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(54) A sanding machine for timber boards.

(57) Each of the single pressure pads (6) in a wide belt sander is supported and controlled in operation by means of an electromagnet assembly (E) comprising a vertically disposed rod (10) made fast at one end to the pad (6) and rigidly associated at centre with a permanent magnetic (12) of annular shape. The top and bottom ends of the rod are accommodated freely and coaxially, and therefore slidably, in a pair of fixed solenoids (13, 14) through which two currents are passed in opposite directions in such a way as to generate corresponding magnetic fields ; the polarities at the two ends (13a-13b, 14a-14b) of the solenoids are respectively opposite, so that with like polarities between each annular surface (12a-12b) of the permanent magnet (12) and the corresponding surface (13a, 14a) of each solenoid, the permanent magnet is poised between respective repulsion forces (F, F1) of which the value can be modulated by a sensing and control facility (20, 26, 25) governing the current input to the two solenoids (13, 14).

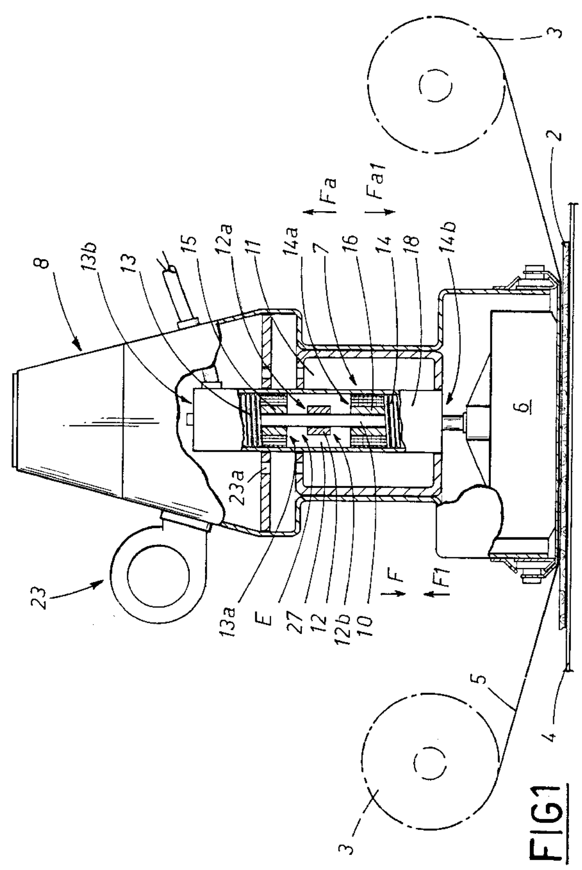

FIG1

EP 0 484 303 A1

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The present invention relates to a sanding machine for timber boards.

Machines of the type in question, known generally as wide belt sanders, consist essentially in a longitudinally extending conveyor table on which stock for sanding (boards, panels) is fed through, and above the table, sanding means consisting in a set of rolls with mutually parallel axes disposed at right angles to the table, and an abrasive belt looped around the rolls; the rolls are subject directly or indirectly to the action of fluid power cylinders in such a way as to tension the belt loop (the machine may be equipped with a number of such sets of rolls for a corresponding number of belts arranged in succession along the feed direction). The machine is equipped further with pressure means impinging on a portion of the abrasive belt loop, generally between two successive rolls positioned immediately above the conveyor table, in such a way as to urge the belt toward the table. Such pressure means therefore serve to control the smoothness ultimately obtainable by determining a more or less intense abrasive action, and to render the finish uniform over the entire expanse of the work, even work exhibiting roughness or different thicknesses. Means of this type consist generally in an actuator (such as a pneumatic cylinder), operating a pad through which pressure is applied to the abrasive belt. Naturally, the machine will be fitted with a plurality of such actuators and pads arranged one beside another (the effective number determined by the width of the abrasive belt) and functioning much in the manner of a keyboard instrument, in that each pad and actuator assembly is piloted by a relative control (e.g. a solenoid valve) to move between what are essentially operating and at-rest limit positions, respectively in contact with and distanced from the belt. Clearly enough, the type of construction in question is adversely affected by defects inherent in the pneumatic systems which occasion difficulties in modulating the abrasive force to suit sanding requirements, and a sometimes slow response.

