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(54) ## Actuating device

(57) A driving device for pressing means (3) of a sanding machine (4), said pressing means being arranged for exerting a working pressure (P3) on a workpiece (6), comprises pneumatic actuator means (11) associated with said pressing means (3), electric valve means (35) arranged for inducing said working pressure (P3) on said pneumatic actuator means (11) and electromagnetic driving means arranged for driving said electric valve means (35), said electromagnetic driving means is electromagnetic driving means having a pulse width modulation cycle (100; 100').

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Description

[0001] The invention relates to a driving device arranged for driving a pneumatic actuator.

[0002] Particularly, the invention refers to a driving device of a pneumatic actuator suitable for being associated with a pad arranged for being used in machine tools, such as sanding machines designed for sanding wood or similar materials.

[0003] The known sanding machines, for example those of wide belt type, comprise a frame supporting a conveyor belt, extending along a longitudinal direction and arranged for transporting a piece to be worked.

[0004] The frame supports a plurality of rollers having parallel axes, said rollers being positioned transversally and above the conveyor belt, said rollers providing for tensioning and driving an abrasive belt, ring closed on the same rollers.

[0005] The abrasive belt is provided with a sanding assembly comprising a pad, arranged for exerting a proper pressure on a portion of the abrasive belt in direction of the conveyor belt so as to exert a higher or lower sanding pressure on the piece to be worked.

[0006] Particularly, the pad is arranged transversally with respect to the advancing direction of the conveyor belt and is partitioned in a plurality of slides adjacent to each other, each of which is arranged for pressing a portion of the abrasive belt.

[0007] The slides are mutually independent and each slide is controlled by a corresponding actuator driven by a respective driving device.

[0008] The driving device comprises an electronic board arranged for driving a first electric valve and a second electric valve.

[0009] The first electric valve and the second electric valve are connected via a pneumatic circuit with a respective pressure chamber and are arranged for inducing on the actuator a first and a second pressure levels respectively.

[0010] In this way, the actuator and the corresponding slide can be actuated with two different pressure levels, which allows the slide to press the abrasive belt with a different intensity.

[0011] Furthermore, the driving device comprises a counter-pressure chamber, connected with the actuator, arranged for supplying the actuator with a counter-pressure.

[0012] This enables a descent velocity of the actuator to be regulated and the slide to be rapidly raised for being disengaged from the abrasive belt.

[0013] A drawback affecting the known devices is the possibility that the surface having to be sanded is damaged near the edge of the workpiece.

[0014] Actually, at the edge, a portion of the surface of the slide can be disengaged from the workpiece and in this way, being the force acting on the slide constant, an excessive pressure can occur of the slide on the workpiece.

[0015] In other words, the slide can be pressed with excessive force against the edge surface, so that the edge surface is damaged and peels off, the surface quality of the machining being compromised.

[0016] Another drawback of the known devices is the consequent excessive number of pieces to be discarded due to the incorrect machining of the edge with the consequent increase of the production costs.

[0017] A further drawback of the known devices relates to the complexity of their structure, their remarkable size and the high cost to be sustained for their implementation.

[0018] An object of the invention is to improve the driving devices arranged for driving actuators of pads of sanding machines.

[0019] A further object is to realize a driving device enabling an edge of a workpiece to be sanded without being damaged.

[0020] A still further object is to obtain a driving device enabling the surface quality of the workpiece to be improved.

[0021] Another object is to reduce the pieces to be discarded due to an incorrect machining.

[0022] Another further object is to realize driving devices provided with a simplified structure, limited size and requiring a limited expenditure of money for being implemented.

[0023] According to the invention, a driving device for pressing means of a sanding machine is provided, said pressing means being arranged for exerting a working pressure on a workpiece, said driving device comprising pneumatic actuator means associated with said pressing means, electric valve means arranged for inducing said working pressure on said pneumatic actuator means and electromagnetic driving means arranged for driving said electric valve means, characterized in that said electromagnetic driving means is electromagnetic driving means having a pulse width modulation cycle.

[0024] Owing to the invention, a range of variable pressures can be optionally induced on an actuator, being used electromagnetic driving means having a pulse width modulation cycle operating according to a PWM (Pulse Width Modulation) cycle for electrically driving the electric valve.

[0025] The parameters regulating such PWM cycle being properly changed, that enables a plurality of pressures to be obtained acting on a single actuator.

[0026] In this way, each actuator has available a number of pressure levels higher than the known devices, with the capability to more accurately modulate the working pressure, particularly near an edge of the workpiece.

[0027] Being the pressure properly regulated, that enables the machining quality to be improved, so that phenomena are prevented such as the edge "peeling" and a better surface quality of the workpiece is assured.

[0028] In this way, the number of pieces to be discarded can be in addition reduced with consequent economic benefits.

[0029] Furthermore, the device according to the invention exhibits a simple, compact structure and requires a limited expenditure of money for being implemented.

[0030] The invention can be better understood and carried out with reference to the accompanying drawings, which illustrate some exemplifying and not limitative embodiments thereof, wherein:

Figure 1 is a cross-section of a driving device associated with a pad of a sanding machine;
Figure 2 is an enlarged detail of Figure 1;
Figure 3 is a diagram representing a PWM working cycle of an electric valve included in the device of Figure 1;
Figure 4 is a schematic top view of the sanding machine provided with a first detecting barrier of the workpiece;
Figure 5 is a schematic top view of the sanding machine provided with a second detecting barrier of the workpiece;
Figure 6 is a cross-section of the second barrier of Figure 5;
Figure 7 is a longitudinal, broken section, of the second barrier of Figure 5.

[0031] With reference to Figures 1 and 2, a driving device 1 of a pad 2 is shown comprising, a plurality of pressers 3 positioned next to each other.

[0032] The driving device 1 is suitable for being associated with a wide belt sanding machine 4, arranged for sanding wood or similar materials, schematically represented in Figures 4 and 5.

