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54 **Machine for cutting templates off a sheet material.**

57 A machine for cutting templates off a sheet material employs for the cutting a tool (16) and mating tool (22) which are movable jointly and wherebetween a sheet material is placed for cutting;

to allow of large size sheet material cutting, the tool (16) and mating tool (22) are mounted on separate carriage holders (15,21) which are driven synchronously.

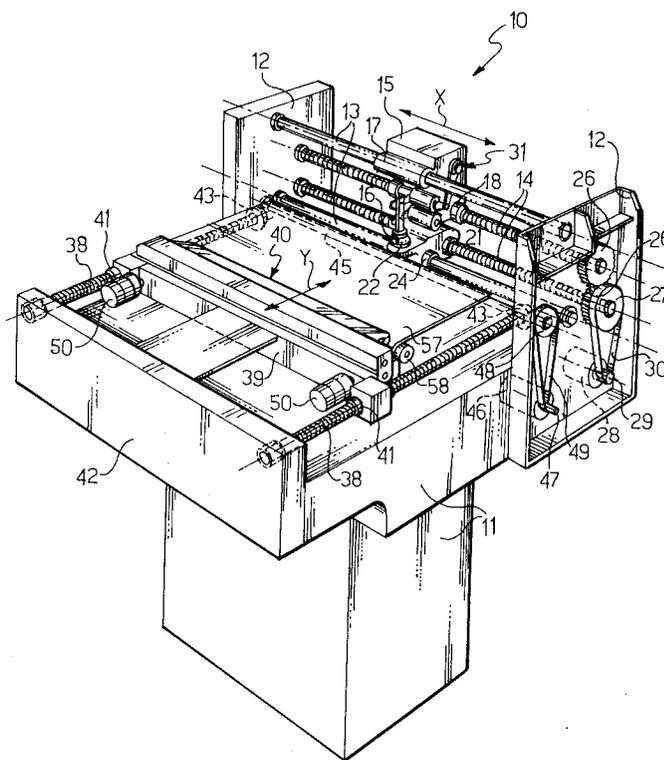


FIG.1

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This invention relates to a machine for cutting templates off a sheet material.

In the footwear industry, as is known, cardboard templates are employed whose contour shape provides a reference contour shape or profile for making shoe uppers.

The cardboard templates are formed from cardboard sheets which are cut according to desired shapes using suitable cutting machines.

For this operation, there are available a number of such cutter types.

Some cutters employ a small knife, or alternatively a laser beam, for the cutting operation which works from one side only of the cardboard sheet. The knife, which interacts with an anvil plate supporting the cardboard sheet, can only cut, however, thin cardboard sheets, whereas for uppers making, a fairly stiff cardboard template is preferred, and accordingly, this would have to be cut from cardboard of some thickness. The use of a laser beam involves high equipment costs and leaves burning marks around the edges of a cardboard template; in addition, cardboard sheets of some thickness require a laser beam of comparatively high power, which aggravates equipment costs.

There are cutters which employ a small rotary mill for cutting. Here again, the results are poor, because the cutting speed tends to be low and the cut is not a sharp one but leaves feathered edges which must be removed.

More effective machines than the ones mentioned above are those employing an upper tool and lower mating tool, with the cardboard to be cut being fed in the nip therebetween. The tool and mating tool are movable jointly across a cutting plane and usually consist of a punch and die, respectively.

The last-mentioned machines do provide a neat and fast cut through the cardboard sheet.

The tool and mating tool are mounted on a C-like structure which interconnects them, and specifically mounted on the ends of the opposing sides of the C-like structure forming holding arms. Such a connecting structure ensures that the tool and mating tool will move jointly with relatively high and consistent mechanical accuracy, that is, that no relative misalignment of the tool and the mating tool will occur.

The largest size of the processable cardboard sheet is tied in with the length of the arms of said C-like structure. Consequently, in order to cut from large size cardboard sheets, the C-like structure must be considerably extensive. This implies that the C-like structure, and hence the machine, become intrusive and very heavy; in addition, the C-like structure may tend to possess inadequate rigidity to provide said accurate joint movement of

the tool and mating tool.

It is the object of this invention to provide a cutter which has none of the limitations of prior machines employing a tool and mating tool mentioned hereinabove.

This object is achieved by a machine for cutting templates off a sheet material, which employs for the cutting a tool and a mating tool jointly movable across a cutting plane in the nip whereof the sheet material to be cut is fed, characterized in that the tool and mating tool are mounted on separate holding means, and that synchronized motion drive means control the joint movement of said holding means.

To make the features and advantages of this invention better understood, a detailed description of an exemplary and non-limitative embodiment thereof is given herein below with reference to the accompanying drawings, where:

Figure 1 is a perspective view of a machine according to the invention for cutting templates off sheet material;

Figures 2 and 3 are perspective views showing some details of the machine in Figure 1; and

Figures 4 and 5 illustrate the operation of one member of the machine in Figure 1.

The machine generally shown in Figure 1 at 10 comprises a structure 11 which carries all the components of the machine 10.

Two webs 12 extend vertically from the supporting structure 11.

