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(54) MACHINE AND UNIT FOR GRINDING AND POLISHING A GLASS SHEET

MASCHINE UND EINHEIT ZUM SCHLEIFEN UND POLIEREN EINER GLASSCHEIBE

MACHINE ET UNITÉ DE BROyage ET DE POLISSAGE D'UNE FEUILLE DE VERRE

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Description

TECHNICAL FIELD

[0001] The present invention relates to a machine and to a unit for grinding and polishing a glass sheet.

[0002] 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

[0003] 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.

[0004] 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.

[0005] 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.

[0006] 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.

[0007] 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.

[0008] 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.

[0009] 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.

[0010] 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.

[0011] Machines having grinding units and polishing units are disclosed, for example, in EP 1 422 024 A1, in IT TO 2008 0765 A1 e in EP 0 689 899 A1. In particular, IT TO 2008 0765 corresponds to the preamble of claim 1 and discloses a set of three units: two of such units are provided with respective grinding wheels, and the other one of such units is provided with a respective polishing wheel.

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 2.

[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 1.

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 slidably 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 unit (30) for grinding and polishing a glass sheet (2), the unit (30) comprising: a guide (37) in a recti-

linear direction (K); a slide (33) coupled to said guide (37) to move in said rectilinear direction (K); and a wheel-carrier head (31), which is mounted on, or is carried by, said slide (33) and carries a grinding wheel (22) or a polishing wheel (27); **characterized by** further comprising an electro-pneumatic assembly (38), which can be configured for movement of said slide (33) in said rectilinear direction (K); the electro-pneumatic assembly comprising: an electric motor (41), a pneumatic actuator (45), and configuration means (56) comprising a variable-volume air chamber (55) that can be pressurised/depressurized by pressurisation means (56, 16) for connecting said slide (33) to said electric motor (41), when the wheel-carrier head carries said grinding wheel (22), and to said pneumatic actuator (45), when said wheel carrier head carries said polishing wheel (27) .

2. A machine (1) for grinding and polishing a glass sheet (2), the machine (1) comprising a conveyor (7) for feeding the sheet (2) in a rectilinear feeding direction (K) and at least one assembly (A, B, C) for grinding and polishing of a sheet (2); the grinding and polishing assembly comprising: at least one grinding unit (19) for grinding the sheet, which has a motor-driven grinding wheel (22); at least one polishing unit (20) for polishing the sheet (2), which is independent of the grinding unit (19) and has a motor-driven polishing wheel (27); and at least one unit (30) for grinding and polishing a glass sheet; **characterized in that** said unit (30) is as claimed in claim 1.
3. The machine according to Claim 2, **characterised in that** the electro-pneumatic assembly comprises a first mobile drive member (44) driven by said electric motor (41) and a second mobile drive member (46) driven by said pneumatic actuator (45); the pneumatic actuator comprising a further variable-volume air chamber (54) and means (56, 16) for pressurising said further variable-volume air chamber (54); said second mobile drive member (46) partially delimiting said further variable-volume chamber (54) and being connected to said slide (33); and wherein said variable-volume air chamber (55) can be pressurised/depressurized for connecting the first (44) and the second mobile drive members (46) rigidly together when said wheel-carrier head (31) carries said grinding wheel (22) or by interposition of said further air chamber (54) when said wheel-carrier head (31) carries said polishing wheel (27).
4. The machine according to Claim 3, **characterised in that**, when said first (44) and second mobile members (46) are rigidly connected together, they have respective shoulders that are brought and kept in abutment against each other by said configuration means.