[0033] The sanding machines 4 comprise a frame, not represented, supporting a conveyor belt 5, developing and moving along a first axis X substantially horizontal in the direction indicated by a first arrow F1, and arranged for transporting a piece to be worked 6 along the said first axis X (Figure 4) .

[0034] The frame further provides to support a plurality of rollers, having parallel axes, not shown, positioned in the use transversally and above with respect to said conveyor belt 5, tensioning and driving an abrasive belt 7, ring closed on the same rollers.

[0035] At the conveyor belt 5 the abrasive belt 7 has a velocity directed along the first axis X.

[0036] Particularly, such velocity may be directed according to the direction indicated by the first arrow F1 in the case of concurring machining, that is when the velocity of the abrasive belt 7 is concurrent with respect to an advancing direction A of the piece to be worked 6, and according to the direction shown by a second arrow F2 in the case of opposing machining, that is when the velocity of the abrasive belt 7 is opposing with respect to an advancing direction A of the piece to be worked 6.

[0037] The abrasive belt 7 is arranged so as to be pressed against the workpiece 6 by the pressers 3, an antifriction cloth 8 being positioned between the pressers 3 and the abrasive belt 7.

[0038] Each presser 3 comprises a slide 9 supporting a section of an insert 10, flexible and suitable for being extracted in transversal direction with respect to the first axis X.

[0039] The insert 10, having substantially the shape of a parallelepiped extending along a transversal direction with respect to the first axis X, is arranged for contacting the antifriction cloth 8 in order to exert an appropriate pressure on a corresponding portion of the abrasive belt 7, in direction of the conveyor belt 5 so as to accomplish the sanding of the workpiece 6.

[0040] Furthermore, each slide 9 is removably associated with an actuator 11.

[0041] The actuators 11 of each presser 3 result independent of each other and are each arranged to move the corresponding section of insert 10 along a second axis Z, substantially vertical, and substantially perpendicular to the first axis X, near to and away from the workpiece 6.

[0042] The slides 9, in variable number depending on the transversal development of the abrasive belt 7, also result positioned near to each other and arranged in a row like the keys of a piano, transversally with respect to the first axis X.

[0043] The actuators 11 are supported by a crosspiece 12, for example an draw piece of aluminum, said crosspiece being supported at the ends thereof by a fixed frame, transversally arranged with respect to the first axis X and positioned above the abrasive belt 7.

[0044] Particularly, the crosspiece 12 is inserted between the tensioning rollers of the abrasive belt 7 and runs parallel to said rollers according to an arrangement substantially known in the sanding machines.

[0045] Thus, during the use, when the insert 10 is lowered along the second axis Z, said insert 10 engages the antifriction cloth 8 and through this latter presses the abrasive belt 7 against the workpiece 6, performing the desired sanding.

[0046] Furthermore, in the crosspiece 12, a counter-pressure chamber 13 and a pressure chamber 14 are obtained, independent of each other and developing mutually parallel substantially along the full length of the crosspiece 12.

[0047] The pressure chamber 14 has a volumetric size higher than the counter-pressure chamber 13 and is positioned operatively above said counter-pressure chamber.

[0048] Particularly, the pressure chamber 14 is arranged for containing air at a first pressure P1, or supply pressure, substantially constant and arranged for moving the actuator 11 near to the workpiece 6, whereas the counter-pressure chamber 13 is arranged for containing air at a second pressure P2, or counter-pressure CP, also said second pressure P2 being substantially constant and arranged for regulating a descent speed of the actuator 11 and for moving said actuator 11 away from the workpiece 6 when machining is completed.

[0049] Furthermore, the second pressure P2 is lower than the first pressure P1 and is arranged, during the use, for opposing the first pressure P1.

[0050] The crosspiece 12, viewed along a cross vertical section, has substantially shape of a square and exhibits a plurality of through housings 15, tight sealed, extending along the second axis Z.

[0051] Each housing 15 is obtained along the transversal development of the crosspiece 12 and centrally with respect to said crosspiece 12.

[0052] Each housing 15 is arranged for accommodating a liner 16 of the actuators 11, having substantially shape of hollow cylinder, developing along the second axis Z.

[0053] The liner 16 exhibits three internal diameter different from each other; a first internal diameter 17 in a first part 18, a second internal diameter 19 in a second part 20 and a third internal diameter 21 in a third part 22, opposed to the first part 18, the second part 20 being interposed between the first part 18 and the third part 22.

[0054] The first internal diameter 17 results smaller than the second internal diameter 19 that in turn is smaller than the third internal diameter 21.

[0055] Each liner 16 is arranged for receiving the respective actuator 11, so as to assure the dimensional precision required in the assembly and increase the sliding capability of said actuator 11along the second axis Z.

[0056] Each actuator 11 has substantially shape of a cylinder, developing along the second axis Z, and exhibits three different external diameter: a first external diameter 23 in a first own portion 24, a second external diameter 25 in a second own portion 26 and a third external diameter 27 in a third own portion 28.

[0057] Particularly, the first external diameter 23 results smaller than the second external diameter 25, that in turn is smaller than the third external diameter 27.

[0058] Thus, between the second portion 26 of the actuator 11 and the second part 20 of the liner 16, a first annular chamber 29 is obtained that is communicating with a second annular chamber 30 obtained between the second portion 26 and the third part 22.

[0059] Each actuator 11 further comprises an active surface 39, having a diameter substantially equal to the third external diameter 27, extending transversally with respect to the second axis Z and defining, together with the third part 22, a cylindrical chamber 40.

[0060] Furthermore, the liner 16 is provided with a substantially horizontal opening 31, arranged for connecting the first annular chamber 29 with the counter-pressure chamber 13.

[0061] Returning to the crosspiece 12, said crosspiece 12 further comprises a surface 32, wherein a through bore 37 is carried out, extending substantially parallel with respect to the second axis Z.