The pad and actuator assembly is mounted to a beam positioned above the abrasive belt and between the tension rolls, generally at right angles to the longitudinal axis of the conveyor table, and made fast in turn to the main frame of the sander.

In effect, the sanding operation performed by such a machine begins when the board advancing along the conveyor table encounters an array of transducers disposed transversely above the table, serving to establish the width and length of the board, and if appropriate a first thickness. These transducers are wired into a central control unit by which the descent and/or ascent of the various pad-actuator assemblies (the actuators are usually single acting and spring returned in operation) is governed on the basis of the information generated following the interaction of the board with the transducers, which obviously will reflect the dimensions of the incoming work. The same control unit also measures the distance from the array of transducers to each beam carrying a battery of the pad assemblies. Thus, in an arrangement of this type, the central control unit seeks to optimize the position of the individual pad-actuator assemblies (hence of the abrasive belt), for instance to the end of avoiding that the side edges of the board become rounded by the sanding action.

Conversely, however, the main drawback presented by machines of the type in question is their inability to provide a fully controlled sanding action suited to any type of board. Such control is possible only if the actual pressure of the pads on the advancing board can be adjusted, especially when the cross sectional profile of the board exhibits parts of different thickness, whereas the pneumatic systems widely in use are essentially on/off in operation and thus will not allow of modulating pressure on the abrasive belt (unless adapted at considerable expense).

Accordingly, the object of the present invention is to overcome the drawback in question through the embodiment of a wide belt sander equipped with a system of controlling several pad-and-actuator assemblies in such a manner as to generate and maintain a constant sanding pressure on work fed through the machine, and at the same time afford a real time and continuous adjustment of the pressure thus generated, according to the external profile of the individual board.

The stated object is realized in a sanding machine as characterized in the appended claims, in which each single pressure pad is associated with support and control means that comprise an electromagnet affording a vertical rod slidably accommodated in a relative seating and made fast at one end to the corresponding pad. The rod is ensheathed by and rigidly associated with a central annular element of permanent magnetic material, and accommodated freely and slidably at the opposite ends within a pair of fixed solenoids through which currents are passed in mutually opposite directions in such a way as to set up corresponding magnetic fields of opposite polarity at the ends of the two solenoids; the end of each solenoid facing the central annular element is of like polarity to the corresponding base surface of the annular element itself, and the resulting repulsion forces induced on either side of the annular element are modulated by sensing, monitoring and control means to which the values of the currents directed through the solenoids are interlocked.

A particular advantage of the invention, stemming from the fact that the support and control means of the single pad are embodied as an electromagnet, is that upstream means of control can be utilized to pilot an adjustment of the pressure of the pads on the abrasive belt in real time and with precision, to suit the profile of the board or panel being sanded.

The invention will now be described in detail, by way of example, with the aid of the accompanying drawings, in which:

– fig 1 shows a pressure pad assembly in the sanding machine according to the invention, illustrated in side elevation with certain parts omitted better to reveal others;

– fig 2 illustrates an alternative embodiment of the pressure pad assembly shown in fig 1, likewise in side elevation with certain parts omitted better to reveal others;

– fig 3 is a side elevation affording a schematic illustration of the sanding machine according to the present invention, in its entirety;

– fig 4 illustrates a further alternative embodiment of the pressure pad assembly shown in fig 1, again in side elevation with certain parts omitted better to reveal others.

Referring to the drawings, a machine according to the invention comprises at least one head 1, shown in its entirety in fig 1, for sanding timber panels or boards 2; such a head comprises a set of rolls 3 (three, in the example illustrated), disposed with axes mutually parallel and mounted transversely above a conveyor table 4 on which the boards 2 are fed through the machine, and a length of abrasive belt material 5 looped around and tensioned by the three rolls 3.

6 denotes a pressure pad positioned between the two bottom rolls 3 of the set, which ride close to the conveyor table 4 at successive points along the feed direction; the head 1 comprises a plurality of such pads 6 disposed one beside the next along an axis parallel to the longitudinal dimension of the rolls 3 and in sliding contact with the reverse side of the abrasive belt 5, i.e. the side opposite from the grit face offered to the board 2.