5. The machine according to Claim 4, **characterised in that** said shoulders partially delimit said further variable-volume air chamber (54).
6. The machine according to Claim 3, **characterised in that** said further variable-volume air chamber (54) extends parallel to, or coaxially with, said rectilinear direction (K).
7. The machine according to Claim 2, **characterised in that** said pneumatic actuator (45) is a double-acting pneumatic actuator having a liner and a fluid-tight plunger, that slides in said liner and delimits said further variable-volume chamber (54) and said variable-volume chamber (55); one between said liner and said plunger being permanently connected to said slide (33), and the other being permanently connected to said first mobile drive member (44).
8. The machine according to Claim 7, **characterised in that** said plunger is permanently connected to said first mobile drive member (44).
9. The machine according to Claim 7, **characterised in that** said plunger is permanently connected to said slide, and the liner is permanently connected to said first mobile drive member (44).
10. The machine according to Claim 3, **characterised in that** said electro-pneumatic assembly further comprises a fixed guide (37), a nut-screw assembly (39,42), which in turn comprises a screw (39), which extends along said rectilinear direction (K) and is rotatably coupled to said guide (37) in an axially fixed position, and a nut (42), which is angularly fixed with respect to said guide and is permanently connected to said first mobile drive member (44); said first mobile drive member (44) being tubular, and said screw (39) traversing said first mobile drive member and being turned by said electric motor (41).
11. The machine according to any one of claims from 2 to 10, **characterised in that** it comprises at least one further said grinding and polishing unit (30).

Patentansprüche

1. Eine Einheit (30) zum Schleifen und Polieren einer Scheibe (2), wobei die Einheit (30) aufweist:
- eine Führung (37) in einer geradlinigen Richtung (K); einen Schlitten (33), der mit der Führung (37) gekoppelt ist, um sich in der geradlinigen Richtung (K) zu bewegen; und einen Radträgerkopf (31), der an dem Schlitten (33) angebracht ist oder von diesem getragen wird und eine Schleifscheibe (22) oder eine Polierscheibe (27)

trägt;

gekennzeichnet durch folgendes aufweisend eine elektro-pneumatische Anordnung (38), die für die Bewegung des Schlittens (33) in der geradlinigen Richtung (K) ausgebildet sein kann; wobei die elektro-pneumatische Anordnung aufweist:

einen elektrischen Motor (41), einen pneumatischen Aktuator (45) und Konfigurationsmittel (56), die eine Luftkammer (55) mit variablem Volumen aufweisen, die durch Druckbeaufschlagungsmittel (56, 16) unter Druck gesetzt/entspannt werden kann, um den Schlitten (33) mit dem elektrischen Motor (41) zu verbinden, wenn der Radträgerkopf die Schleifscheibe (22) trägt, und mit dem pneumatischen Aktuator (45) zu verbinden, wenn der Radträgerkopf die Polierscheibe (27) trägt.

2. Eine Maschine (1) zum Schleifen und Polieren einer Glasscheibe (2), wobei die Maschine (1) einen Förderer (7) zum Zuführen der Scheibe (2) in einer geradlinigen Zuführungsrichtung (K) und mindestens eine Anordnung (A, B, C) zum Schleifen und Polieren einer Scheibe (2) aufweist, wobei die Schleif- und Polieranordnung aufweist: mindestens eine Schleifeinheit (19) zum Schleifen der Scheibe, die eine motorgetriebene Schleifscheibe (22) aufweist; mindestens eine Poliereinheit (20) zum Polieren der Scheibe (2), die von der Schleifeinheit (19) unabhängig ist und eine motorgetriebene Polierscheibe (27) aufweist; und mindestens eine Einheit (30) zum Schleifen und Polieren einer Glasscheibe; **dadurch gekennzeichnet, dass** die Einheit (30) nach Anspruch 1 ausgeführt ist.
3. Die Maschine nach Anspruch 2, **dadurch gekennzeichnet, dass** die elektro-pneumatische Anordnung ein erstes bewegliches Antriebselement (44), das von dem elektrischen Motor (41) angetrieben wird, und ein zweites bewegliches Antriebselement (46) aufweist, das von dem pneumatischen Aktuator (45) angetrieben wird, wobei der pneumatische Aktuator eine weitere Luftkammer (54) mit variablem Volumen und Druckbeaufschlagungsmittel (56, 16) der weiteren Luftkammer (54) mit variablem Volumen aufweist; wobei das zweite bewegliche Antriebselement (46) die weitere Luftkammer (54) mit variablem Volumen teilweise begrenzt und mit dem Schlitten (33) verbunden ist; und wobei die Luftkammer (55) mit variablem Volumen mit Druck beaufschlagt/unter Druck gesetzt werden kann, um das erste (44) und das zweite bewegliche Antriebselement (46) starr miteinander zu verbinden, wenn der Radträgerkopf (31) die Schleifscheibe (22) trägt, oder durch Zwischenschaltung der weiteren Luftkammer (54), wenn der Radträgerkopf (31) die Polierscheibe (27) trägt.