[0062] The surface 32 is also surmounted by a cover 33, arranged for defining with the surface 32 a hollow 34 arranged for accommodating the driving device 1 of the actuator 11.

[0063] The driving device 1 comprises a valve-holder body 51 provided with a seat, not shown, arranged for receiving an electric valve 35, illustrated with dotted line.

[0064] The valve-holder body 51 comprises an inlet 41, through which air enters at the first pressure P1, which air is conveyed to the electric valve 35 via duct means 80, shown with dotted line.

[0065] The inlet 41 is connected with the pressure chamber 14 via a first conduit 36, for example a flexible pipe, communicating with the bore 37.

[0066] The valve-holder body 51 further comprises an outlet 42 from which air escapes at a variable, working pressure P3.

[0067] The outlet 42 is connected with the electric valve 35 by means of further duct means 81, represented with dotted line, and with the cylindrical chamber 40 via a second conduit 38 extending along the second axis Z and partially received in the housing 15.

[0068] Each electric valve 35 is pneumatically fed with the first pressure P1 and is electrically actuated by means of electromagnetic driving means having a pulse width modulation cycle 100.

[0069] The electromagnetic driving means having a pulse width modulation cycle 100 is arranged for driving an electric valve according to a "Pulse Width Modulation" cycle with substantially constant average voltage, normally referred to as PWM cycle.

[0070] The PWM pulse width modulation, briefly described since substantially already known in other embodiments, is a type of digital modulation in which an information is coded in the form of duration in the time of each signal pulse.

[0071] In other words, the PWM modulation consists in varying the duration of the pulses of a signal.

[0072] In Figure 3 a DC ("Duty cycle") working cycle of a PWM signal is shown in a diagram.

[0073] Such diagram comprises the time in abscissa and the control voltage of the electric valve 35 in ordinate.

[0074] The DC working cycle of the PWM signal represented in the diagram of Figure 3 comprises a train of rectangular pulses characterized by a fixed frequency, a voltage V, and a cycle time T defined as the sum of an activation time T1 and a rest time T2.

[0075] Particularly, the activation time T1 is defined as the percentage of the cycle time T in which the electric valve 35 is fed at the voltage V.

[0076] It was verified that by regulating the first pressure P1, while keeping the voltage V at a constant continuous value and the frequency fixed at a value F, values of working pressure P3 can be obtained in the cylindrical chamber 40 varying in the range from 0 to about P1.

[0077] Further, it was verified that, in order that possible vibrations of the actuator 11, due to the variability of the pneumatic supply, are made unappreciable, it is convenient to use fixed frequencies of cycle higher than or equal to a predefined minimum threshold value.

[0078] It is to be noted that, by varying the parameters regulating the PWM signal, different working pressures P3, varying in the range between 0 and the first pressure

P1, can be obtained in the cylindrical chamber 40 of the corresponding presser 3 and consequently the pressers 3 can be pressed on the workpiece 6 with a range of pressures varying optionally below of, or at most substantially equal to, a network value, in the case described above, substantially equal to the first pressure P1.

[0079] With reference to Figure 4 the sanding machine 4 is schematically shown provided with a detecting barrier 43 arranged for controlling the driving devices 1 of each presser 3.

[0080] The detecting barrier 43 is positioned above with respect to the conveyor belt 5 and upstream of the pressers 3 with respect to the advancing direction A of the workpiece 6.

[0081] When the workpiece 6 is positioned on the moving conveyor belt 5, said workpiece 6 passes under the detecting barrier 43, which provides to detect the transversal size thereof. The detecting barrier 43 is opposed and substantially parallel with respect to the inserts 10 of the pressers 3, and comprises a plurality of sensors 44 free from contact, which are grouped for example in sets of three sensors every presser 3 of the pad 2.

[0082] In other words, the detecting barrier 43 has a barrier pitch 45 having width equal to one third of the width of the pitch 46 of the presser 3.

[0083] Thus, each presser 3 is controlled by the three respective barrier pitches 45 facing said presser 3 along the first axis X.

[0084] When a workpiece 6 activates all the three sensors 44 of a corresponding presser 3, that means that the detecting barrier 43 is reading a portion of the workpiece 6 corresponding to three barrier pitches 45, that is said detecting barrier 43 is reading an internal portion of the workpiece 6.

[0085] At this point, the sensors 44 send a signal to the electromagnetic driving means having a pulse width modulation cycle 100.

[0086] The electromagnetic driving means having a pulse width modulation cycle 100 comprises an input electronic board 47, a programmable logic controller 50, or PLC, and an output electronic board 49.

[0087] The input electronic board 47 receives the signal from the sensors 44 and transmits said signal to the PLC 50, that is known and for that reason will not be described in detail.

[0088] The PLC 50 processes the signal coming from the sensors 44 and a further advancing signal of the conveyor belt 5 sent by a decoder 48, and transmits such signals to the output electronic board 49 that elaborates the corresponding PWM cycle for driving the respective electric valve 35.

[0089] In the above described case, where all the three barrier pitches 45 of a sensor 44 have been activated, the PWM cycle elaborated by the electromagnetic driving means having a pulse width modulation cycle 100 is designed in such a way as to direct the corresponding electric valve 35 to supply the cylindrical chamber 40 of the respective actuator 11 with a first maximum predicted working pressure PP1.

[0090] In other words, the electric valve 35 is supplied at the voltage V for a first activation time TT1, during which time TT1 said electric valve 35 withdraws air from the pressure chamber 14, which air is conveyed through the first conduit 36, the duct means 80, the further duct means 81, the second conduit 38, and the cylindrical chamber 40 towards the active surface 39 of the actuator 11.

[0091] The actuator 11 is then forced to press via the corresponding presser 3 the underlying portion of abrasive belt 7 with the first working pressure PP1.

[0092] Vice versa, where one or two barrier pitches 45 have been activated, see the right and left hand portion of Figure 4 respectively, that means that a portion of the workpiece 6 is under processing near to an edge 51.

