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(54) IMPROVEMENTS IN OR RELATING TO WOODWORKING MACHINES

(71) We, BEKAERT ENGINEERING a corporate body organised under the laws of Belgium of Leo Bekaetstraat 1, 8550 Zwevegem, Belgium, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the shaping and finishing by machine of planar workpieces of wood and similar materials, such as plastics, fibreboard and chipboard.

Known machines for this purpose have a number of disadvantages which render the production of components for the furniture industry very expensive: for instance:—

(a) The workpieces move only in one plane perpendicular to the feed direction of the workpiece so that the leading and trailing edges of the workpiece have to be finished separately;

(b) The driving is by means of carrier hooks on a block chain; due to the movability of the chain links, vibrations are generated by the impact resistance against the cutting tools which leads to damage to the workpiece;

(c) The guiding support, template and workpiece must first of all be clamped to each other in a frame or on a trolley which must be dismantled again afterwords;

(d) The absence of a return conveyor requires operating personnel at both ends of the machine; the next operation can only be started when the foregoing cycle is completely finished;

(e) The use of a machine bed with two block-chains results in irregular finishing because these chains deform unequally under the influence of strain and lateral forces.

According to the invention there is provided a method of shaping and finishing at least a part of the periphery of a planar workpiece of wood or similar material including the steps of mounting the workpiece and a template on a carrier block, engaging said block with a conveyor chain and drawing said carrier block along a machine bed through a shaping stage whereat the workpiece is shaped by at least one pivotally mounted material removing shaping tool in accordance with the template, further drawing said carrier block through a finishing stage whereat the workpiece is sanded by at least one pivotally mounted sanding device, pressing and maintaining said workpiece on said carrier block by a plurality of overlying rollers during passage through said shaping and finishing stages and returning said carrier block to the input region of the machine.

Viewed from another aspect the invention provides a machine for shaping and finishing workpieces of wood or similar material comprising a machine bed, a carrier block adapted to be drawn along said machine bed from an input region to an end region of the machine, said block being adapted to receive thereon a template and a workpiece, at least one pivotally mounted material removing shaping tool adapted to shape the workpiece as it passes thereby in accordance with said template, at least one pivotally mounted sanding device adapted to finish the workpiece after shaping, a plurality of overlying rollers adapted to press and maintain the workpiece on the carrier block as it passes through said shaping and finishing stages, and a conveyor for returning a finished workpiece from said end region to the input region of the machine.

In order that the invention may be readily understood an embodiment thereof will now be described by way of example with reference to the accompanying drawings in which:—

Fig. 1 is a perspective view of a carrier block;

Fig. 2 is a view of a catch at the underside of the guiding support;

Fig. 3 is a sectional view of the carrier block;

Fig. 4 is a perspective overall view of the main components in the machine bed;

Fig. 5 is a schematic view of a set up of the different operations.

In the maching operation, a workpiece mounted on a carrier block as shown in Fig. 1 is passed through the machine.

The carrier block 1 is made of a strong material, such as plywood, aluminium or

similar material and is provided with a template 2 which will be copied in the machine.

The workpiece 3 is placed on this template whereby both template and workpiece abut to a nose piece 4 preferably made of wood to avoid damage of the cutting tools. With some precautions this nose piece 4 may be omitted to be able to machine the workpiece around its complete periphery. For attaching and positioning the whole, the carrier block is provided on the underside and on the centre axis with at least one and preferably two catches 5 which may engage with the slat and chain belt, see Fig. 2. If one of these catches is omitted, the guiding support itself may serve as guide between the ridges of the machine bed. Fig. 2 shows a slot 6 at the underside of the guiding support 1, which comprises certain interruptions 7 which acts as an actuator for the automatic speed adjustment of the slat and chain belt which will be further described.

The sectional view of Fig. 3 shows that these catches 5 have an oblique profile 9 to activate certain contacts selectively. At the upperside of the carrier block, the nose piece 4 and template 2 are fixedly attached by means of bolts 10. The workpiece 3 lies freely thereon and may even show a slight curvature at the upperside 11. In some cases the template 2 may also lie loosely on the guiding support.