4. Die Maschine nach Anspruch 3, **dadurch gekennzeichnet, dass** das erste (44) und das zweite bewegliche Element (46), wenn sie starr miteinander verbunden sind, jeweils Schultern aufweisen, die durch die Konfigurationsmittel in Anschlag zueinander gebracht und gehalten werden. 5
5. Die Maschine nach Anspruch 4, **dadurch gekennzeichnet, dass** die Schultern teilweise die weitere Luftkammer (54) mit variablem Volumen begrenzen. 10
6. Die Maschine nach Anspruch 3, **dadurch gekennzeichnet, dass** die weitere Luftkammer (54) mit variablem Volumen sich parallel oder koaxial zu der geradlinigen Richtung (K) erstreckt. 15
7. Die Maschine nach Anspruch 2, **dadurch gekennzeichnet, dass** der pneumatische Aktuator (45) ein doppelt wirkender pneumatischer Kolben ist, der in der Einlage und einem fluiddichten Kolben ist, der in der Einlage gleitet und die weitere Kammer (54) mit variablem Volumen und die Kammer (55) mit variablem Volumen abgrenzt, wobei eine der Einlagen und der Kolben permanent mit dem Schlitten (33) und die andere permanent mit dem ersten beweglichen Antriebselement (44) verbunden ist. 20
8. Die Maschine nach Anspruch 7, **dadurch gekennzeichnet, dass** der Kolben dauerhaft mit dem ersten beweglichen Antriebselement (44) verbunden ist. 25
9. Die Maschine nach Anspruch 7, **dadurch gekennzeichnet, dass** der Kolben dauerhaft mit dem Schlitten verbunden ist und die Einlage dauerhaft mit dem ersten beweglichen Antriebselement (44) verbunden ist. 30
10. Die Maschine nach Anspruch 3, **dadurch gekennzeichnet, dass** die elektro-pneumatische Anordnung ferner eine feste Führung (37), eine Mutter-Schrauben-Anordnung (39, 42), die ihrerseits eine Schraube (39) aufweist, die sich entlang der geradlinigen Richtung (K) erstreckt und drehbar mit der Führung (37) in einer axial festen Position gekoppelt ist, und eine Mutter (42), die in Bezug auf die Führung winkelfest ist und dauerhaft mit dem ersten beweglichen Antriebselement (44) verbunden ist, wobei das erste bewegliche Antriebselement (44) rohrförmig ist und die Schraube (39) das erste bewegliche Antriebselement durchsetzt und von dem elektrischen Motor (41) gedreht wird. 35
11. Die Maschine nach einem der Ansprüche 2 bis 10, **dadurch gekennzeichnet, dass** sie mindestens eine weitere Einheit (30) zum Schleifen und Polieren aufweist. 40