[0093] In that case, the PWM cycle elaborated by the electromagnetic driving means having a pulse width modulation 100 is designed so as to direct the corresponding electric valve 35 to supply the cylindrical chamber 40 of the respective actuator 11 respectively with a second working pressure PP2 and a third working pressure PP3 equal to one third and two thirds of the first working pressure PP1 respectively in order to prevent the edge 51 from being damaged.

[0094] In other words, the electric valve 35, supplied at the voltage V for a second activation time TT2 and a third activation time TT3 respectively, withdraws air from the pressure chamber 14, which air is conveyed through the first conduit 36, the duct means 80, the further duct means 81, the second conduit 38, and the cylindrical chamber 40 towards the active surface 39 of the actuator 11.

[0095] The actuator 11 is therefore forced to press by means of the corresponding presser 3 the underlying portion of abrasive belt 7 with the second working pressure PP2 and the third working pressure PP3 respectively.

[0096] It is to be noted that the first working pressure PP1, and consequently the second working pressure PP2 and the third working pressure PP3 are defined during a calibrating phase of the sanding machine 4 before a working cycle is started.

[0097] It is further to be noted that the slide 9 of every actuator 11 moves independently from the others, each slide 9 being actuated with a working pressure P3 suitable for the corresponding portion of piece 6 to be worked.

[0098] In addition, it is to be noted that in this way each presser 3 is provided with an actuator 11 suitable for being actuated with at least three different working pressure P3: PP1 or PP2 or PP3.

[0099] That enables the pressers 3 to modulate the pressure in a larger extent with respect to what the known devices can do, particularly near to an edge of the workpiece 6.

[0100] In this way, the pressure can be regulated more properly, that makes machining more accurate, in order phenomena to be prevent like the "peeling" of the edge and a better surface quality of the workpiece 6 to be assured.

[0101] Furthermore, during machining and before machining is started, the actuator 11 is evenly stressed by the counter-pressure CP, opposing, according to the necessity, the first working pressure PP1, the second working pressure PP2 or the third working pressure PP3.

[0102] The counter-pressure CP works in the following way: the air existing in the counter-pressure chamber 13 is conveyed via the opening 31, through the first annular chamber 29, towards the second annular chamber 30.

[0103] The counter-pressure CP is exerted on an annular surface 53 of the actuator 11 opening on the second annular chamber 30 and opposed to the active surface 39, and enables the actuator 11 to be rapidly raised when the sanding of the workpiece 6 is finished, that is when the forcing action exerted by the first working pressure PP1, or by the second working pressure PP2 or by the third working pressure PP3 is concluded.

[0104] Furthermore, the counter-pressure CP enables the descent speed of the actuator 11 to be adjusted and the pressers 3 to be maintained raised when the machining is finished.

[0105] With reference to Figures 5 to 7 the sanding machine 4 is schematically shown provided with a further detecting barrier 53 arranged for controlling the driving devices 1 of each presser 3.

[0106] The further detecting barrier 53 is positioned above with respect to the conveyor belt 5 and upstream of the pressers 3 with respect to the advancing direction A of the workpiece 6. When the workpiece 6 is positioned on the moving conveyor belt 5, said workpiece 6 passes under the further detecting barrier 53, that provides to detect a variation of thickness of the workpiece 6.

[0107] The further detecting barrier 53 is opposed and substantially parallel with respect to the insert 10, and comprises a plurality of capacitive sensors 54 arranged for detecting the variation of thickness of the workpiece 6.

[0108] The capacitive sensors 54 comprise tracers 55 positioned near to each other, arranged in a row like the keys of a piano transversally with respect to the first axis X, and moving independently of each other along the second axis Z.

[0109] Each feeler pin 55 comprises a rod 57 extending substantially parallel to the second direction Z and provided at one end 58 thereof with a wheel 56, that is maintained in contact, by means of elastic means not shown, with the workpiece 6.

[0110] Each capacitive sensor 54 is further provided with an armature 60 associated with a further end 59, opposed to the end 58, of the rod 57.

[0111] The further detecting barrier 53 further comprises a supporting plate 62, extending transversally with respect to the first direction X, arranged for supporting the capacitive sensors 54.

[0112] The supporting plate 62 is surmounted by a further cover 63.

[0113] The further cover 63 defines with the supporting plate 62 a further hollow 66 in which a support 64 is positioned.

[0114] The support 64 is associated with the supporting plate 62 and is arranged for supporting a further fixed armature 65.

[0115] In this way, when the armature 60 of a feeler pin 55 is moved by means of the rod 57 along the second direction Z in function of the detected thickness of the workpiece 6, said armature 60 varies a value of electric capacity between the armature 60 and the further armature 65.

[0116] Each capacitive sensor 54 is arranged for controlling a respective presser 3 of the pad 2.

[0117] In other words, the further detecting barrier 53 has a number of capacitive sensors 54 equal to the number of pressers 3.

[0118] In this way, each presser 3 is controlled by the corresponding wheel 56 facing said presser 3 along the first axis X.

[0119] When a workpiece 6 passes under the further detecting barrier 53 each wheel 56 contacts the workpiece 6 and moves along the second direction Z in function of the detected thickness.

[0120] In this way, the rod 57 and thus the armature 60 associated with said rod 57 move with respect to the further fixed armature 65, which varies the respective capacity value.

[0121] At this point, the capacitive sensors 54 send a signal of variation of the capacity value corresponding to a detected vertical displacement, to further electromagnetic driving means having a pulse width modulation cycle 100'.

[0122] The further electromagnetic driving means having a pulse width modulation cycle 100' comprises a further input electronic board 67, a further programmable logic controller 70, or PLC, and a further output electronic board 69.

[0123] The further input electronic board 67 receives the signal from the capacitive sensors 54 and transmits it to the further PLC 70.

[0124] The further PLC 70 processes the signal coming from the capacitive sensors 54 and a further advancing signal of the conveyor belt 5 sent by a further encoder 68, and transmits such signals to the further output electronic board 69 that elaborates for each received signal the corresponding PWM cycle for driving the respective electric valve 35.