The pressure pads 6 are suspended from and operated by respective support and control means 7 mounted to a cross beam 8; such means 7 are dynamically independent in operation one from another such that the individual pads 6 can be drawn closer to and distanced from the conveyor table 4, and piloted by sensing, monitoring and control means 9 (fig 3) to be described in due course.

In the example of figs 1 and 2 in particular, and according to the invention, each of the support and control means 7 consists in an electromagnet E with a central vertically disposed rod 10 accommodated in a relative seating 11 afforded by the beam 8. The bottom end of the rod 10 is made fast to the corresponding pad 6, whilst the middle section is ensheathed by a rigidly associated element 12 of annular embodiment fashioned in permanent magnetic (or ferromagnetic) material. The annular element 12 is flanked on either hand by a first and a second fixed solenoid 13 and 14 respectively, the first positioned above and the second below the annular element 12, for the purposes of the description; each fixed solenoid 13 and 14 ensheaths a relative annular element 15 and 16 of ferromagnetic material freely and coaxially associated with the rod 10, such that the rod is able to slide back and forth. The resulting coil assemblies, i.e. solenoids 13 and 14 and ferromagnetic annular cores 15 and 16, are fixed in relation to the rod 10 and set apart one from the other at a distance such as to compass the full stroke of the rod toward and away from the conveyor table 4.

The entire electromagnet assembly E is accommodated internally of a cylinder or barrel 18 fashioned from diamagnetic material and exhibiting a shape complementary to that of the seating 11 afforded by the beam 8, which provides a protective casing around the space accommodating the movement of the annular element 12, i.e. the gap 27 (of which the height corresponds in effect to the stroke of the rod 10) in such a way that magnetic permeability is maintained constant in the space in question.

To advantage, the annular element 12 might consist in a third solenoid 17 encompassing a respective third ferromagnetic annular element 17a rigidly ensheathing the rod 10; the current flowing through such a third solenoid 17 will be of constant value. In the example illustrated, the sensing, monitoring and control means 9 aforementioned consist in a plurality of transducers 20, e.g. voltage dividers or potentiometers, arrayed transversely to the advancing board 2 and preceding the electromagnet assemblies E in the feed direction. The function of these transducers 20 is to intercept each incoming board 2, and thus to generate individual voltage signals of which the value is proportional to the thickness of the work registering moment by moment. The outputs from the transducers 20 are connected (see fig 3) to an analog-digital converter 24, connected further to the input of an electronic processor 25 of which the output is connected in turn to the electromagnets E. The processor 25 is also in receipt of the input signals from further transducers 26 (analog or digital sensing elements) serving to monitor the displacement of the board 2, and thus is able to pilot the operation of the electromagnets E on the basis both of dimensional information received from the first transducers 20, and of the distance between these same transducers and the electromagnets E, i.e. that monitored by the displacement transducers 26.

The electromagnets E are energized by passing currents through the first and second solenoids 13 and 14 in opposite directions, in such a way as to generate and sustain corresponding magnetic fields of which the polarities at the two ends 13a-13b and 14a-14b of the coils are respectively opposed; the ferromagnetic element or core 15 and 16 associated with each of the first and second solenoids 13 and 14 then magnetizes by induction, thereby enhancing the electrically generated field.

Thus, with the central annular element 12 embodied as a permanent magnet, or as a third solenoid 17, and/or with currents directed through the first and second solenoid 13 and 14 in such a way that like polarities are induced in the base surfaces 12a and 12b of the central element 12 and the corresponding ends of the two solenoids 13 and 14 (denoted 13a and 14a in the example illustrated), the effect is to produce repulsion forces F and F1 proportional to the strength of the current passing through each solenoid 13 and 14 and to the distance between the core 15 or 16 and the central annular element 12; such forces increase, clearly enough, as this same distance decreases.