Revendications

1. Unité (30) pour le meulage et le polissage d'une feuille de verre (2), l'unité (30) comprenant : un guide (37) dans une direction rectiligne (K) ; un coulisseau (33) accouplé audit guide (37) pour se déplacer dans ladite direction rectiligne (K) ; et une tête porte-meule (31), qui est montée sur ledit coulisseau (33) ou est portée par celui-ci et porte une meule (22) ou une meule de polissage (27) ; **caractérisée en ce qu'elle** comprend en outre un ensemble électropneumatique (38), qui peut être configuré pour le déplacement dudit coulisseau (33) dans ladite direction rectiligne (K) ; l'ensemble électropneumatique comprenant : un moteur électrique (41), un actionneur pneumatique (45), et un moyen de configuration (56) comprenant une chambre à air à volume variable (55) pouvant être mise sous pression/dépressurisée par un moyen de pressurisation (56, 16) pour relier ledit coulisseau (33) audit moteur électrique (41), lorsque la tête porte-meule porte ladite meule (22), et audit actionneur pneumatique (45), lorsque ladite tête porte-meule porte ladite meule de polissage (27). 5
2. Machine (1) pour le meulage et le polissage d'une feuille de verre (2), la machine (1) comprenant un transporteur (7) pour introduire la feuille (2) dans une direction rectiligne (K) d'introduction et au moins un ensemble (A, B, C) pour le meulage et le polissage d'une feuille (2) ; l'ensemble de meulage et de polissage comprenant : au moins une unité de meulage (19) pour meuler la feuille, qui a une meule (22) entraînée par moteur ; au moins une unité de polissage (20) pour polir la feuille (2), qui est indépendante de l'unité de meulage (19) et a une meule de polissage (27) entraînée par moteur ; et au moins une unité (30) pour le meulage et le polissage d'une feuille de verre ; **caractérisée en ce que** ladite unité (30) est telle que revendiquée selon la revendication 1. 10
3. Machine selon la revendication 2, **caractérisée en ce que** l'ensemble électropneumatique comprend un premier organe mobile d'entraînement (44) entraîné par ledit moteur électrique (41) et un second organe mobile d'entraînement (46) entraîné par ledit actionneur pneumatique (45) ; l'actionneur pneumatique comprenant une autre chambre à air à volume variable (54) et un moyen (56, 16) pour mettre sous pression ladite autre chambre à air à volume variable (54) ; ledit second organe mobile d'entraînement (46) délimitant partiellement ladite autre chambre à volume variable (54) et étant relié audit coulisseau (33) ; et dans laquelle ladite chambre à air à volume variable (55) peut être mise sous pression/dépressurisée pour solidariser les premier (44) et second organes mobiles d'entraînement (46) ensemble lorsque ladite tête porte-meule (31) porte ladite meule (22) ou par interposition de ladite autre chambre à 15

air (54) lorsque ladite tête porte-meule (31) porte ladite meule de polissage (27).

4. Machine selon la revendication 3, **caractérisée en ce que**, lorsque lesdits premier (44) et second organes mobiles (46) sont solidaires, ils ont des épaulements respectifs amenés et maintenus en appui l'un contre l'autre par ledit moyen de configuration. 5
5. Machine selon la revendication 4, **caractérisée en ce que** lesdits épaulements délimitent partiellement ladite autre chambre à air à volume variable (54). 10
6. Machine selon la revendication 3, **caractérisée en ce que** ladite autre chambre à air (54) à volume variable s'étend parallèlement ou coaxialement à ladite direction rectiligne (K). 15
7. Machine selon la revendication 2, **caractérisée en ce que** ledit actionneur pneumatique (45) est un actionneur pneumatique à double effet ayant une chemise et un piston étanche, qui coulisse dans ladite chemise et délimite ladite autre chambre à volume variable (54) et ladite chambre à volume variable (55); l'un parmi ladite chemise et ledit piston étant relié à demeure audit coulisseau (33), et l'autre étant relié à demeure audit premier organe mobile d'entraînement (44). 20 25
8. Machine selon la revendication 7, **caractérisée en ce que** ledit piston est relié à demeure audit premier organe mobile d'entraînement (44). 30
9. Machine selon la revendication 7, **caractérisée en ce que** ledit piston est relié à demeure audit coulisseau, et la chemise est reliée à demeure audit premier organe mobile d'entraînement (44). 35
10. Machine selon la revendication 3, **caractérisée en ce que** ledit ensemble électropneumatique comprend en outre un guide fixe (37), un ensemble écrou-vis (39, 42), qui comprend lui-même une vis (39), qui s'étend le long de ladite direction rectiligne (K) et est accouplée en rotation audit guide (37) dans une position axialement fixe, et un écrou (42), qui est fixe angulairement par rapport audit guide et est relié à demeure audit premier organe mobile d'entraînement (44); ledit premier organe mobile d'entraînement (44) étant tubulaire, et ladite vis (39) traversant ledit premier organe mobile d'entraînement et étant tournée par ledit moteur électrique (41). 40 45 50
11. Machine selon l'une quelconque des revendications 2 à 10, **caractérisée en ce qu'elle** comprend au moins une autre unité de meulage et de polissage (30). 55