[0125] In this way, the further electromagnetic driving means having a pulse width modulation cycle 100' controls the electric valve 35 in such a manner that, in function of the detected vertical displacement and thus of the variation of the capacity value, a further working pressure P4 correspondingly operates in the cylindrical chamber 40 of the respective presser 3.

[0126] Such further working pressure P4 is comprised in a range of values defined by a minimum value and a maximum value determined during the calibrating phase of the sanding machine 4 before the working cycle starts.

[0127] It is to be noted that the further PLC 70 is also provided with software capable of distinguishing the pressers 3 positioned near the edge 51 of the workpiece 6, from the pressers 3 positioned in an internal portion of the workpiece 6.

[0128] In this way, at equal vertical displacement of the feeler pin 55, the further working pressure P4 induced on the pressers 3 positioned near the edge 51 of the workpiece 6 is anyway lower than the further working pressure P4 exerted on the pressers 3 positioned in an internal portion of the workpiece 6.

[0129] It is to be noted that the slide 9 of each actuator 11 moves independently from the others, each actuator 11 being actuated by a further working pressure P4 adapted to the thickness of the corresponding portion of workpiece 6.

[0130] It is to be noted that in this version of the invention, a range of working pressures is available for use.

[0131] That enables the pressers 3 to modulate even more the contact pressure on the workpiece 6 with respect to the known devices.

[0132] As in the previous case, during machining and before machining is started, the actuator 11 is evenly stressed by the counter-pressure CP opposed to the further working pressure P4.

[0133] The operation of the counter-pressure CP is substantially similar to what previously described and for this reason is not disclosed in the following.

Claims

1. Driving device for pressing means (3) of a sanding machine (4), said pressing means (3) being arranged for exerting a working pressure (P3) on a workpiece (6), said driving device comprising pneumatic actuator means (11) associated with said pressing means (3), electric valve means (35) arranged for inducing said working pressure (P3) on said pneumatic actuator means (11) and electromagnetic driving means arranged for driving said electric valve means (35), **characterized in that** said electromagnetic driving means is electromagnetic driving means having a pulse width modulation cycle (100; 100').

2. Device according to claim 1, wherein said electromagnetic driving means having a pulse width modulation cycle (100; 100') is driven with a pulse frequency higher than or equal to 40 Hz.

3. Device according to claim 1, wherein said electromagnetic driving means having a pulse width modulation cycle (100; 100') is driven with a pulse frequency substantially equal to 100 Hz.

4. Device according to any preceding claim, wherein said electromagnetic driving means having a pulse width modulation cycle (100; 100') is controlled by a signal detected by detecting barrier means (43; 53) arranged for detecting said workpiece (6).

5. Device according to claim 4, wherein said detecting barrier means (43; 53) is operatively positioned above said workpiece (6) and upstream of said pressing means (3), with respect to an advancing direction (A) of said workpiece (6).

6. Device according to claim 4, or 5, wherein said detecting barrier means (43; 53) comprises feeler pin means (55) arranged for contacting said workpiece (6).

7. Device according to claim 6, wherein said feeler pin means (55) is movable along a substantially vertical axis (Z).

8. Device according to any one of claims 4 to 7, wherein said detecting barrier means (43; 53) comprises digital barrier means (43) arranged for detecting a size of said workpiece (6), said size being transversal with respect to said advancing direction (A).

9. Device according to claim 8, wherein said digital barrier means (43) comprises sensor means (44).

10. Device according any one of claims 4 to 7, wherein said detecting barrier means (43; 53) comprises analog barrier means (53) arranged for detecting a thickness variation of said workpiece (6).

11. Device according to claim 10, wherein said analog barrier means (53) comprises capacitive position sensor means (54).

12. Device according to claim 11, wherein said capacitive position sensor means (54) is provided with armature means (60) associated with said feeler pin means (54).

13. Device according to claim 12, as claim 8 is appended to claim 7 and claim 10 is appended to claim 8 or 9, wherein said capacitive position sensor means (54) comprises further armature means (65) fixed with respect to said axis (Z) and arranged for interacting with said armature means (60).

14. Device according to any preceding claim, wherein said electric valve means comprises an electric valve (35) arranged for inducing said working pressure (P3) on surface means (39) of said pneumatic actuator means (11) for moving said pneumatic actuator means (11) near to said workpiece (6).

15. Device according to claim 14, wherein said electric valve (35) is received in a seat of a valve-holder body

(51).

16. Device according to claim 15, wherein said valve-holder body (51) has duct means (80, 81) communicating with said electric valve (35).

17. Device according to claim 16, wherein said duct means (80, 81) comprises an inlet duct (80) arranged for pouring in a pressurized fluid in said electric valve (35) and an outlet duct (81) arranged for pouring out said pressurized fluid of said electric valve (35).

18. Device according to any one of claims 5 to 17, as claims 6 to 14 are appended to claim 5, wherein said pressing means (3) comprises pressure chamber means extending along a substantially transversal direction with respect to said advancing direction (A), said pressure chamber means comprising chambers (13, 14) mutually independent and arranged substantially near to each other.

19. Device according to claim 18, wherein said chambers (13, 14) comprise a pressure chamber (14) and a counter-pressure chamber (13).

20. Device according to claim 19, as claim 18 is appended to claim 17, wherein said pressure chamber (14) communicates with said inlet duct (80) through first duct means (36).

21. Device according to any one of claims 17 to 20, as claim 18 is appended to claim 17, wherein said pressing means (3) comprises second duct means (38) arranged for putting in communication said outlet duct (81) with said pneumatic actuator means (11).

22. Device according to any one of claims 19 to 21, as claim 21 is appended to claim 19, or 10, wherein said pressure chamber (14) and said counter-pressure chamber (13) are obtained inside crosspiece means (12) supporting said pneumatic actuator means (11), and are arranged substantially above each other.

