wheel zeroing is carried out at the same time for all grinding wheels, interrupting the feeding of sheets to be processed to the machine and waiting for the complete emptying of the grinding station i.e. of the sheets in the grinding step and the sheets in the polishing step. At this point, all of the grinding wheels are zeroed, then, the feeding of the sheets to be ground is resumed and the previously interrupted grinding process continued. On resuming the grinding, the polishing wheels do not operate until they receive the first ground sheet.

[0010] One such method of zeroing the grinding wheels, even though used, has the drawback of generating an elevated loss of production as a result of suspending and resuming the feeding of the sheets to be processed to the grinding station. Moreover, suspensions and restarts are not so infrequent, since some grinding wheels, especially finishing grinding wheels, wear out more than others.

[0011] In addition to this, if an immediate zeroing is required as a result of a sudden loss of functionality of one of the grinding wheels, all of the wheels downstream of such wheel in the feeding direction of the sheets operate in reduced conditions of removal as they are different from those specified by the grinding programme for relatively long periods, with the result that many of the sheets being processed may have geometric, size, or shape defects. As a result, the sheets being processed must be discarded, with a consequent loss of production and, if kept, compromise the consistent quality of the batch produced.

DISCLOSURE OF INVENTION

[0012] One purpose of the present invention is to provide a method for grinding glass sheets, which allows the drawbacks stated above to be overcome in a simple and inexpensive manner and which allows, in particular, a drastic reduction in machine stopping to zero the grinding wheels with a consequent loss of production.

[0013] Another purpose of the present invention is to zero a grinding wheel only when it reaches a degree of wear that is no longer tolerable.

[0014] According to the present invention a method is provided for grinding glass sheets, the method comprising the steps of: feeding an ordered succession of glass sheets arranged at a predetermined distance from each other along a longitudinal direction and through a grinding station; progressively grinding, in said grinding station, at least one peripheral surface of the sheets by means of at least one abrasive grinding wheel independent from each other and side-by-side in a direction parallel to said

longitudinal direction; detecting the wear of each of said abrasive grinding wheels and; repositioning each of the abrasive grinding wheels according to the wear detected, characterised in that the repositioning of at least a first of said abrasive grinding wheels is carried out by keeping the succession of sheets moving through said grinding station and in a time period ranging between the moment in which a sheet being ground on the first abrasive grinding wheel has disengaged the first abrasive grinding wheel and before a consecutive sheet to be ground, reaches said first abrasive grinding wheel.

[0015] Preferably, in the method defined above, the repositioning of said first abrasive grinding wheel is carried out by spacing apart said sheet being ground and said sheet to be ground from each other until they are arranged at a new determined distance from each other, which is greater than said determined distance.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The invention will now be described with reference to the attached figures, which illustrate a preferred embodiment thereof, wherein:

Figure 1 illustrates, schematically and substantially in block diagrams, a grinding machine for actuating a preferred embodiment of the grinding method according to the dictates of the present invention; and Figure 2 is a figure similar to Figure 1 and illustrates a different mode of actuating the grinding method according to the invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0017] In Figures 1 and 2, the number 1 indicates, as a whole, a machine for grinding glass sheets 2, in the illustrated example, flat, rectangular glass sheets having two opposing, extended, flat surfaces, indicated with 3 and four consecutive, flat peripheral or side surfaces, of which at least one is for grinding, indicated with 5.

[0018] The machine 1, which can be either a rectilinear machine or a bilateral machine, comprises a rigid rectilinear structure 6 elongated along a rectilinear feeding path 12 of a succession 7 of sheets 2 to be ground, arranged at a distance D from one another.

[0019] The machine 1 also comprises a motorised unit 8 for conveying sheets, known in itself and partially visible in the attached figures. In this particular case, the unit 8 comprises an input conveyor 9 for the sheets 2 to be ground, an output conveyor 10 for the ground sheets, and an intermediate conveyor 11 for retaining and feeding sheets 2. Conveyor 9 can be controlled independently of conveyor 11, while conveyors 10 and 11 are normally synchronised.

