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(54) **MACHINE AND UNIT FOR GRINDING AND POLISCHING A GLASS SHEET**

(57) A perimeter surface (5) of a glass sheet (2) is ground and polished in a grinding and polishing machine (1) having at least one grinding unit (19) having a grinding wheel (22), at least one polishing unit (20) having a polishing wheel (27) and at least one grinding/polishing unit (30); the grinding/polishing unit (30) having a slide (33) able to move in a rectilinear direction (K), a wheel-carrier head (31) carried by the slide (33) and carrying, in turn, a grinding wheel (22) or a polishing wheel (27), and an electro-pneumatic device (35) that can be configured for moving the slide (33); the electro-pneumatic device (35) comprising an electric motor (41), a pneumatic actuator (45) for driving a pneumatic selection device (56) to connect the slide (33) to the electric motor (41) when the grinding wheel (22) is mounted on the wheel-carrier head (31), and to the pneumatic actuator (45) when the polishing wheel (27) is mounted on the wheel-carried head (31).

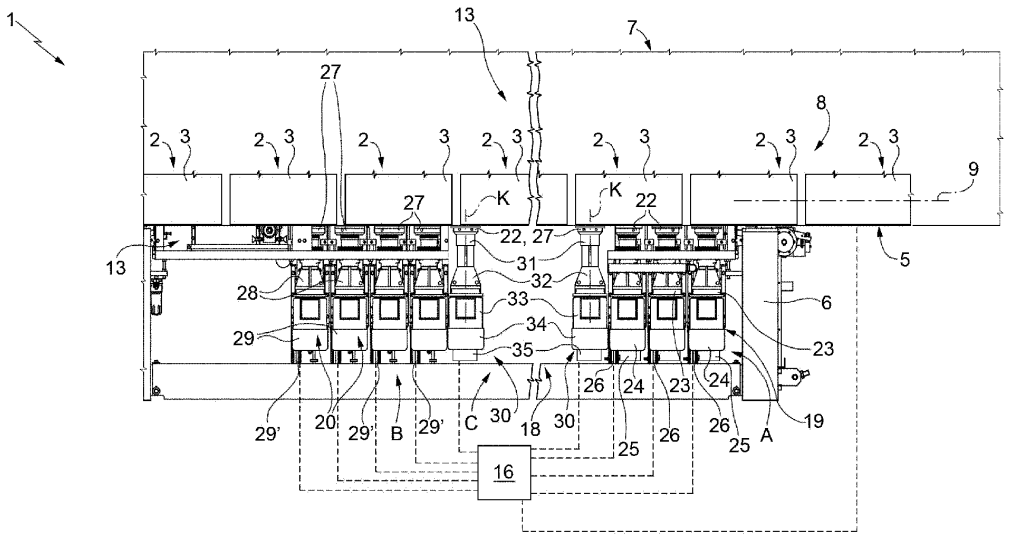

FIG. 1

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims priority from Italian patent application no. 102019000002941 filed on 28/02/2019.

TECHNICAL FIELD

[0002] The present invention relates to a machine and to a unit for grinding and polishing a glass sheet.

[0003] In particular, the present invention relates to a machine and a unit for grinding and polishing perimeter surfaces of a glass sheet, that is to say, those outer perimeter surfaces that extend transversely to the major surfaces of said glass sheet.

BACKGROUND ART

[0004] As is known in the prior art, two types of machines are used for grinding the perimeter surfaces of a glass sheet. A first type belongs to the category of so-called "bilateral" grinding machines, into which the sheets are fed flat and their opposite perimeter surfaces are ground simultaneously by two grinding-polishing assemblies arranged opposite one another.

[0005] A second type comprises the so-called "rectilinear" grinding machines, into which the sheets are fed at an angle and are ground by moving the perimeter surfaces over an underlying grinding-polishing assembly.