23. Device according to claim 22, wherein between said pneumatic actuator means (11) and said crosspiece means (12) housing means (15) is interposed.

24. Device according to claim 23, wherein said housing means comprises liner means (16).

25. Device according to any one of claims 22 to 24, wherein said pressing means (3) comprises counter-pressure means arranged for inducing a counter-pressure (CP) on first annular chamber means (29) communicating with second annular chamber means (30), said first annular chamber means (29) and said second annular chamber means (30) being obtained between said pneumatic actuator means (11) and said crosspiece means (12) for moving said pneumatic actuator means (11) away from said workpiece (6).

26. Device according to any one of claims 7 to 25, as claims 8 to 18 are appended to claim 7, wherein said pneumatic actuator means comprises an actuator (11) substantially cylindrical extending and moving along said axis (Z).

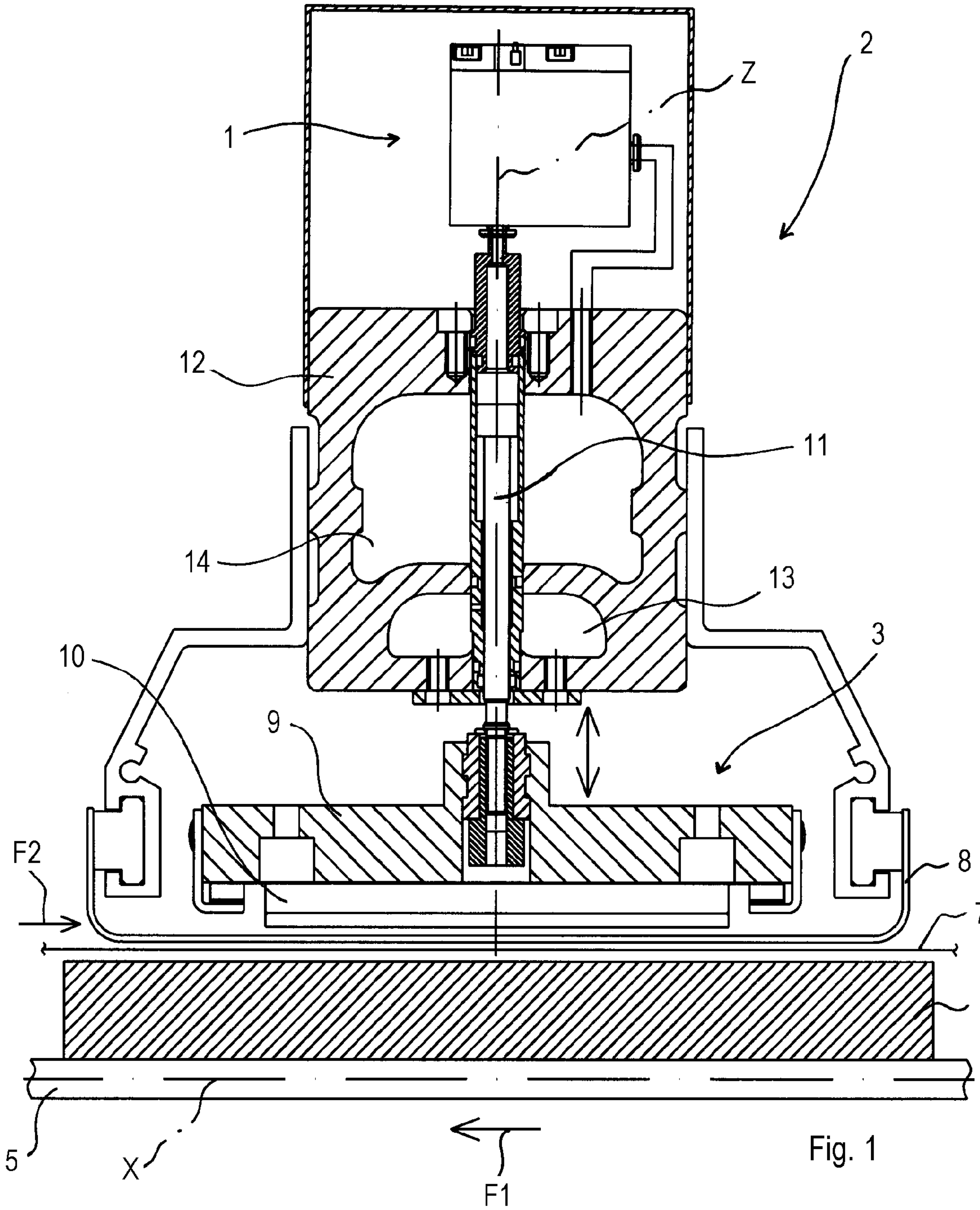

Fig. 1

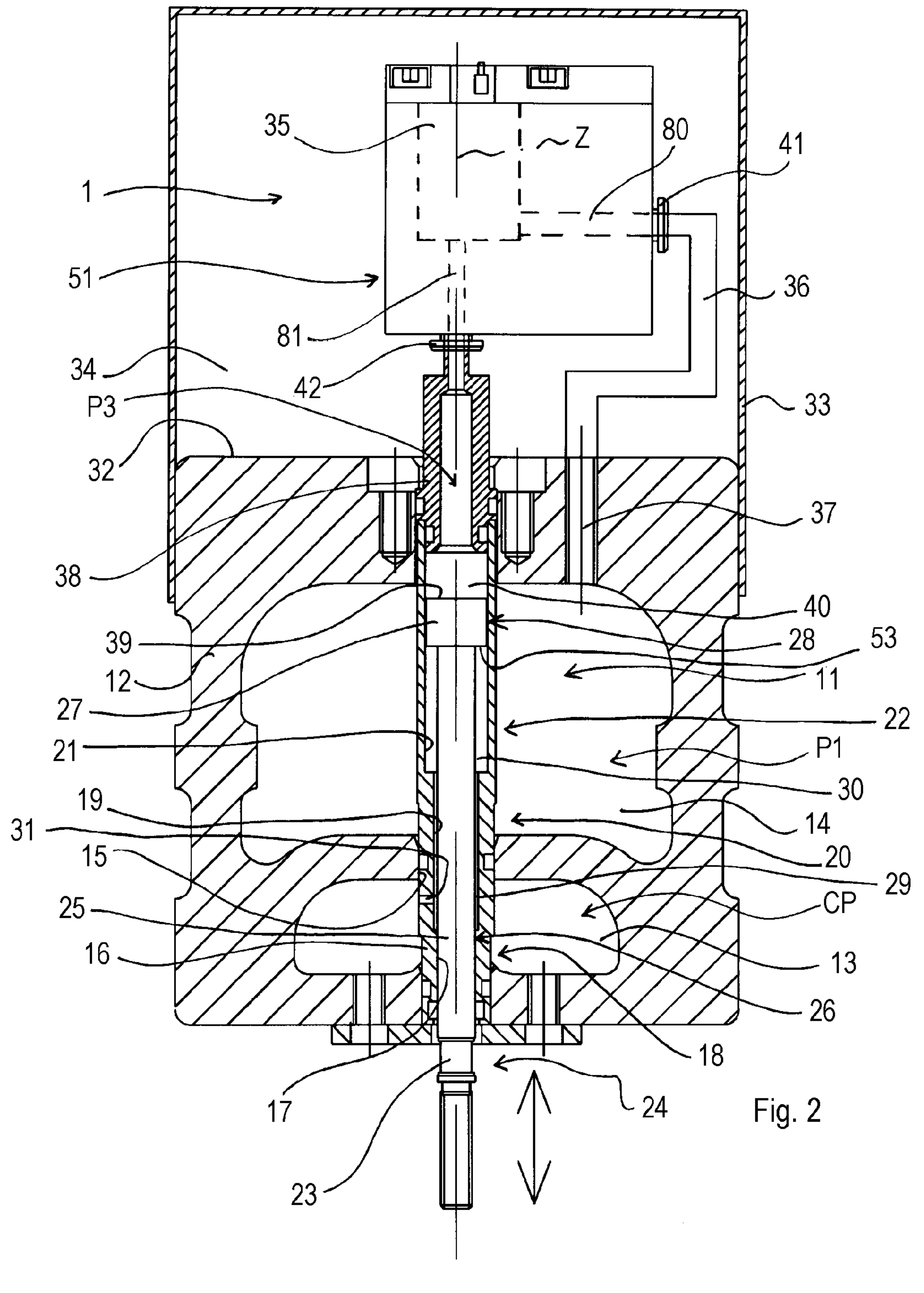
35
Z
80
41
1
51
36
81
34
42
33
P3
32
37
38
40
39
28
53
12
11
27
22
21
P1
30
19
14
31
20
15
29
25
CP
16
13
26
18
17
24
23

Fig. 2

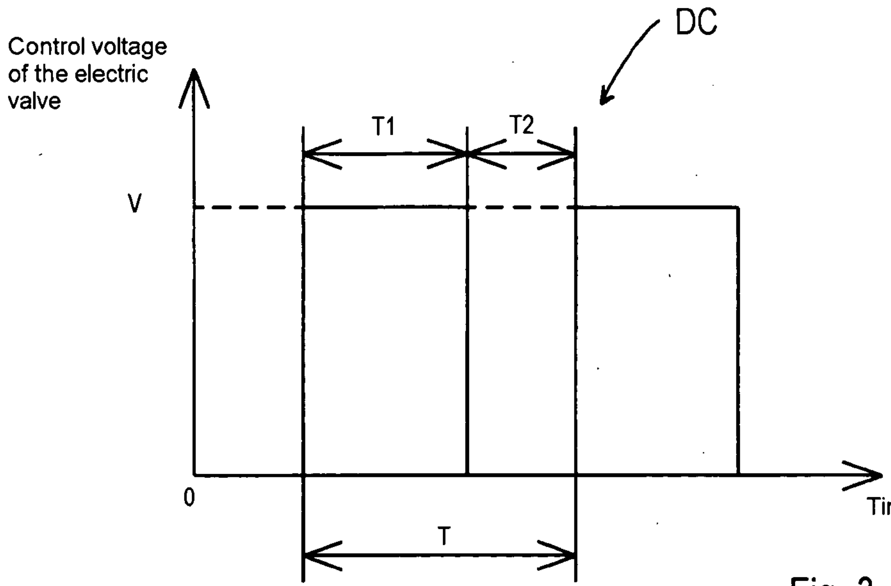
DC
Control voltage of the electric valve
T1
T2
V
0
Time
T