The procedure whereby the single electromagnets E and the relative pressure pads 6 are set in motion may be summarized thus: departing from a centred or intermediate position with the annular element 12 or third solenoid 17 balanced, which is produced by directing currents of opposite direction but equal strength through the first and second solenoids 13 and 14, the rod 10 is made to descend (that is, to shift the pad 6 into the operating position) simply by increasing the strength of the current directed through the upper solenoid 13; thus, recalling the configuration of the magnetic fields, the repulsion force F of the first solenoid 13 becomes greater than the opposing repulsion force F1 of the second solenoid 14. The system stays dynamically balanced even in this situation, however, since the opposing repulsion force F1 increases as clearance between the relative solenoid 14 and the central element 12 or 17 decreases, to the point at which the system finds a new balance that is a function of the two opposite forces F and F1. Naturally, the decreased or increased strength of currents flowing through the solenoids 13 and 14 is selected and controlled by the processor 25 commensurately with the values (i.e. voltages) received from the potentiometers 20 as determined by the thickness of each incoming board 2 encountered.

To cause the rod 10 to reascend, it suffices to reduce current through the upper solenoid 13 to a value equal to the original energizing value, and at the same time to begin increasing that through the lower solenoid 14 to the point at which the central annular element 12 or third solenoid 17 returns to the position occupied initially; in short, the procedure described above is reversed. The entire electromagnet assembly E will of course be provided with ventilation means, denoted 23 in the drawings, which act directly or indirectly on the solenoids 13 and 14 (for example a fan unit mounted direct to the cross beam 8). To this end, the beam 8 affords passages 23a and 23b directed toward the fan unit 23, through which air can be ducted to the required location.

The option also exists of adopting an attraction system to operate the rods, likewise utilizing the components described thus far.

In this instance, the first and second solenoids 13 and 14 carry currents of opposite direction such as will generate two corresponding magnetic fields of unlike polarity in relation both one to another and each to the respective base surface 12b and 12b of the central annular element 12. The effect is to induce an attraction force Fa and Fa1 proportional to the strength of the current passing through the solenoid 13 and 14 and to the distance between the core 15 and 16 and the central annular element 12, which obviously will increase as this same distance decreases.

The procedure whereby the processor 25 activates the electromagnets E and pressure pads 6 may be summarized thus: departing from the same centred position with the first and second solenoids 13 and 14 carrying currents of opposite direction and equal strength and the annular element 12 or third solenoid 17 balanced, the rod 10 is made to descend by increasing the strength of the current directed through the lower solenoid 14; thus, by reason of the magnetic field configuration described above, the attraction force F1a of the lower solenoid 14 exceeds the opposing attraction force Fa of the upper solenoid 13.

To cause the rod 10 to reascend, it suffices to reduce current through the lower solenoid 14 to a value equal to the original energizing value, and at the same time to begin increasing that through the upper solenoid 13, continuing to the point at which the annular element 12 or third solenoid 17 returns to the position occupied initially.

A further solution (see fig 4) might employ mixed electromagnetic and mechanical means comprising a solenoid 13 as already described, i.e. positioned above the annular element 12, and a spring 28 coaxially ensheathing the part of the rod 10 below the annular element. The spring 28 is thus retained at one end by the annular element 12, and at the remaining end by the bottom of the seating 11, or in effect by the end wall of the barrel 18.

Thus, an increase in the strength of the current directed through the solenoid 13 has the effect of displacing the annular element 12 (hence the rod 10 also) in the direction denoted F, by repulsion, with the result that the spring 28 is compressed between the annular element 12 and the bottom of the seating 11. A return to the former position is brought about as the spring 28 expands in response to a weakening of the repulsion force F induced by the solenoid 13.

Claims

1) A sanding machine for timber boards, comprising at least one sanding head (1) consisting substantially in a set of rolls (3) with parallel axes disposed transversely and above a conveyor table (4), and an abrasive belt (5) looped around and tensioned by the rolls, wherein the space between at least two successive rolls (3) riding close to the table (4) is occupied

by a plurality of pressure pads (6), disposed one beside the next along an axis parallel with the longitudinal axis of the rolls (3) and offered in sliding contact to the reverse side of the abrasive belt (5), each capable of movement toward and away from the conveyor table (4) through the agency of associated support and control means (7) mounted to a beam (8), dynamically independent one from another and interlocked in operation to sensing, monitoring and control means (9), characterized
in that each of the support and control means (7) consists in an electromagnet (E) comprising:

– a central rod (10) slidable vertically within and in sealed association with a relative seating (11) afforded by the beam (8), of which the bottom end is made fast to the relative pressure pad (6) and a substantially central portion is ensheathed by a rigidly associated annular element (12) fashioned from permanent magnetic material;