[0020] The conveyor 11 moves the sheets 2 to be ground inside a station 13 for grinding the peripheral surfaces 5 arranged along the feeding path 12, taking the sheets 2 from one entrance 14 of the station 13. Conveyors 9,10 and 11 are commanded and controlled by an electronic command and control unit 15 for feeding the sheets 2 at a constant speed, generally varying between 0.2 and 20 metres a minute, in a feeding direction 16. The passage of a head and a tail of each of the sheets 2 entering the station 13 is detected by a presence sensor 17 connected to the unit 15. By means of the sensor 17, the unit 25 knows the exact position of all of the sheets 2 along the entire path 12.

[0021] Again with reference to Figure 1, the station 13 houses a row 18 of grinding units, known in themselves, which are independent of one another and arranged side-by-side in a direction parallel to the path 12. The row 18 of grinding units comprises an assembly A of abrasive units 19, and an assembly B of polishing units 20, which polish the surfaces ground by the assembly A.

[0022] Each of the abrasive units 19 comprises a respective grinding wheel 22, which has an abrasive surface thereof 22A and is rotated about an axis M thereof orthogonal to the path 12 by a respective motor 23 commanded by the unit 15.

[0023] Each motor 23 is carried by a relative slide 24, which is slidably coupled to the frame 6 of the machine 1 and in opposite directions along the relative axis M under the thrust of a servomotor 25 controlled by the electronic command and control unit 15.

[0024] For each abrasive grinding wheel 22, the machine 1 further comprises a respective device for zeroing or repositioning the grinding wheel, known in itself and indicated with 27, connected to the unit 15. Each device 27 allows the wear of the relative abrasive grinding wheel 22 to be detected and the correction of the position of the relative slide 24 so as to keep, over time, the relative abrasive surface 22A of the grinding wheel 22 practically always in a zero position specified in the grinding cycle and illustrated with a continuous line in Figure 1.

[0025] In the described solution, besides the relative motor 25, each device 27 comprises a reference dowel 30 arranged along the relative axis M in a fixed position, facing and spaced apart from the relative abrasive surface 22A when the abrasive surface 22A itself is arranged in the zero position thereof. Then, each device 27 comprises a contact sensor 31 communicating with the unit 15. A position transducer, known and not visible in the attached figures, is associated with the slide 24 or motor 25, to determine the variation of the travel of the slide 24 following the wear of the grinding wheel 22. The electronic unit 15, to which the position of the reference dowel 30 is known, comprises a comparator block 33, which, depending on the signal received from the transducer, detects the wear of the relative grinding wheel 22, i.e. the deviation between the actual position of the abrasive surface 22A and the zero position of the abrasive surface 22A itself. The electronic unit 15 also comprises a position corrector block 34, which, depending on the stated deviation, brings the abrasive surface 22A of the grinding wheel 22 back into the zero position thereof.

[0026] The method of grinding the surfaces 5 of the

sheets 2 will now be described starting from the condition in which the abrasive surface 22A of each grinding wheel 22 is arranged in the zero position thereof specified by the grinding cycle and the succession 7 of sheets is fed into the station 13 at a constant speed.

[0027] Starting from this condition, when the electronic unit 15 determines, for example, by detecting the variation in current absorbed by the relative gearmotor 23 or by the gearmotor 23 of the grinding wheel downstream or upon the signalling by a person in charge of the machine 1 or again by counts of the quantity of glass removed by the abrasive grinding wheel that the wear of one of the grinding wheels 22, for example, the grinding wheel 22' in Figure 1, has reached or is reaching a limit value to guarantee the correct execution of the grinding cycle, it stops, or slows down the input conveyor 9, leaving conveyors 10 and 11 active. The slowing down or stopping of the sheets fed from the conveyor 9 increases the distance D or the space between the last sheet entering the station 13, indicated by 2', and the sheet 2 to be ground, arranged immediately upstream of the entrance 14 to the station 13 and indicated by 2", bringing it to a value D1, which is greater than D. The distance D1 or space between the sheets 2' and 2" is calculated by multiplying a grinding wheel repositioning time by the translation speed of the sheets 2 in the grinding station 13. The grinding wheel repositioning time is at least equal to the sum of a stop time of the rotation of the abrasive grinding wheel, of a wear detection time of the abrasive grinding wheel, of a position adjustment time of the abrasive grinding wheel along the axis M thereof and of a grinding wheel restart time. Experimentally, it was possible to observe that the repositioning time is in the order of 5-10 seconds.