Figure 4 is a perspective view of the structure of the machine.

The machine is composed of a frame 12 to which are attached fixedly the different components. The bottom of the machine bed 13 comprises a number of freely running bearing rollers 14 forming the conveyor surface and which support the carrier block moving in the direction indicated by an arrow. Catches 15 are activated (only one of which is shown) by the carrier block when the latter passes over them. A central slot 16 in the machine bed guides a slat and chain belt 17 whose apertures are adapted to receive the catches 5 of the carrier block with as little play as possible. The tolerances between the chain and the slot are also kept minimal since they determine the accuracy of the positioning of the carrier block. The size of the slat and chain belt will therefore also determine the distance between the cathces 5. Preferably this chain is a single core slat and chain belt, also called block chain, but it may also be a double core or triple core chain, i.e. with three or four parallel links, depending on the forces to be withstood. To maintain an accurately uniform rectilinear movement during the run usually a chain with double pitch is used on an ordinary cog wheel. The guiding of the chain in the slot is improved by letting it run in countersunk position and to support the engaged catch 5 of Fig. 2 by a fitting ring 18 between the slot ridges 19 so that this ring takes up the lateral forces with minimal shifting.

Over the length of the machine bed are continuous working presses which consist of a pair of pressure rollers 20, preferably coated with rubber, which are freely rotatable and are held in a tiltable yoke 21 of which the hinge point 22 is located opposite a connecting rod 23 driven by a pressure cylinder. The position of the roller yoke 21 is usable to control the pressing programme of the connecting rods 23 by a judicious choice of the hinge point position 22. The rollers which are preferably in the form of cylinders coated with synthetic material may also comprise a spindle on which rings with different outer diameters are slid.

A shaping attachment 24 is mounted at a station beside the machine bed and attached to the machine frame 12 by means of a vertical supporting shaft 25 which acts as a stand. Preferably this supporting shaft 25 is mounted on a connecting bushing 26 which makes the entire shaping attachment adjustable for height. The entire shaping attachment 24 is mounted rotatably around the shaft 25 by by means of the swivelling arm 27. The turning movement of this arm can be controlled by a pressure cylinder 28 which urges the arm away from the frame 12.

The shaping attachment 24 mainly comprises a driving motor 76 for the shaper and the drive shaft 29 which rests on the swivelling shaper head 27. The motor 76 is located above the shaft 25 and drives the shaft of the shaper 29 by for example a belt transmission 30. The cutting tool, specifically the shaper 31 has the form and dimensions as required by the piece to be machined. The working height thus is adjusted to that of the workpiece by means of the screw thread on the connecting bushing 26. Under the shaper 31 and resting on the shaft 29 a tracer 32 is located which is preferably composed of a rolling contact which scans the contour line of the model or template 2 on the guiding support so providing that the same profile is cut out of the workpiece by the shaper 31.

For easy verification of the adjustment and for arbitrary exchangeability, the template and finished piece have the same dimensions but this need not always be so. Owing to a difference in position and dimensions, the profile of the template could possibly be different from that of the finished workpiece.

In conjunction with an attachment for shaping certain profiles, an attachment for sanding the surface of workpiece can be provided. For that purpose, a loop-shaped sanding belt may preferably be used. By way of example, the attachment 33 of Figure 4 will be described.

The sanding attachment 33 is attached to the machine frame 12 by means of a supporting shaft 34 of which the connecting bushing 35 is adjustable for height by means of a screw thread. The swivelling shaper head 36

supports a floating shaft 37. A sanding bobbin 38 on shaft 37 with a preferably flexible surface such as rubber, presses the sanding belt 39 against workpiece. This sanding belt is for example composed of an endless loop of paper or cloth, provided at the outer side with a layer of abrasive material, such as silicon carbide or the like. A contact roller as used in the shaper attachement is not always necessary here. The sanding belt is held against the workpiece with steady or adjustable pressure and follows automatically the workpiece profile. The contact pressure is applied by pressure cylinder 40 which makes the swivelling shaper head 36 rotate away from the frame 12 according to the supporting shaft 34. The sanding belt 39 is driven by the motor 41 through the shaft 42 and the driving roller 43. An adapted guide and support ensures that the driving part with motor 41, shaft 42 and roller 43 are at an adjustable distance from the floating shaft 37 and the sanding bobbin 38. In this manner a pressure cylinder 44 may produce a certain tension on the sanding belt 39 between the driving section and the grinding section.