[0006] Whichever type of machine is used, each grinding-polishing assembly comprises a plurality of grinding units that are arranged alongside one another and are independent of one another to remove a given amount of material from the sheet, and a plurality of polishing units that are also independent of one another and arranged alongside one another and downstream of the grinding units in the feeding direction of the sheets to polish the surfaces that have been ground by said grinding units.

[0007] Each grinding unit comprises a respective grinding wheel, an electric motor to make the grinding wheel rotate about its axis, and a device for positioning the grinding wheel in a given operating position for removing the material. Each positioning device comprises, in turn, a slide to support the wheel and an electric motor for moving and positioning said slide.

[0008] Each polishing unit comprises a respective polishing wheel that is also made to rotate about its axis by an electric motor and is also mounted on a respective slide driven by a respective actuator suitable to push the respective slide and, as a consequence, the respective polishing wheel, against the ground surface of the sheet. Depending on the application, the slides carrying the polishing wheels are driven by pneumatic cylinders, or by means of mechanical springs with variable preload or even by means of electric torque-controlled motors.

[0009] The grinding machines known in the prior art of the type described above are usually designed and built according to the customer's needs and, in particular, according to the type of sheets to be machined, but especially according to the machining processes to be performed to obtain the desired profile and required level of precision/surface finish. To do this, a given number of grinding units and a predefined number of polishing units are provided and fitted at the planning stage.

[0010] Once assembled, the number of grinding units or of finishing units cannot usually be changed and so the machine cannot be converted or customised to perform different machining processes, or to carry out a different grinding and/or polishing programme.

[0011] This inflexibility makes it impossible to meet the emerging need among users to reconfigure the machine when production requirements change and to reconfigure it quickly to reduce downtimes to a minimum.

DISCLOSURE OF INVENTION

[0012] The purpose of the present invention is to provide a grinding machine, with characteristics such as to satisfy the needs described above and, in particular, the need to reconfigure or modify the current or planned configuration within a very short time and in a simple and cost-effective manner.

[0013] A further purpose of the present invention is to provide a machine, with characteristics such as to allow the machine to be reconfigured without having to dismantle or add or replace the grinding/polishing assemblies mounted on the machine at the time of production.

[0014] According to the present invention there is provided a grinding and polishing machine, as claimed in Claim 1.

[0015] The present invention also relates to a unit for grinding and polishing a glass sheet.

[0016] According to the present invention there is provided a grinding and polishing unit, as claimed in Claim 13.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The invention will now be described with reference to the accompanying drawings, illustrating a non-limiting embodiment thereof, in which:

Figure 1 is a schematic and substantially block diagram view of a preferred embodiment of a machine for grinding and polishing glass sheets according to the present invention; and

Figures 2 and 3 are cross-sectional views on an enlarged scale of the grinding and polishing unit in Figure 1 arranged in two different functional conditions and produced according to the teachings of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0018] In the accompanying Figure, denoted as a whole by reference numeral 1 is a machine for grinding and polishing glass sheets 2, in the example that is illustrated flat rectangular glass sheets having two opposite flat major surfaces, denoted by reference numeral 3, and four consecutive flat perimeter or lateral surfaces, one of which is denoted by reference numeral 5.

[0019] The machine 1, which may be either a bilateral machine, that is to say, where the sheets 2 are fed flat, or a rectilinear machine, that is to say, where the sheets 2 are fed at an angle, comprises a rigid base 6 and a motor-driven sheet conveyor assembly 7, of a type known in the prior art and partially visible in the accompanying figures, to feed a series 8 of sheets 2 to be ground along a rectilinear path 9 and through a station 13 for grinding and polishing the perimeter surfaces 5. The assembly 7 is controlled by an electronic control unit 16 of the machine 1.

[0020] Again with reference to Figure 1, the station 13 houses a row 18 of grinding units independent of one another and arranged alongside one another in a direction parallel to the path 9.

[0021] The row 18 of abrasive units comprises a group A of grinding units 19, of a type known in the prior art, and a group B of polishing units 20, also of a type known in the prior art, which polish the surfaces 5 ground by the group A.