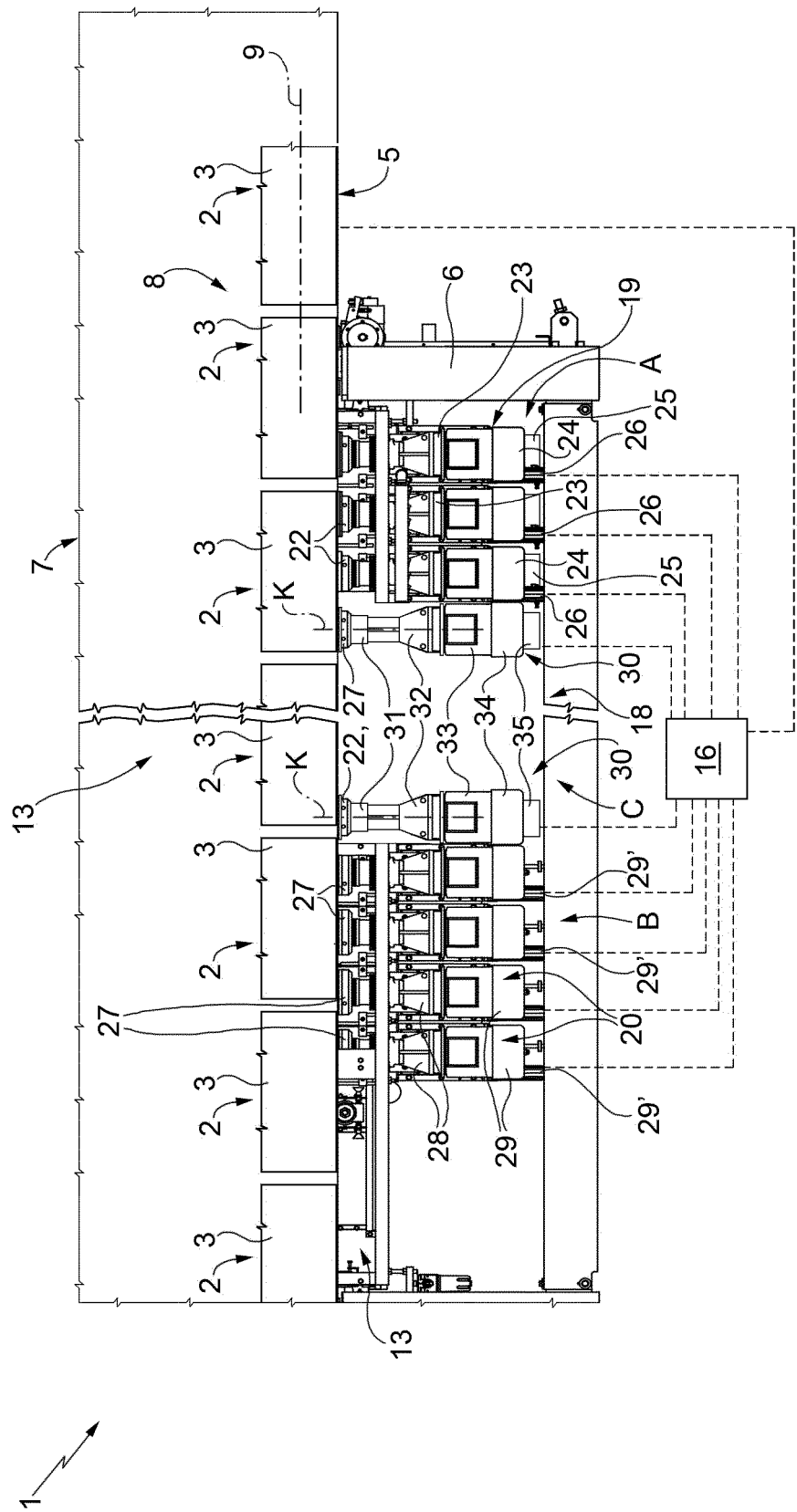


FIG. 1

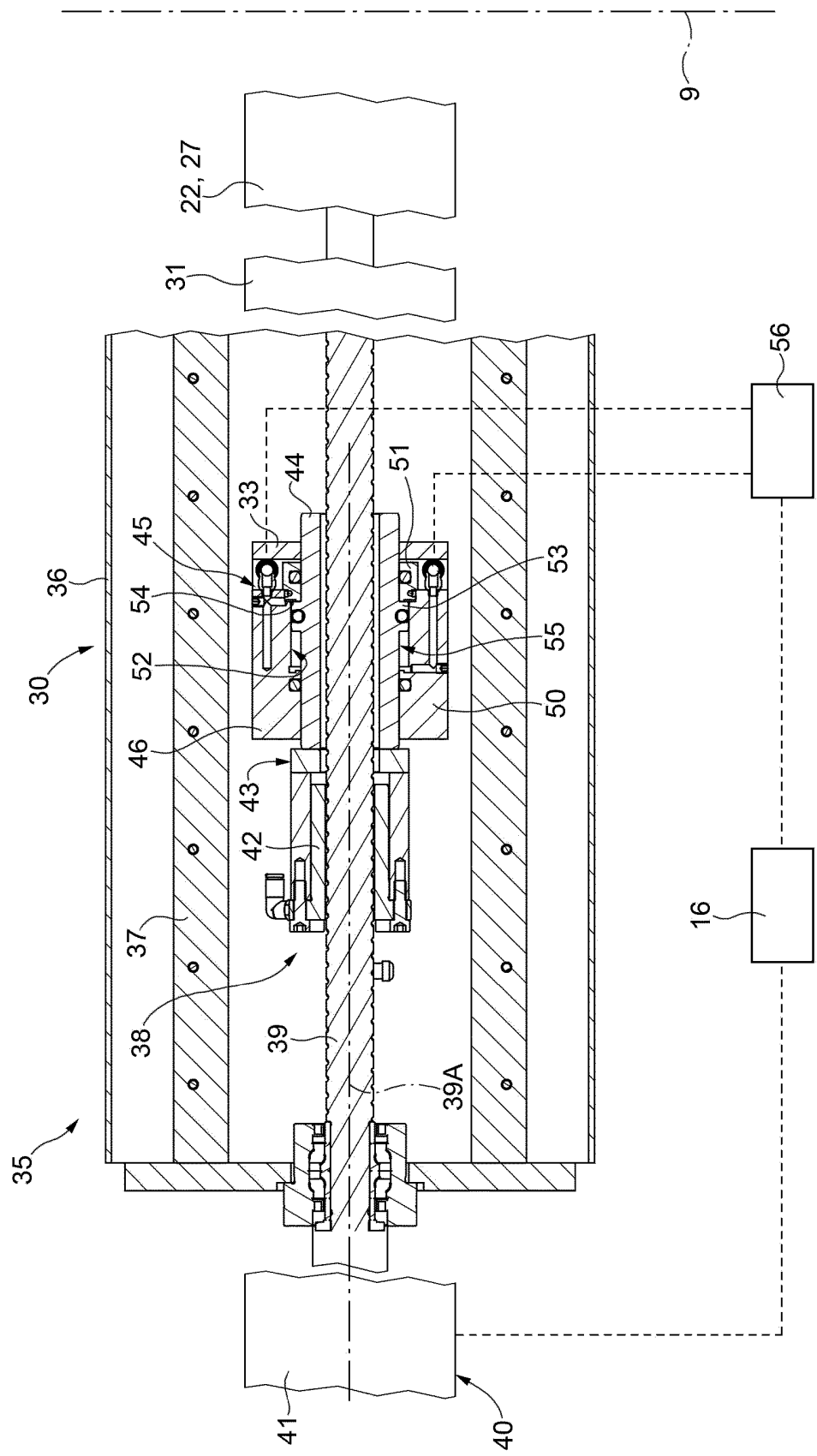