To obtain a more uniform workpiece surface the sanding belt 39 is oscillated vertically by giving the driving roller 43 a tilting movement by means of a pressure cylinder 45. The reversal of the tilting movement takes place via a sliding contact 46 which controls the pressure cylinder 45. This sliding contact 46 is for example a hard metal plate with oblique upperside which touches the underside of the sanding belt 39. Through the descent of the sanding belt, this sliding contact may activate a pneumatic valve which sands a signal to the pressure cylinder which generates the tilting movement.

To benefit from all advantages of the invention and to reach a finishing of the workpiece of at least three side planes and, by observing certain precautions, the whole periphery with a simple feed through of the carrier block, it is important that the centres of shafts 29 and 37 of the tools in fully swung-out position reach or exceed the central axis of the chain 17.

An equal number of shaping and sanding attachments, generally called material-removal attachments, are provided in convention design on both sides of the machine bed. At its driven end, the chain is first received by a plane guiding wheel 47, slightly bent and engaged by a sprocket 48, as illustrated in Fig. 5. In this process the catches 5 of the guiding support 1 are gradually released from the chain. The chain is returned to the front side of the machine through an underlying slot 49.

Not only for saving space but also for reasons of optimalization, a return bed 50 is provided in which a conveyor system is mounted which is composed of a supporting structure 51, a series of supporting rollers 52 and, for example, a pair of trapezoidal supporting belts 53.

It is evident to attach the shaper arrangement 24 and the sanding arrangement 33, to the frame 12 by means of a stand mounted adjacent the machine bed. Yet for some applications, it may be advantageous to fix these arrangements to a stand at the upper part of the frame in a suspended configuration. It may be considered that the stand must not be mounted beside the machine bed, but may also be located over the feed bed so that another dimensioning may be applied, for example some treatments of the upper plane of the workpiece. In this case the swivelling shaper head may also be bent or double-hinged instead of rectilinear.

Fig. 5 gives a schematic view of the structure of a fully equipped machine. The carrier block 54 lies ready on the feed table 55 and is pushed by a simple hand movement into the machine. The catches 56 of the guiding support engage into the slat and chain belt 57 and are driven by motor 58. In the bottom of the feedbed switches 59 are provided, which, when contact is made, activate the pressure cylinders 60 which each time press a set of pressure rollers on the carrier block 54 to hold the workpiece in place by friction only.

It is recommended to provide such a number of sets of pressure rollers 61 so that during the cutting operation the workpiece is held by at least two such sets and a finishing with high dimensional accuracy is obtained. It is evident that this is favourable to take up a greater cutting force of the tools. In this sense also the manufacture of oblong workpieces is advantageous. The material-removing operation takes place between the sets of pressure rollers.

An additional contact 62 in the bottom of the machine bed will be activated by the guiding support to have a first shaping attachment 63 swing aside so that the contact roller strikes the nose piece and connecting template and so that the shaper, following this movement, traces and shapes the workpiece. When, at the end of the template, the contact roller moves over the machine bed axis line, a supplementary contact may return the tool to its starting position. In this manner the successive process stations may finish the workpiece automatically while the carrier block keeps moving forward.

Fig. 5 shows successively for example the attachment 63 for rough shaping and next the attachment 64 for fine shaping or finishing. It can be seen that the swivelling direction of shaper attachment 64 is contrary to that of shaper attachment 63. The rotating direction of the shaper can also be adapted to the fibre direction of the wood. In those cases where also the front side of the workpiece is shaped, there will be no nose piece on the carrier

block. In the starting position the shaper attachment will be aside with the shaping tool in the centre of the machine bed. The contact roller strikes directly the front side of the template and will trace it at one side. In such cases the shape of the template must be such that the contact roller cannot hook behind a corner of the template and block the machine. A similar shaper attachment mounted at the other side of the machine bed will in a similar manner follow the other side of the template.