[0028] On reaching the distance D1, the conveyor 9 introduces the sheet 2" into the grinding station 13 and from this point on, both sheets 2' and 2" are fed into the grinding station 13 at the stated constant speed, while the remaining sheets 2 to be processed continue to be arranged at the distance D.

[0029] While the sheets 2 in the station 13 continue to be processed, the unit 15 waits for the sheets 2' and 2" to be arranged close to the grinding wheel 22' and, when the tail of the ground sheet 2' overtakes the grinding wheel 22', i.e. the abrasive wheel 22', it is arranged at the space D1, (Figure 1). Keeping the speed of the sheets 2 passing through the station 13 constant, the unit 15 itself stops the rotation of the grinding wheel 22', after which it activates the feeding motor 25 and moves the abrasive surface 22A of the grinding wheel 22' against the relative reference abutment 30, as shown by the dotted line in Figure 1, actuating the relative motor 25. At this point, the abrasive surface 22A is arranged against the reference abutment 30. As shown by the dotted line in Figure 1, the unit 15 calculates, in a known manner, the wear, withdraws the slide 24, inverting the direction of rotation of the positioning motor 25 and brings the abrasive surface 22A back into the zero position thereof, and the grinding wheel 22' rotating about the axis M thereof, before the head of the sheet 2" to be ground reaches the grinding wheel 22'.

[0030] The grinding wheel repositioning described above is repeated for all the grinding wheels 22 of the assembly A at different times and when one of the grinding wheels 22 is close to reaching or has reached a condition of wear.

[0031] Conveniently, after creating the space D1 for one of the abrasive grinding wheels, for example, abrasive grinding wheel 22', one or more of the abrasive grinding wheels 22 arranged downstream of abrasive grinding wheel 22' in the sheet 2 feeding direction 2 can, if necessary, be repositioned when the space D1 is arranged at the abrasive grinding wheels concerned.

[0032] Alternatively, the distance or the space D1 is defined so that a part of the abrasive grinding wheels 22 set side-by-side or even all of the abrasive grinding wheels 22 can be simultaneously zeroed when they are at the space D1, as shown in Figure 2. Clearly, the number of spaces D1 possible inside the station 13 varies as the number of grinding wheels 22 varies.

[0033] According to one variation, the conveyor 9 is also synchronised with conveyors 10 and 11 and in such case, the sheets 2 to be ground are arranged on the conveyor manually by an operator or by an automated feeder. In such case, when it is necessary to stop the sheets 2 to be processed from entering the station 13 to create the space D1, the unit 15 sends a suspension signal or commands the feeder so that sheets 2 are not arranged on the conveyor 9 until the space D1 has been created and, at that point, the feeder can start again.

[0034] From the above, it is clear how the grinding wheel zeroing or repositioning method described above allows the position of the abrasive surfaces of all of the grinding wheels 22 to be taken into account and corrected, without interrupting the feeding of the sheets 2 being processed in the station and without having to remove all of the sheets from the grinding station, as is the case in known machines. On the one hand, this allows the production of ground sheets to be kept basically unchanged because, during the repositioning, the abrasive grinding wheels not affected by the repositioning and the polishing wheels continue to process the sheets and, on the other hand, it allows elevated standards of quality and precision, in terms of the size and shape of the entire ground batch. The above is due to the fact that any grinding wheel can be zeroed or repositioned immediately after detecting the attainment thereof of an advisable or limit wear for safeguarding the correct grinding of the sheets and thus, without waiting for the limit wear of other grinding wheels to be reached, as is the case in known solutions. In other words, the described method allows the greater or lesser wear of determined wheels to be taken into account with respect to others and, thus, the grinding of the sheets to always occur under the optimum grinding conditions specified by the grinding cycle, avoiding compromised conditions, as in the known solutions.

[0035] From the above it is clear that the considerations presented above are not only valid independently of the characteristics of the grinding wheels, but also of the arrangement of the grinding wheels in the row of grinding wheels.