[0022] Each grinding unit 19 comprises a respective grinding wheel 22, which is made to rotate by a respective electric motor 23 controlled by the electronic unit 16 and is carried by a corresponding slide 24. The slide 24 is coupled to a guide 25 fixed to the base 6 so as to be able to slide in a direction orthogonal to the path 9 in opposite directions driven by an electric motor 26, conveniently a servomotor controlled by the electronic unit 16.

[0023] Each polishing unit 20 comprises a respective polishing wheel 27, which is made to rotate about its respective axis by an electric motor 28 controlled by the electronic unit 16 and is mounted on a slide 29 driven by a corresponding actuator 29', for example, a pneumatic cylinder controlled by a proportional solenoid valve, controlled, in turn, by the electronic unit 16 to push the corresponding spring 27 against the surface 5 of the sheet 2.

[0024] Again with reference to Figure 1, the row 18 of abrasive units comprises a group C of abrasive grinding/polishing units 30 arranged between the units 19 and 20.

[0025] Each of the abrasive units 30 is configurable, that is to say, it can be adjusted or set to grind or to polish the surfaces 5, as will be described in more detail below.

[0026] Each unit 30, which is independent of the other abrasive units, comprises a wheel-carrier head 31, on which a grinding wheel 22 or a polishing wheel 27 can be mounted. The wheel-carrier head 31 is made to rotate about its respective axis by an electric motor 32 controlled by the electronic unit 16 and is mounted on or carried by a slide 33. The slide 33 is coupled to a rectilinear guide 34 integral with the base 6 and is able to move in a direction orthogonal to the path 9 in a direction K driven by a configurable electro-pneumatic device, denoted by reference numeral 35.

[0027] With reference to Figures 2 and 3, the device 35 comprises an attachment frame 36 integrally connected to the base 6 and a rectilinear guide 37 integrally connected to the frame 36 and extending in a direction orthogonal to the path 9. The slide 33 is slidingly coupled to the guide 37 and is able to move in opposite directions along the guide driven by a configurable electro-pneumatic actuator assembly, denoted by reference numeral 38.

[0028] Again with reference to Figures 2 and 3, the assembly 38 comprises a drive screw 39 orthogonal to the path 9 and rotatably coupled to said guide 37 in an axially fixed position by means of a pair of end bearings. The screw 39 is made to rotate in opposite directions by a geared motor 40 of a type known in the prior art and schematically illustrated, having an electric motor 41 controlled by the unit 16.

[0029] With reference to Figures 2 and 3, coupled to the screw 39 is a nut-screw 42 to which there is integrally connected a tubular sleeve 43, which forms an axial extension of the nut-screw 42 and surrounds the screw 39 with radial clearance.

[0030] A section of the sleeve 43 defines the rod 44 of a double-acting pneumatic actuator 45, which is part of the assembly 38 and extends coaxially with the axis 39A of the screw 39. The pneumatic cylinder 45 comprises a liner 46, which is permanently connected to the slide 33 by means of screws, surrounds the rod 44 and has two opposite end sections, denoted by reference numerals 50 and 51. The sections 50 and 51 are coupled to an outer side surface of the rod 44 in a fluid-tight manner so as to delimit with said rod an airtight chamber 52. The chamber 52 houses a plunger 53, which surrounds the rod 43 and is permanently connected to said rod 43. Conveniently, the plunger 53 is formed as one piece with the rod 43. The plunger 53 divides the chamber 52 into two variable-volume airtight chambers, denoted by reference numerals 54 and 55. The chambers 54 and 55 are both connected by means of ducts to a pneumatic valve selection assembly 56 of the type comprising proportional valves and controlled by the unit 16 to selectively pressurise the chambers 54 and 55 in a continuous and controlled manner.