The instruction to a shaper attachment in order to catch in swung-out position a carrier block, can be transmitted by the guiding support via incorporated catches such as 65 and 66 in Fig. 1. A difference in catch length may select through adapted contact switches the desired position of the shaper arrangement.

In the same way a sanding attachment 67, as described in Fig. 4 for rough polishing and a similar sanding attachment 68 for fine polishing of the workpiece can be provided.

It is evident that the setup described so far mainly relates to one side of the machine and that at the other side of the machine bed is equipped with similar attachments. It is also essential that in this setup the opposite attachments are not located at the same height for reasons of geometric overcutting of the tools in swung-out position. In fact the successive material-removing attachments are alternated.

At the end of the machine the carrier block is pushed on a receiving elevator table 69 by the chain 57. This table serves as an elevator and will, by means of an automatic connection, bring the carrier block down and will drive in countersunk position between the conveyor belts 70. These conveyor belts are preferably trapezoidal supporting belts whether or not toothed. A block chain however is a usable alternative.

This movement can be generated by a pressure cylinder 71 which is mounted in the foundation. The carrier block is received by conveyor belts 70 which are driven by motor 72. As soon as this carrier block has left the elevator 69 the latter rises immediately to the starting position to receive the next carrier block.

In the meantime the preceding carrier block is moved by the belts 70 in the return bed 73 where it is slid on the countersunk elevator table 74 which is moved by the pressure cylinder 75. At that moment the table 55 brings the carrier block to its starting position 54 while the elevator forms at the same time the supplying table 55.

The machine operator can now remove the workpiece which was finished on the basis of the used template and simply put a new workpiece on the template to restart the cycle, whereafter the table 55 moves downwards again to obtain the next carrier block. Indeed, in the meantime a number of other carrier blocks may already be sent through the machine. Preferably the successive carrier blocks are detained in the return bed 73 when there is a slow down in the exchange of workpieces. This return bed then serves as a supply magazine.

So it is clear that a workpiece in the finishing cycle does not constitute any obstacle for further loading the machine. The exchange of workpieces takes place very rapidly as the workpieces lie loosely on the template. If there is no nose piece as 4 of Fig. 1 then the upper surface of the template can be made rougher by gluing sandpaper on it. The greater friction under the pressure of the pressure rollers 65 then is useful to ensure an unchangeable position of the workpiece on the template.

The aforegoing description is only an example of an embodiment of the machine. A great number of variants are possible.

In the description the elements serving for material treatment and transportation were preferably provided with electric drives and those for positioning and clamping with pressure cylinders. In this respect pressurized air is the most advantageous driving force.

It is evident that the elevator tables 69 and 74 of Fig. 5 may be operated by hydraulic means as well as with mechanical linkage elevators, whereas the swivelling of the shaper attachment can be achieved by means of electric servo motors. Other components can be operated by a pressure cylinder in combination with a spring.

The contacts between fixed and moving parts were mainly represented as catch switches which may be electric as well as electro-pneumatic. Alternatively this information could be transmitted by magnetic signals received in the guiding support, or by pneumatic signals induced through holes in the guiding support. These means may be applied in combination or/and with time relays so that a judicius programming of the cycle becomes possible.

An embodiment of the shaper arrangement is shown whereby the contact roller and shaper are mounted on the same vertical shaft so that a geometrically uniform copy is made.

For example, a horizontal slot may be provided in the template in which in one particular shaper attachment runs a narrow contact roller, so that a corresponding portion is removed of the workpiece by a shaper with specific shape. Due to the adjustability for height of the attachment, contact roller, and shaper, the slot in the template must not necessarily be in the same place as on the workpiece. The template may be subdivided accordingly into several levels which control separate attachments.

It is neither excluded that a contact roller

having a vertical shaft runs over the template profile, while a material removing tool fixedly attached to it and rotating around a horizontal shaft achieves the shaping of the workpiece. The shaper can also be made as a saw plate or similar tool and for example provide a tooth and slot profile in some parts of the workpiece. It is also possible to round the upper surface of the workpiece by means of such methods.