Claims

1. A method for grinding glass sheets, the method comprising the steps of: feeding an ordered succession of glass sheets arranged at a predetermined distance from each other along a longitudinal direction and through a grinding station; progressively grinding, in said grinding station, at least one peripheral surface of the sheets by means of at least one abrasive grinding wheel independent from each other and side-by-side in a direction parallel to said longitudinal direction; detecting the wear of each of said abrasive grinding wheels and; repositioning each of the abrasive grinding wheels according to the wear detected, **characterised in that** the repositioning of at least a first of said abrasive grinding wheels is carried out by keeping the succession of sheets moving through said grinding station and in a time period ranging between the moment in which a sheet being ground on the first abrasive grinding wheel has disengaged the first abrasive grinding wheel and before a consecutive sheet to be ground, reaches said first abrasive grinding wheel.

2. The method according to claim 1, **characterised in that** the repositioning of said first abrasive grinding wheel is carried out by spacing said sheet being ground and said sheet to be ground from each other until they are arranged at a new determined distance from each other greater than said determined distance.

3. The method according to claim 2, **characterised in that** said spacing is carried out inside said grinding station.

4. The method according to claim 2 or 3, **characterised in that** said new determined distance is calculated with reference to a repositioning time of said first grinding wheel and considering the translational speed of the sheets in said grinding station.

5. The method according to claim 3 or 4, **characterised in that** said spacing is carried out by delaying the input of said sheet to be worked into said grinding station.

6. The method according to claim 5, **characterised in that** said spacing is carried out by slowing down or stopping the feeder of said sheets into said grinding station.

7. The method according to claim 5, **characterised in that** said spacing is carried out by interrupting, stopping or slowing down a sheet input conveyor in said grinding station or by temporarily interrupting the feeding of the sheets to be worked onto said input conveyor.

8. The method according to claim 4, **characterised in that** said grinding wheel repositioning time is at least equal to the sum of a grinding wheel rotation stopping time, a wear detection time of the grinding wheel, a position adjustment time of said grinding wheel and a grinding wheel restart time.

9. The method according to one of the claims 2 to 4, **characterised in that** said new distance is determined so as to allow the simultaneous repositioning of a part of said abrasive grinding wheels arranged side-by-side.

10. The method according to one of the claims 2 to 4, **characterised in that** said new distance is determined so as to allow the simultaneous repositioning of all the abrasive grinding wheels present in said grinding station.

11. The method according to any one of the preceding claims, **characterised in that** it comprises a polishing step of said ground sheets; said polishing step is carried out in said grinding station by using at least one polishing wheel and during the repositioning of at least one of said abrasive grinding wheels.