[0031] The particular embodiment of the assembly 38 allows each unit 30 to be configured as a grinding unit or as a polishing unit according to the processes to be performed in the different grinding and polishing cycles. With reference to Figure 2, it is apparent that when the chamber 54 is depressurised and the chamber 55 is pressurised, the end section 51 of the liner 49 has an axial shoulder in abutment against the plunger 53, thus achieving a rigid coupling between the plunger 43, the liner 46 and the slide 33. It therefore follows that, when a grinding

wheel 22 is mounted on the wheel-carrier head 31, the unit 30 acts as one of the grinding units 19.

[0032] When, instead, the chamber 55 is depressurised and the chamber 54 is pressurised, as illustrated in Figure 3, a pneumatic spring is created between the plunger 53 and the section 51, the stiffness of such spring being variable or settable by adjusting the air pressure inside the chamber 54 by means of the valve assembly 56.

[0033] The pressure inside the chamber 54 can also be adjusted by means of the motor 41, that is to say, by adjusting the position of the plunger 53 in relation to a reference position and, thus, varying the volume of the chamber 54.

[0034] In any case, when a polishing wheel 27 is mounted on the wheel-carrier head 31, the unit 30 thus configured acts as one of the polishing units 20. In fact, during polishing, the wheel 27 is pushed against the sheet 2 by applying a predefined and constant pushing force.

[0035] Based on the above, it is apparent that the grinding and polishing machine 1 described herein is a machine that can be configured in an extremely simple way and in a very short time to enable quick production changeover. This is essentially due to the fact that some of the units mounted on-board the machine can perform the twofold function of grinding and polishing, and switching between the two functions is achieved simply by pressurising/depressurising the two air chambers.

[0036] In other words, the machine 1 described herein can be configured to perform grinding and polishing processes in different grinding-polishing programmes.

[0037] From the above it is apparent that modifications and variations may be made to the machine 1 described herein without departing from the scope of the independent claims.

[0038] In particular, the machine 1 could comprise just one unit 30 or a number of units 30 other than the number described herein and chosen, in the planning stage, to obtain sheets with perimeter surfaces having different geometries regardless of their thickness or perimeter surfaces with different surface finishes.

[0039] Moreover, in each assembly 38, the liner 46 of the actuator 45 could be permanently connected to the nut-screw 42 and the plunger 53 could be permanently connected to the slide 33.

[0040] In addition, the pneumatic actuator 45 could be arranged in an eccentric position with respect to the axis of the screw 39.

[0041] In some cases, the grinding head carries both the grinding wheel and the polishing wheel on a same rotating shaft and these are selected in a way that is known in the prior art.

Claims

1. A machine for grinding and polishing a glass sheet, the machine comprising a conveyor for feeding the sheet in a rectilinear feeding direction and at least one assembly for grinding and polishing of a sheet; the grinding and polishing assembly comprising at least one grinding unit for grinding the sheet, which has a motor-driven grinding wheel, and at least one polishing unit for polishing the sheet, which is independent of the grinding unit and has a motor-driven polishing wheel; **characterised in that** said assembly for grinding and polishing further comprises at least one sheet grinding/polishing unit comprising a slide able to move in a rectilinear direction orthogonal to said feeding direction, a wheel-carrier head, which carries a grinding wheel or a polishing wheel, and an electro-pneumatic assembly that can be configured for moving said slide in said transverse direction; the electro-pneumatic assembly comprising an electric motor, a pneumatic actuator, and configuration means for connecting said slide to said electric motor when the wheel-carrier head carries said grinding wheel and said pneumatic actuator when said wheel-carrier head carries said polishing wheel.

2. The machine according to Claim 1, **characterised in that** said electro-pneumatic assembly comprises a first mobile drive member driven by said electric motor and a second mobile drive member driven by said pneumatic actuator; the pneumatic actuator comprising at least a first variable-volume air chamber and means for pressurising said first variable-volume air chamber; said second mobile drive member partially delimiting said first variable-volume chamber and being connected to said slide; and **in that** said configuration means can be activated for connecting the first and the second mobile drive members rigidly together when the slide carries said grinding wheel or by interposition of said first air chamber when said slide carries said polishing wheel.