With respect to the method described there are possible alternatives such as omitting or adding certain process attachments. The return channel can be above the machine. A supplementary attachement can be provided to prevent the conveyor belts from removing the carrier blocks from the elevator 69 of Fig. 5 or from placing them on the feeding table 74 of Fig. 5. According to the nature of the finished workpieces a programme-selective carrier block removal can be provided, whereby for example a portion is moved to another part of the workplace and still another portion would return to the starting postion through the return bed. If one copy of a certain workpiece is available it is also possible to use the shaper attachments for example in reverse order to exchange contact roller and shaper so that, by means of an existing copy, a usable template can be produced. This is useful in cases whereby template and workpiece cannot have the same geometric shape.

The process and the machine as set forth above obviate these disadvantages in such a manner that not only a better finishing is obtained, but also that the workpieces are made much faster, whereas adjustment and operation are reduced to a minimum. The machine can make a widely divergent assortment of workpieces without additional interventions, whereas a modified set-up offers still further possibilities.

WHAT WE CLAIM IS:—

1. A machine for shaping and finishing workpieces of wood or similar material comprising a machine bed, a carrier block adapted to be drawn along said machine bed from an input region to an end region of the machine, said block being adapted to receive thereon a template and a workpiece, at least one pivotally mounted material removing shaping tool adapted to shape the workpiece as it passes thereby in accordance with said template, at least one pivotally mounted sanding device adapted to finish the workpiece after shaping, a plurality of overlying rollers adapted to press and maintain the workpiece on the carrier block as it passes through said shaping and finishing stages, and a conveyor for returning a finished workpiece from said end region to the input region of the machine.

2. A machine according to claim 1 in which the or at least one shaping tool comprises a contact roller for engagement with said template.

3. A machine according to claim 2 in which the shaping tool and contact roller have coaxial axes.

4. A machine according to claim 1, 2 or 3 in which said machine bed includes a longitudinal slot in or beneath which is disposed a chain, said carrier block being provided on its underside with one or more catches adapted for engagement with said chain whereby the carrier block may be drawn through the machine.

5. A machine according to claim 4 in which said chain comprises a single-core slat and chain belt.

6. A machine according to any of the preceding claims in which said machine bed is provided with a plurality of support rollers over which said carrier block passes.

7. A machine according to any of the preceding claims in which the or at least one sanding device includes an endless sanding belt.

8. A machine according to claim 7 including means for imparting to said belt cyclic vertical oscillations.

9. A machine according to claim 8 in which said oscillation imparting means comprises a pressure cylinder serving to tilt a driving roller for said belt.

10. A machine according to claim 9 in which a pneumatic valve is connected to a sliding contact mounted adjacent the sanding belt and serves to actuate said pressure cylinder.

11. A machine according to any of the preceding claims in which the or at least one said shaping tool and sanding device are mounted on each longitudinal side of the machine bed.

12. A machine according to any of the preceding claims in which said overlying rollers are mounted in sets on respective tiltable yokes.

13. A machine according to any of the preceding claims in which the pivotal movement of the or at least one shaping tool and sanding device is effected and controlled by a pneumatic cylinder.

14. A machine according to any of the preceding claims including a plurality of sensing means disposed on the machine bed and adapted to be triggered by the carrier block for successively bringing the or each said shaping tool and sanding device into operative engagement with a workpiece.

15. A machine according to any of the preceding claims in which the or each shaping tool and/or sanding device is height adjustably mounted on a respective shaft by means of a mounting attachment.

16. A machine according to any of the preceding claims in which said return con-

veyor is disposed above or below said machine bed.

17. A machine according to claim 16 including an elevator table at said end region for transferring carrier blocks from the machine bed to the return conveyor.

18. A machine according to claim 16 or 17 in which said return conveyor comprises two roller-supported belts.

19. A machine according to claim 16, 17 or 18 including a further elevator table at said input region for transferring carrier blocks from the return conveyor to the machine bed.