Fig. 3

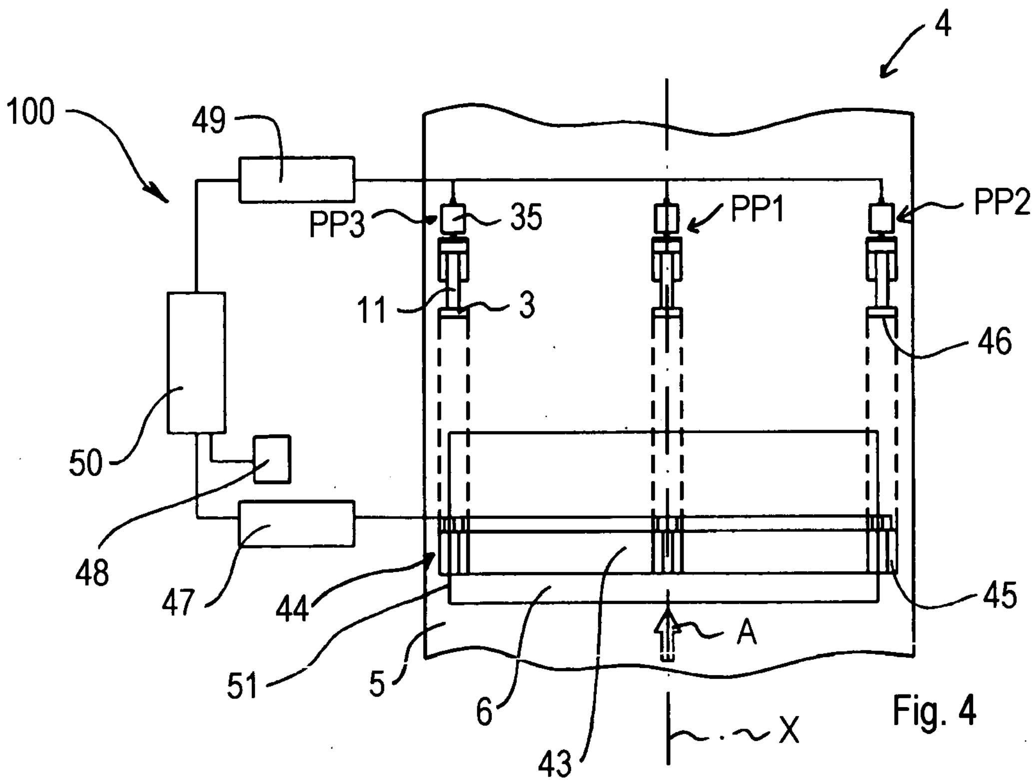
4
100
49
PP3
35
PP1
PP2
11
3
46
50
48
47
44
45
A
51
5
6
43
X

Fig. 4

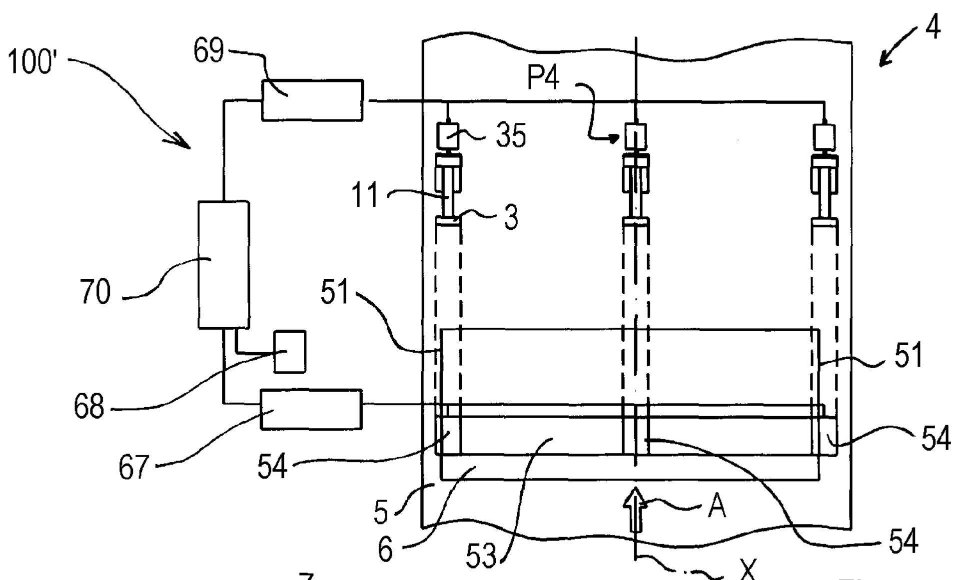

Fig. 5

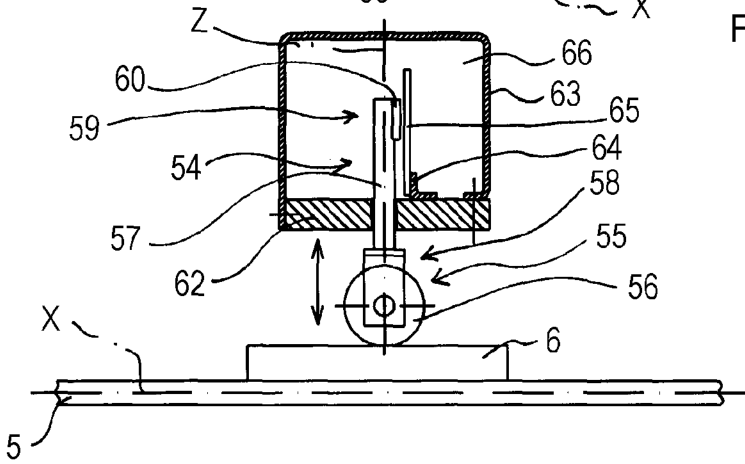

Fig. 6

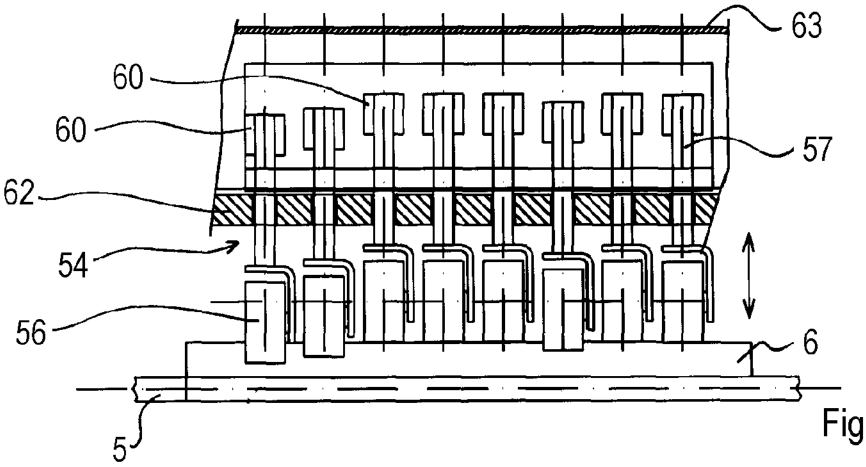

Fig. 7