3. The machine according to Claim 1 or 2, **characterised in that** said configuration means comprise pneumatic means.

4. The machine according to Claim 3, **characterised in that** said configuration means comprise a second variable-volume air chamber that can be pressurised by means of further pressurisation means.

5. The machine according to Claim 2, **characterised in that**, when said first and second mobile members are rigidly connected together, they have respective shoulders that are brought and kept in abutment against each other by said configuration means.

6. The machine according to Claim 5, **characterised in that** said shoulders partially delimit said first variable-volume air chamber.

7. The machine according to Claim 2, **characterised in that** said first variable-volume air chamber extends parallel to, or coaxially with, a said transverse direction.

8. The machine according to Claim 4, **characterised in that** said pneumatic actuator is a double-acting pneumatic actuator having a liner and a fluid-tight plunger that slides in said liner and delimiting said first variable-volume chamber and said second variable-volume chamber; one between said liner and said plunger being permanently connected to said slide and the other being permanently connected to said first mobile drive member.

9. The machine according to Claim 8, **characterised in that** said plunger is permanently connected to said first mobile drive member.

10. The machine according to Claim 8, **characterised in that** said plunger is permanently connected to said slide, and the liner is permanently connected to said first mobile drive member.

11. The machine according to Claim 2, **characterised in that** said electro-pneumatic assembly further comprises a fixed guide, a nut-screw assembly, which in turn comprises a screw, which extends along the corresponding said rectilinear direction and is rotatably coupled to the corresponding said guide in an axially fixed position, and a nut, which is angularly fixed with respect to the corresponding said guide and is permanently connected to the corresponding said first mobile drive member; said first mobile drive member being tubular and said screw traversing said first mobile drive member and being turned by said electric motor.

12. The machine according to any one of the preceding claims, **characterised in that** it comprises at least one further said grinding and polishing unit.

13. A unit for grinding and polishing a glass sheet, the unit comprising a slide able to move in a rectilinear direction, a wheel-carrier head, which carries a grinding wheel or a polishing wheel, and an electro-pneumatic assembly, which can be configured for movement of said slide in said rectilinear direction; the electro-pneumatic assembly comprising an electric motor, a pneumatic actuator, and configuration means for connecting said slide to said electric motor, when the wheel-carrier head carries said grinding wheel, and said pneumatic actuator, when said wheel-carrier head carries said polishing wheel.