FIG. 2

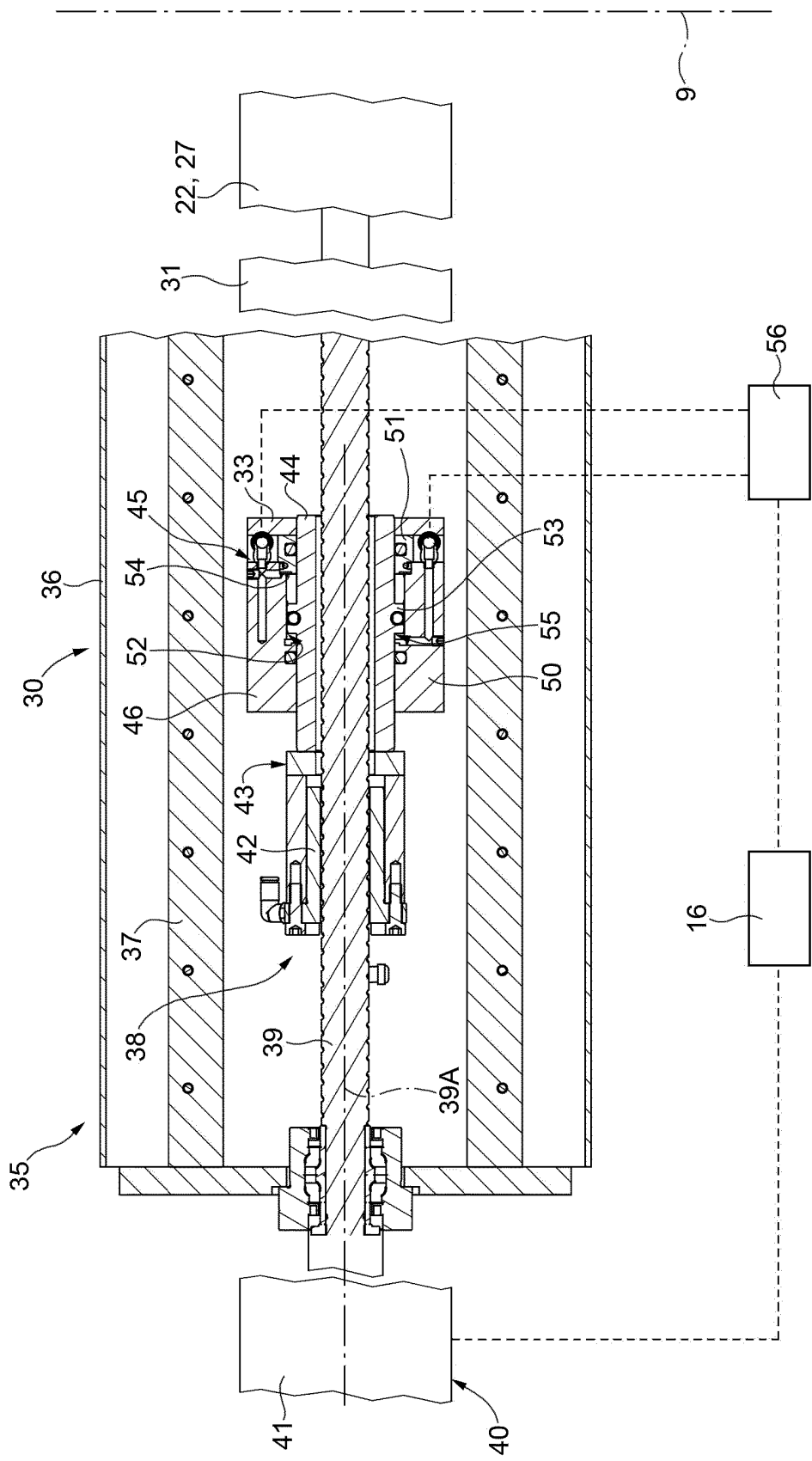


FIG. 3

REFERENCES CITED IN THE DESCRIPTION

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