– a pair of fixed solenoids (13, 14), each wound around a corresponding fixed annular element or core (15, 16) of ferromagnetic material freely and coaxially ensheathing the rod (10), positioned on opposite sides of the annular element (12) and set apart one from the other at a distance such as to compass the full stroke of the rod toward and away from the conveyor table, through which respective currents are passed in opposite directions so as to generate and sustain corresponding magnetic fields of which the polarities at the two ends (13a-13b, 14a-14b) of the solenoids (13, 14) are respectively opposite, thereby obtaining like polarities between each base surface (12a, 12b) of the permanently magnetic annular element (12) and the corresponding end (13a, 14a) of each solenoid, and inducing two respective repulsion forces (F, F1) to which the annular element (12) is exposed on either side; and in that sensing, monitoring and control means (9) comprise a plurality of transducers (20) positioned to intercept the incoming board (2), by which respective output voltage signals proportional in value to the thickness of the board are generated and relayed to an electronic processor (25) capable of controlling the value of the currents directed through the solenoids (13, 14) in proportion to the voltage signals received from the transducers (20), and thus of modulating the value of the repulsion forces (F, F1) according to the thickness of the board as sensed by the transducers.

2) A sanding machine as in claim 1, wherein sensing, monitoring and control means (9) further comprise an analog-digital converter (24) in receipt of the signals from the thickness transducers (20), and transducers (26) serving to sense the displacement of the board (2), both of which connected to the input of the electronic processor (25), in such a way that the electromagnets (E) can be activated by the processor according to the signal received from the displacement transducers (26), hence to the distance between the transducers (20) and the electromagnets (E).

3) A sanding machine as in claim 1, wherein currents are passed through the solenoids (13, 14) of the electromagnet (E) in opposite directions in such a manner as to generate and sustain corresponding magnetic fields of which the polarities at the two ends (13a-13b, 14a-14b) of the solenoids (13, 14) are respectively opposite, thereby obtaining unlike polarities between each base surface (12a, 12b) of the permanently magnetic annular element (12) and the corresponding end (13a, 14a) of each solenoid, and inducing two respective attraction forces (F, F1) to which the annular element (12) is exposed on either side.

4) A sanding machine as in claim 1, wherein the rod (10) is ensheathed by and rigidly associated with an annular element (12) embodied in ferromagnetic material.

5) A sanding machine as in claim 1, wherein support and control means (7) comprise a substantially central third solenoid (17) wound around an annular element (17a) of ferromagnetic material ensheathing and rigidly associated with the rod (10), through which a current of constant value is directed.

6) A sanding machine as in claim 1, wherein the electromagnet (E) is accommodated internally of a protective element (18) embodied in diamagnetic material shielding at least the manoeuvring space or gap (27) of the annular element (12) in such a way as to maintain a constant magnetic permeability within the space, and associated with ventilation means (23) acting directly or indirectly on the solenoids (13, 14) to the end of maintaining the operating temperature of the electromagnet at a constant value.

7) A sanding machine as in claim 1, wherein each of the support and control means (7) consists in an electromagnet (E) comprising:

– a central rod (10) slidable vertically within and in sealed association with a relative seating (11) afforded by the beam (8), of which the bottom end is made fast to the relative pressure pad (6) and a substantially central portion is ensheathed by a rigidly associated annular element (12) fashioned from permanent magnetic material;

– a fixed solenoid (13) positioned above the annular element (12), wound around a corresponding fixed annular element or core (15) in ferromagnetic material freely and coaxially ensheathing the rod (10), and set apart from the annular element (12) at a distance fully compassing the stroke of the rod toward and away from the conveyor table (4), through which current is passed in a direction such as to generate and sustain a magnetic field of which the polarity at the end (13a) of the solenoid (13) directed toward the permanent magnetic annular element (12) is the same as the polarity of the corresponding base surface (12a) of the annular element, thereby inducing a repulsion force (F) to which the annular element (12) is exposed on one side;

– a spring (28) coaxially ensheathing the rod (10) on the side of the annular element (12) opposite to the solenoid (13), retained at the one end by the annular element (12) and at the remaining end by the bottom end of the seating (11), of which the function is to return the rod (10) elastically in response to a weakening of the repulsion force (F) induced by the solenoid (13).