14. The unit according to Claim 13, **characterised in that** said configuration means are pneumatic means.

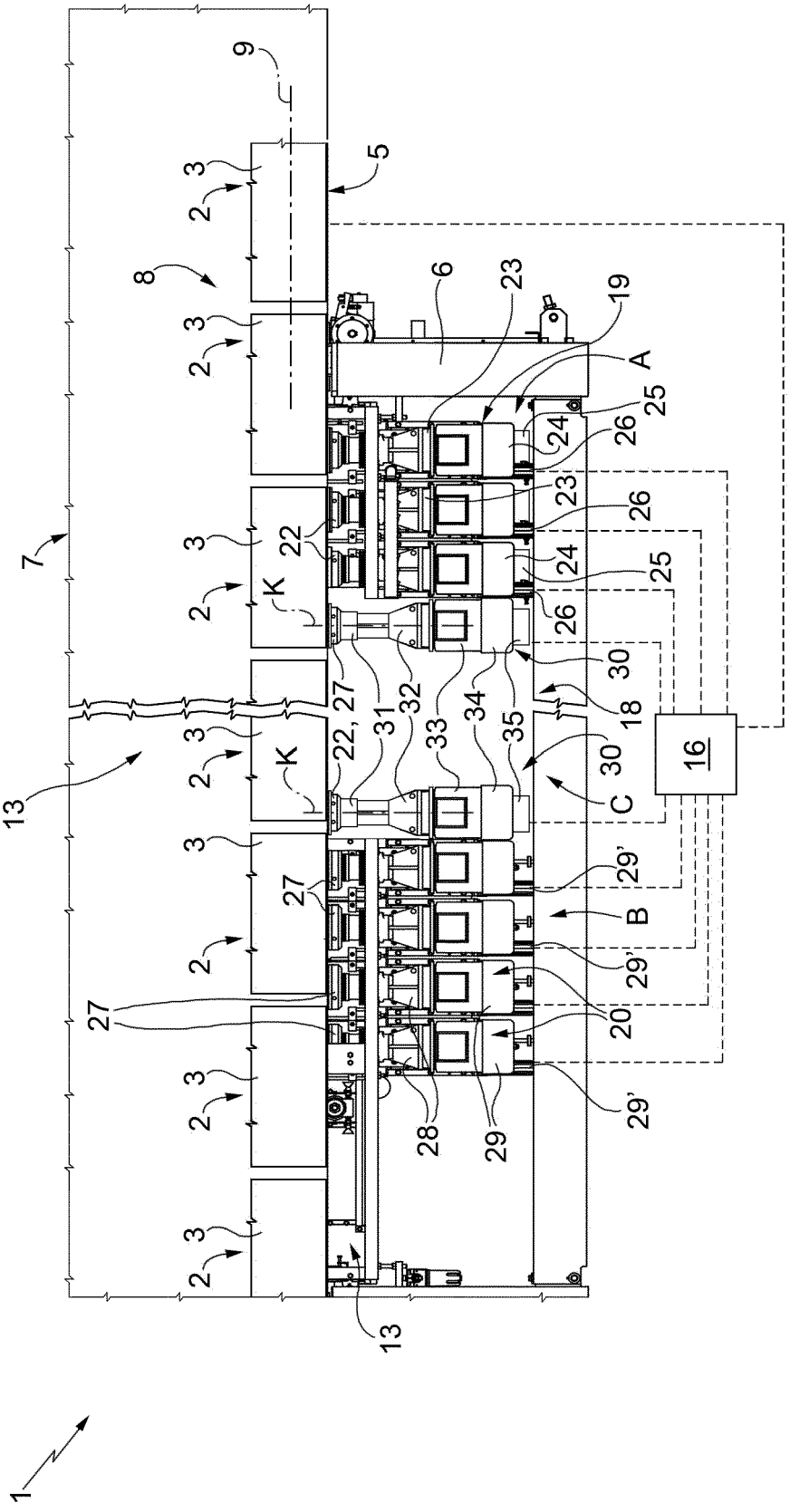
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FIG. 1