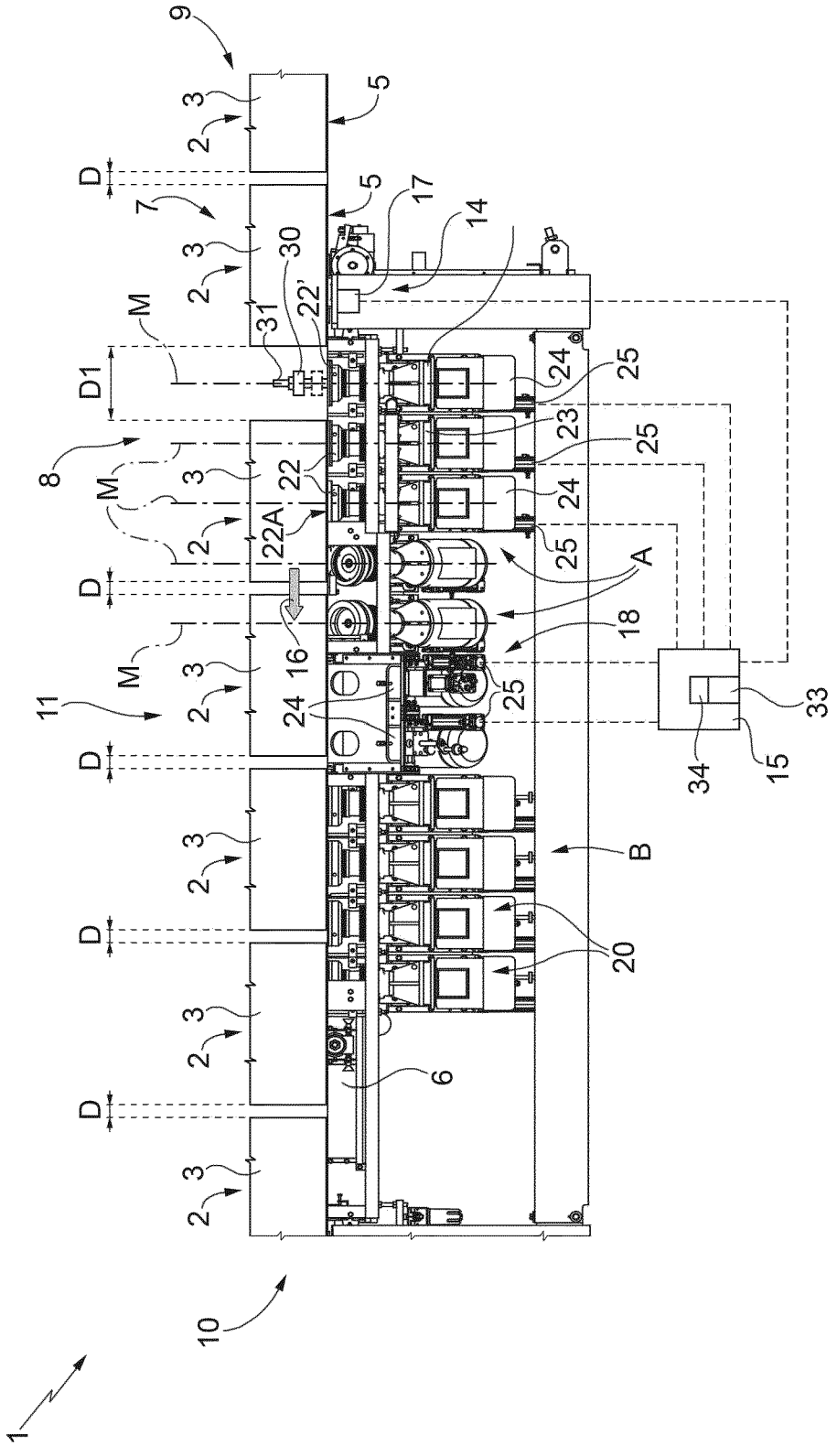
9
3
2
5
D
7
3
2
30
22'
5
17
14
M
31
D1
24
25
8
M
3
22
23
25
2
22A
24
25
D
A
M
3
18
16
11
2
24
25
33
D
34
15
3
2
B
D
20
3
2
6
D
3
2
10
1