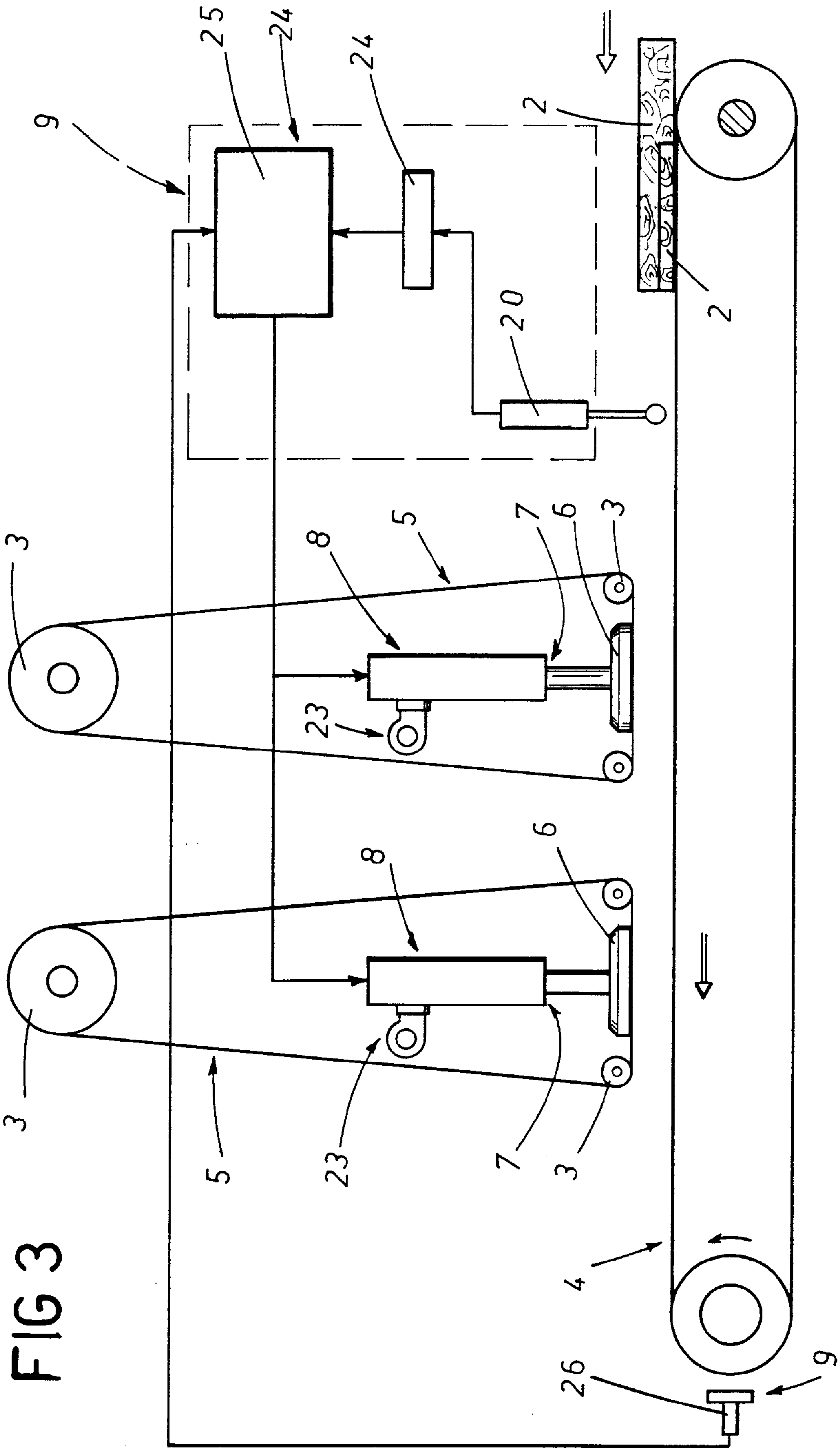

FIG 3

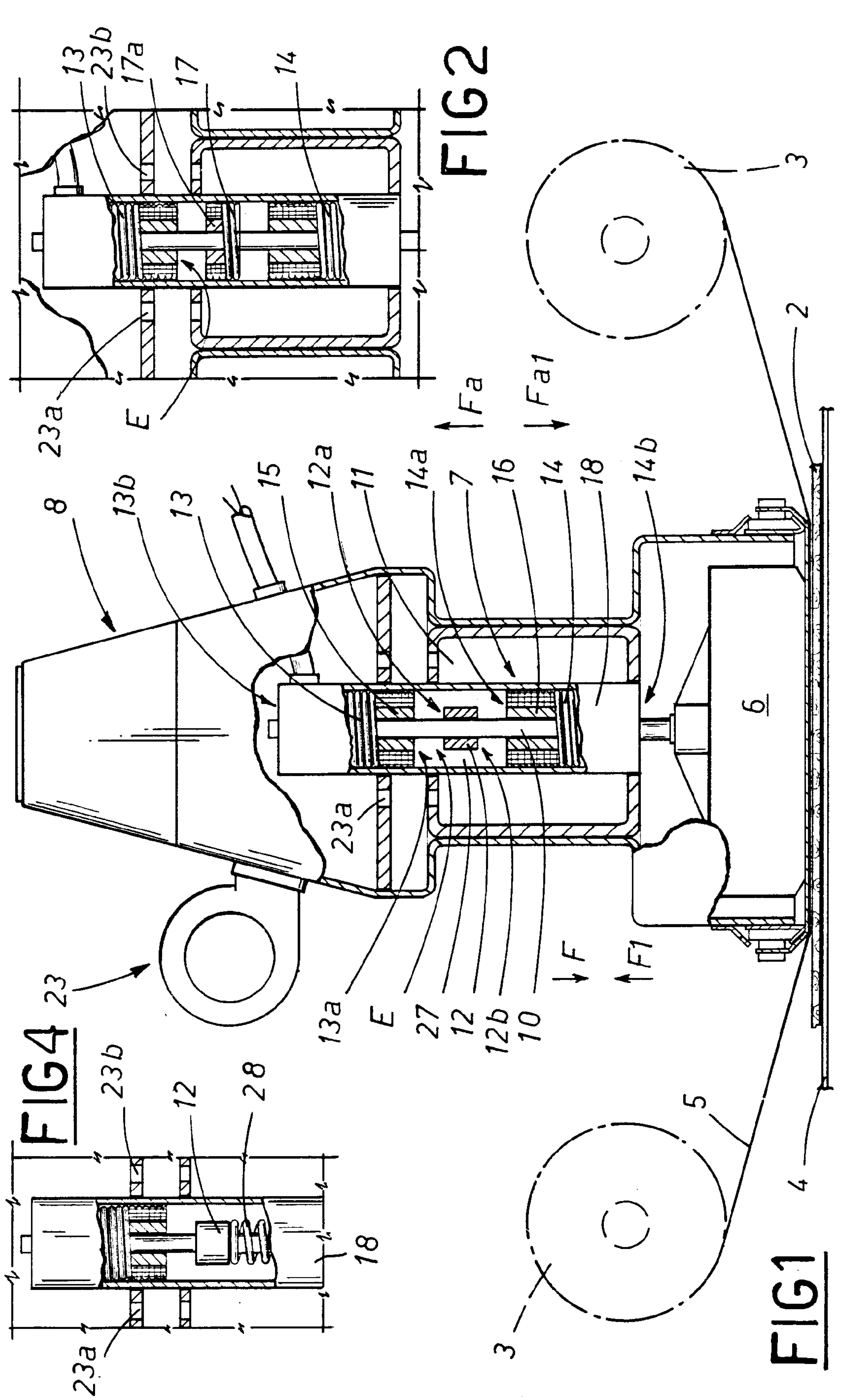

FIG1 FIG2 FIG4

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EUROPEAN SEARCH REPORT

Application Number

EP 91 83 0478

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-4 527 359 (STUMP ET AL.) * claims; figures * ---	1	B24B21/08
A	US-A-4 835 503 (EVERETT) * abstract * ---	1	
A	FR-A-2 460 533 (S.A. DES EQUIPEMENTS S.E.I.M.) * claim 1; figures * -----	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)
B24B H01F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 FEBRUARY 1992	ESCHBACH D.P.M.

CATEGORY OF CITED DOCUMENTS

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