20. A method of shaping and finishing at least a part of the periphery of a planar workpiece of wood or similar material including the steps of mounting the workpiece and a template on a carrier block, engaging said block with a conveyor chain and drawing said carrier block along a machine bed through a shaping stage whereat the workpiece is shaped by at least one pivotally mounted material removing shaping tool in accordance with the template, further drawing said carrier block through a finishing stage whereat the workpiece is sanded by at least one pivotally mounted sanding device, pressing and maintaining said workpiece on said carrier block by a plurality of overlying rollers during passage through said shaping and finishing stages, and returning said carrier block to the input region of the machine.

21. A method according to claim 20 including engaging said carrier block with said chain by means of one or more catches provided on the underside of said block.

22. A method according to claim 20 or 21 including pivoting the or each shaping tool so that their operating shafts pass beyond the longitudinal axis of said carrier block travel.

23. A method according to any of claims 20 to 22 including engaging the leading edge of said workpiece with the or each said shaping tool.

24. A method according to any of claims 20 to 23 including performing said sanding operation by means of an endless sanding belt and imparting to said belt cyclic vertical oscillations by cyclically tilting a drive shaft for said belt.

25. A method according to claim 24 including controlling the amplitude of said oscillations by means of a sliding contact adjacent the belt.

26. A method according to any of claims 20 to 25 including returning the carrier block to the input region by means of a return conveyor disposed above or below the machine bed.

27. A method according to claim 26 including detaining a plurality of carrier blocks on the return conveyor to act as a supply magazine.

28. A method according to any of claims 20 to 27 including controlling the operation of the or each said shaping tool and sanding device by means of a plurality of sensing mean disposed on the machine bed and triggered by said carrier block as it passes therepast.

29. A method according to any of claims 20 to 28 including removing material from the workpiece on both sides of its axis of movement.

30. A machine for shaping and finishing workpieces of wood or similar material, substantially as hereinbefore described with reference to the accompanying drawings.

31. A method of shaping and finishing at least a part of the periphery of a planar workpiece of wood or similar material, substantially as hereinbefore described with reference to the accompanying drawings.