FIG. 1

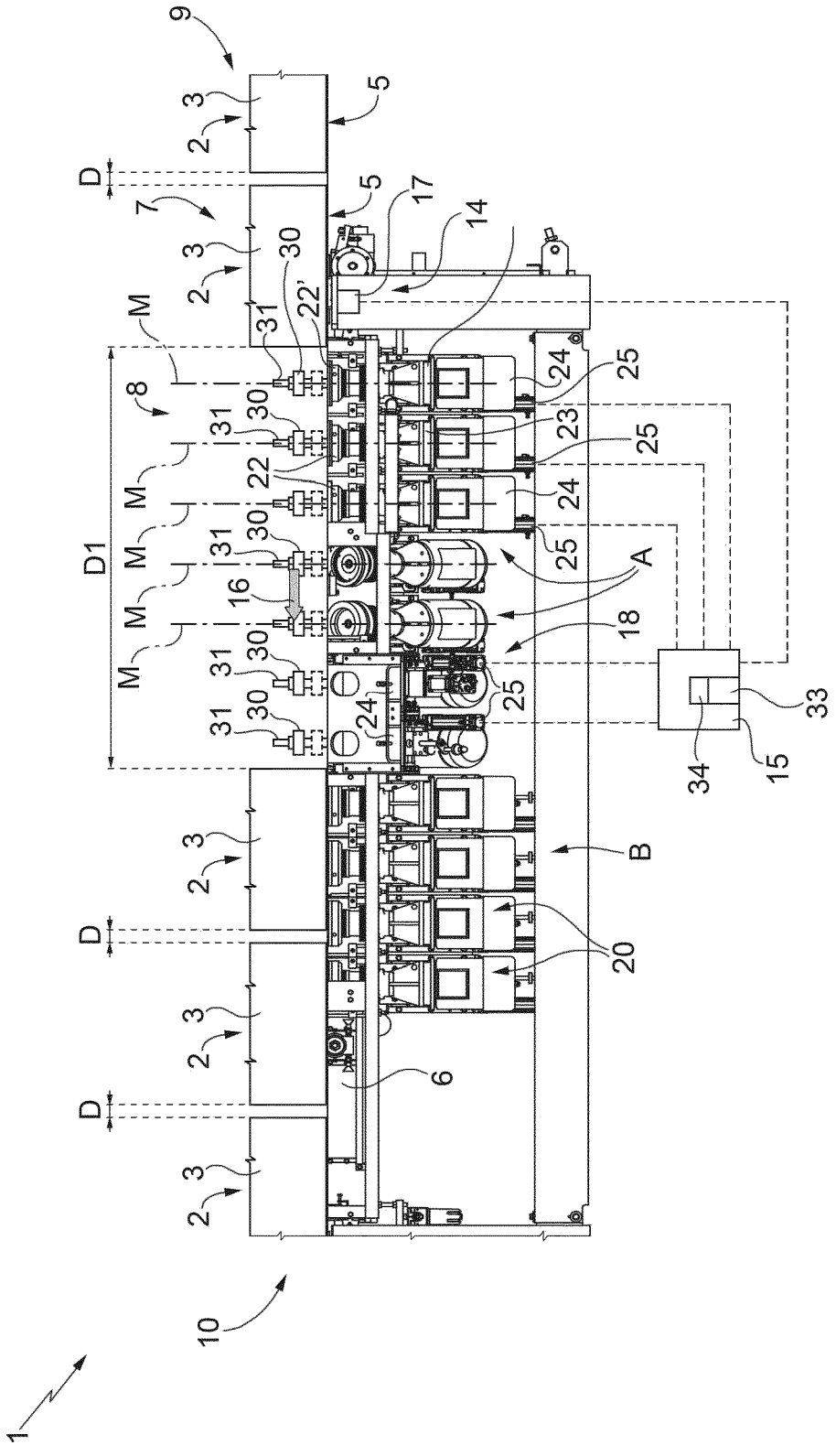

FIG. 2

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 19 20 4175

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 865 870 A2 (PRAGMA S R L [IT]) 23 September 1998 (1998-09-23) * column 2, lines 17-39 * * column 5, lines 20-27 * * column 6, lines 5-14, 29-35 * * claim 1; figures 1-5a * -----	1-11	INV. B24B7/06 B24B9/10 B24B27/00 B24B9/00 B24B49/18
A	EP 1 422 024 A1 (BIESSE SPA [IT]) 26 May 2004 (2004-05-26) * paragraphs [0004], [0005], [0007], [0012] * * paragraphs [0025], [0039], [0045], [0050], [0058] * * claims 1, 3, 4; figures 1-4 * -----	1-11	
A	EP 1 063 053 A2 (BAVELLONI Z SPA [IT]) 27 December 2000 (2000-12-27) * paragraphs [0007], [0024], [0025], [0028], [0040]; figures 1, 2 * -----	1-11	
A	WO 2018/037303 A1 (ELETTROMECCANICA BOVONE SRL [IT]) 1 March 2018 (2018-03-01) * the whole document * -----	1-11	TECHNICAL FIELDS SEARCHED (IPC) B24B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 February 2020	Herrero Ramos, J

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 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 20 4175

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-02-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0865870 A2	23-09-1998	DE 69809986 D1	23-01-2003
		EP 0865870 A2	23-09-1998
		ES 2186934 T3	16-05-2003
		IT MO970039 A1	11-09-1998
		PT 865870 E	30-04-2003
EP 1422024 A1	26-05-2004	AT 408476 T	15-10-2008
		EP 1422024 A1	26-05-2004
EP 1063053 A2	27-12-2000	AT 251523 T	15-10-2003
		CN 1278472 A	03-01-2001
		DE 60005749 T2	05-08-2004
		EP 1063053 A2	27-12-2000
		ES 2207440 T3	01-06-2004
		IT MI991382 A1	21-12-2000
		KR 20010007448 A	26-01-2001
		US 6416382 B1	09-07-2002
WO 2018037303 A1	01-03-2018	BR 112019003671 A2	21-05-2019
		CA 3034854 A1	01-03-2018
		EP 3504027 A1	03-07-2019
		US 2019193239 A1	27-06-2019
		WO 2018037303 A1	01-03-2018

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- IT 102018000009638 **[0001]**