FIG. 2

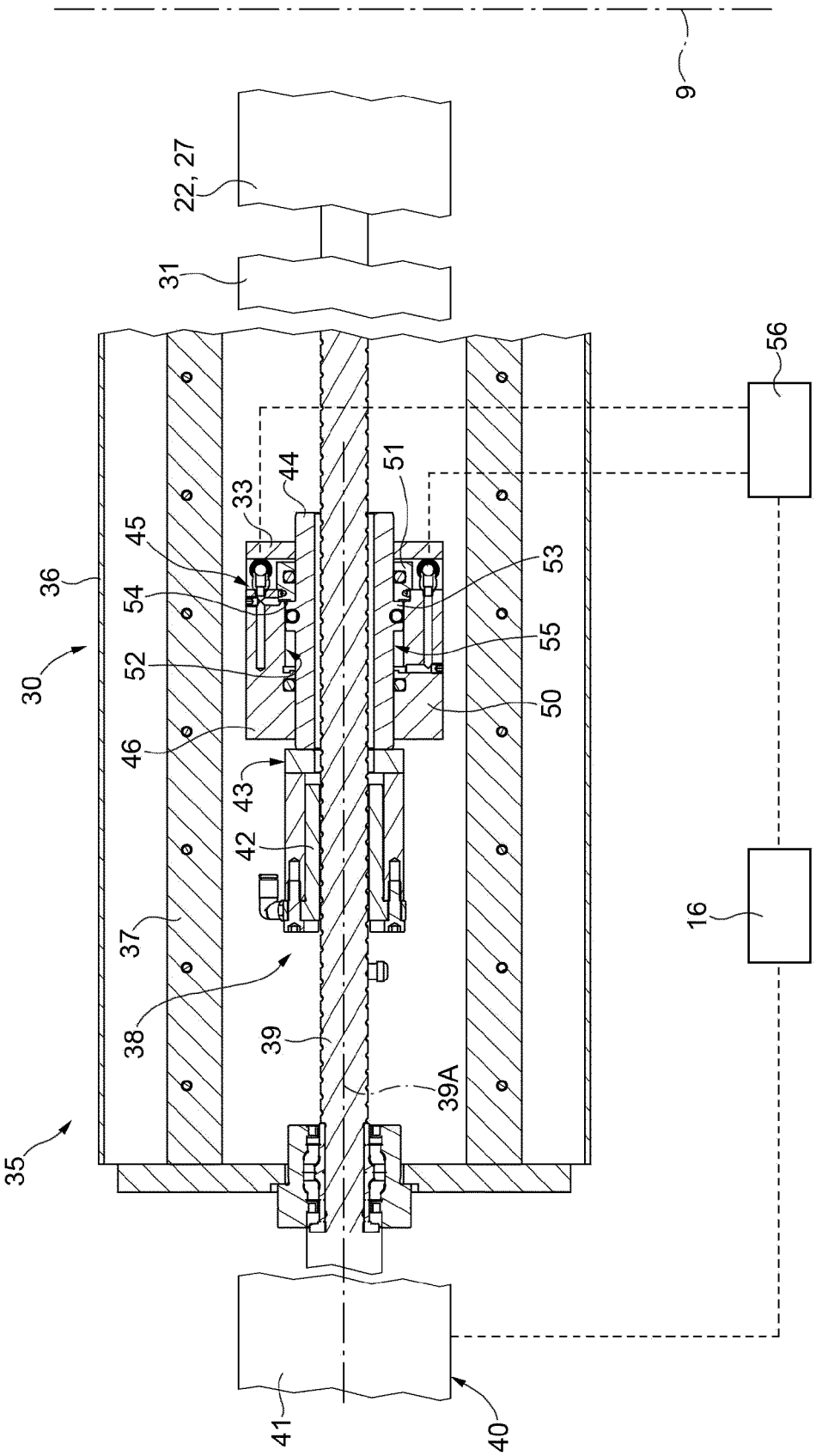
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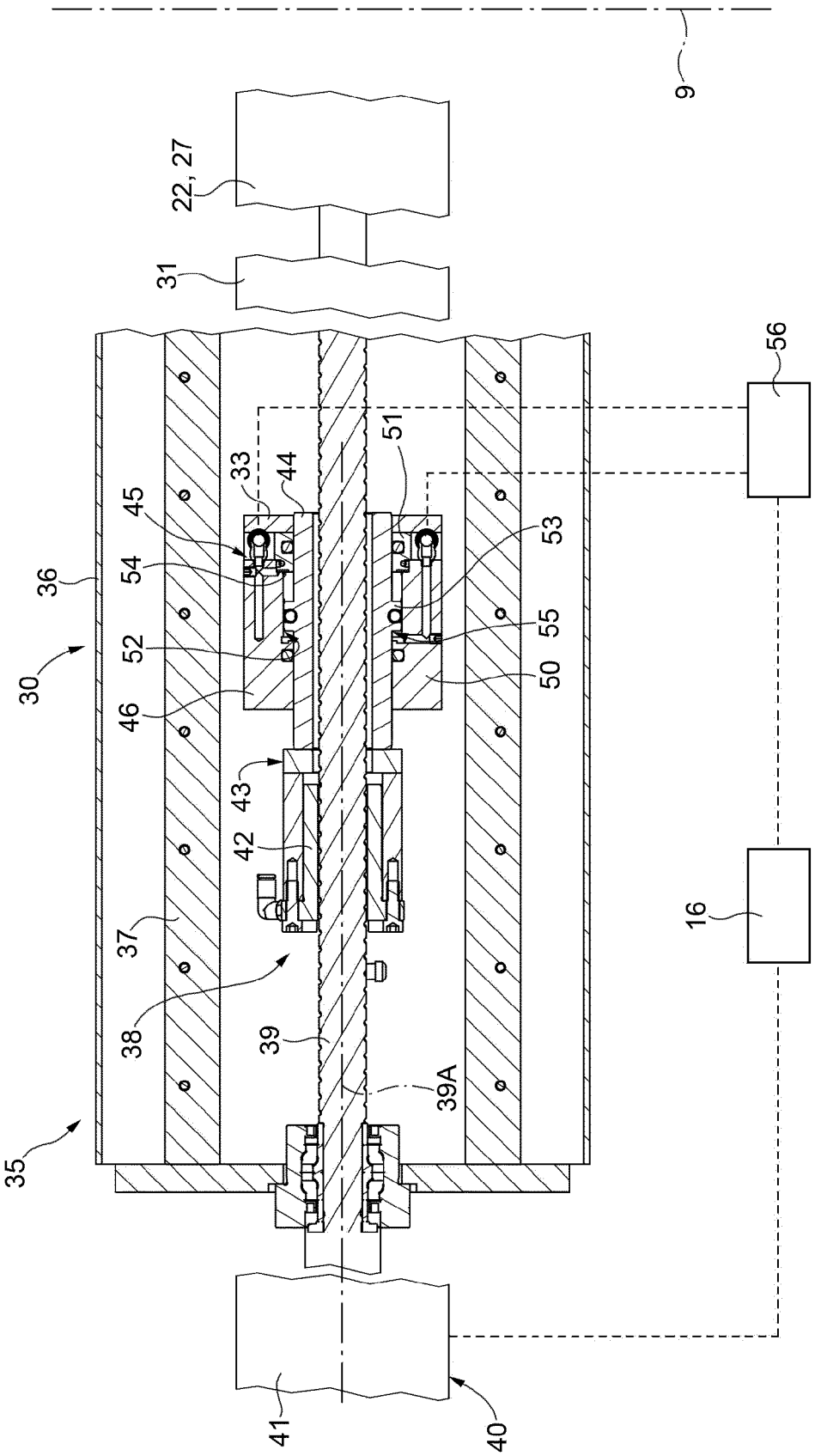
FIG. 3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EUROPEAN SEARCH REPORT

Application Number
EP 20 15 9903

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 1 422 024 A1 (BIESSE SPA [IT]) 26 May 2004 (2004-05-26) * paragraph [0022]; figures 1,2 * -----	1-14	INV. B24B9/10 B24B27/00 B24B47/22
A	IT TO20 080 765 A1 (BIESSE SPA) 18 April 2010 (2010-04-18) * claims 1, 2; figures 1, 2 * -----	1-14	
A	EP 0 689 899 A1 (BOTTERO SPA [IT]) 3 January 1996 (1996-01-03) * claim 1; figure 1 * -----	1-14	
			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	19 June 2020	Herrero Ramos, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 15 9903

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19-06-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1422024 A1	26-05-2004	AT 408476 T	15-10-2008
		EP 1422024 A1	26-05-2004
IT TO20080765 A1	18-04-2010	NONE	
EP 0689899 A1	03-01-1996	EP 0689899 A1	03-01-1996
		IT TO940531 A1	28-12-1995

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

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Patent documents cited in the description

- IT 102019000002941 **[0001]**