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Sheet 1

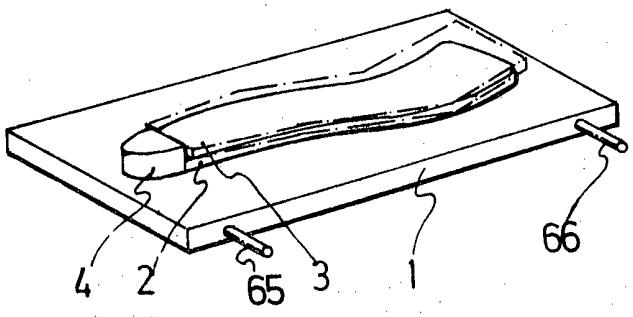

FIG.1

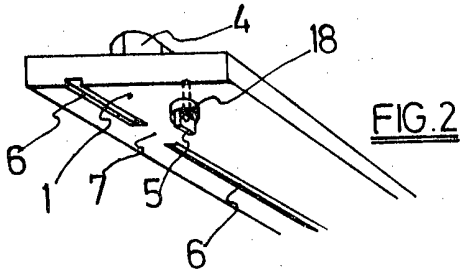

FIG.2

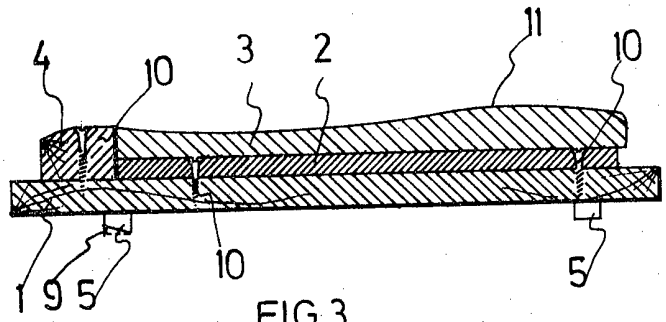

FIG.3

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Sheet 2

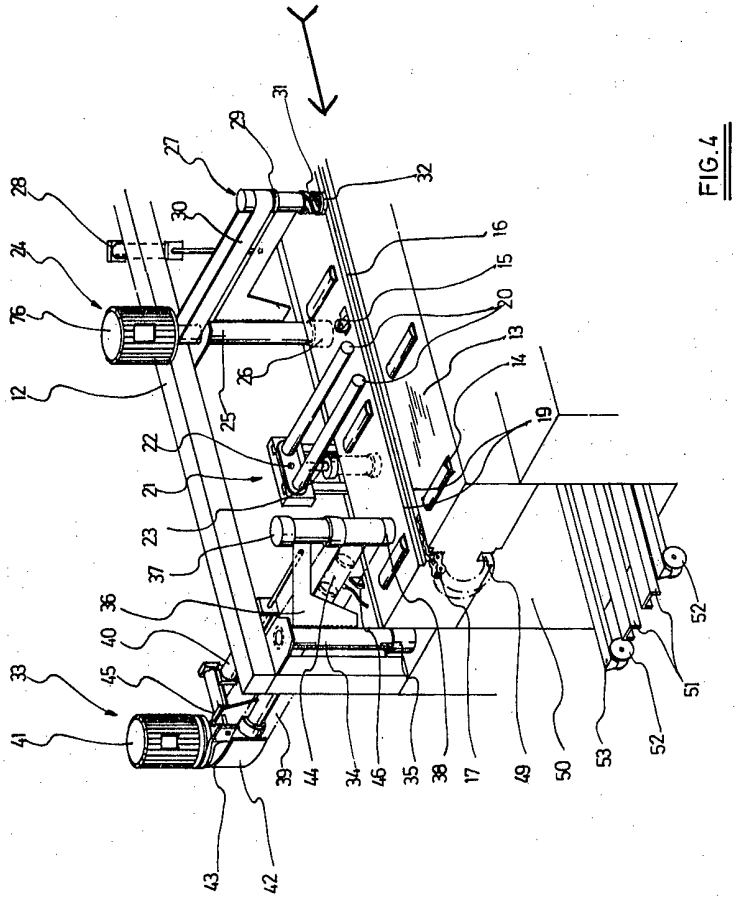

FIG.4

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Sheet 3

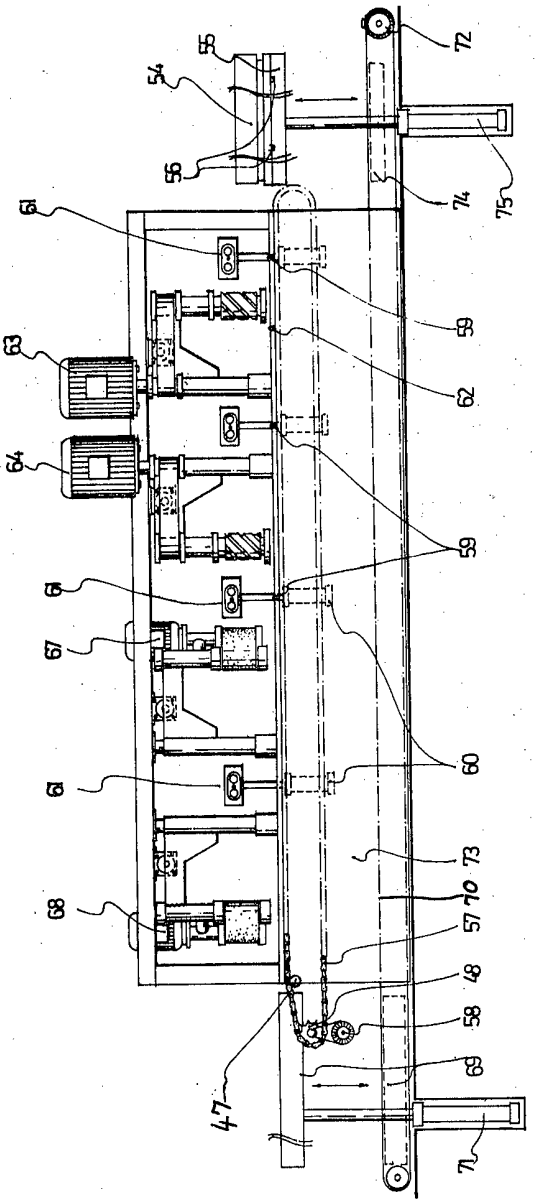

FIG. 5