Disposed between the two webs 12 are two parallel guide bars 13, an upper one and a lower one, which are attached at their ends to the webs 12. Also disposed between the two webs 12 are two identical drive screws 14, an upper one and a lower one, extending parallel to each other and to the bars 13 whose ends are journaled in the webs 12.

Mounted on the upper bar 13 and the upper screw 14 is an upper carriage 15 holding a punch 16 best shown in Figure 3. Specifically, the carriage 15 is provided with a bush 17 fitted over the upper bar 13 in a freely slidable manner, and a bush 18 fitted over the upper screw 14. As shown in the cutaway view of Figure 2, bush 18 has an internal nut 19 which engages with the upper screw 14, with the interposition of balls 20 arranged to circulate in a closed loop path within the bush 18.

Mounted on the lower bar 13 and the lower screw 14 is a lower carriage 21 holding a die 22, best shown in Figure 3, it being formed with a ring set of holes 23. Specifically, the carriage 21 has a bush 24 fitted over the lower bar 13 in a freely slidable manner and a bush 25 fitted over the lower screw 14. In exactly the same manner as discussed above in connection with bush 18, the bush 25 has an internal nut, not shown, which engages

with the lower screw 14, with the interposition of balls arranged to circulate in a closed loop path within the bush 25.

The two screws 14 are interconnected rotatively by two identical gear wheels 26 in mutual mesh engagement, being each unitary with one end of a respective one of screws 14. The gear wheel 26 connected to the lower screw 14 is unitary with a cogged pulley 27 which is driven by an electric motor 28. The drive connection of the electric motor 28 to the cogged pulley 27 is provided by a pinion pulley 29 being unitary with the shaft of the motor 28 and a cogged drive belt 30 which is trained around the pinion pulley 29 and the cogged pulley 27.

Detailed in Figure 3 is the drive mechanism for the punch 16. This mechanism, which is mounted on the upper carriage 15, comprises a camming device 31 driven by an electric motor, not shown and also mounted on the carriage 15. The device 31 drives of rotary reciprocating motion a lever 33 via a rod 32 of the device. The lever 33 transfers this motion to a rod 34 where to a connecting rod 35 is pivoted; the connecting rod 35 is also pivoted to a rod 36 lying parallel to rod 34, being in turn pivoted on the body of carriage 15, thereby forming an articulated quadrilateral comprised of the body of carriage 15, the two rods 34, 36, and the connecting rod 35. Thus, the connecting rod 35 is driven of linear reciprocating motion. Attached to the bottom end of the connecting rod 35 is a head 37 firmly holding the punch 16.

Also disposed on the structure 11 are two more drive screws 38 lying parallel to each other and perpendicular to drive screws 14. On the screws 38, there is mounted a holder 39 carrying a clamp 40 of elongate shape. The holder 39 is provided at its ends with two bushes 41, each having an internal nut, not shown, for engagement with a respective one of screws 38 with the interposition of circulating ball bearings accommodated inside the bush, in exactly the same manner as bushes 18, 25 and the screws 14.

Each screw 38 is journalled with one end on a wall 42 of the structure 11, and has a bevel gear 43 affixed to the other end. The two bevel gears 43 are identical with each other and enmesh with two more bevel gears 44 (Figure 2), also identical with each other, which are rigidly interconnected by a shaft 45 perpendicular to the screws 38. The shaft 45 is driven by an electric motor 46, and to this aim, the drive connection between the motor 46 and the shaft 45 is established by means of a pinion pulley 47 rigid with the shaft of the motor 46, a cogged pulley 48 rigid with shaft 45, and a cogged drive belt 49 which is trained around the pinion pulley 47 and the cogged pulley 48. The pinion 47 and pulley 48 are positioned on the same

web 12 of the structure 11 which mounts pinion pulley 29 and cogged pulley 27.

The clamp 40 is actuated by two electric motors 50. The actuation of clamp 40 is detailed in Figures 4, 5, where reference is made to the movement brought about by one of the two motors 50, the other being quite identical and synchronous. As shown in Figures 4 and 5, the clamp 40 comprises a fixed jaw 51 and a moving jaw 52. The moving jaw 52 is connected to the motors 50, and for the purpose, each motor 50 is provided with a lever 53, pivoted at 54 on the holder 39; attached to one end of the lever 53 is the moving jaw 52, whereas to the other end of the lever 53 there is drivingly connected a rod 55 driven by motor 50. Each motor 50 is thread coupled to its respective actuating rod 55 such that a rotation of the motor will produce a linear displacement of the rod 55.

This machine 10 operates as follows.

It will be assumed that a template is to be cut off a cardboard sheet.

Motors 50 are first operated to extend the rods 55, thereby the lever 53 will be pivoted in a counterclockwise direction and the moving jaw 52 raised off the fixed jaw 51 of the clamp 40, as shown in Figure 4.

Through the gap between the jaws 51 and 52, the cardboard sheet is then passed as shown in phantom lines at 56, until a strip of a selected size is brought past the jaws 51, 52; thereafter, the motors 50 are again operated, in the reverse direction, to bring jaw 52 back down and clamp the cardboard sheet 56 between the jaws, 51 and 52, as shown in Figures 4 and 5.

The cardboard strip bears onto a deck 57 made of a flexible material which is anchored with one end on the structure 11, at the location of the punch 16 and the die 22, and is wound with the other end around a rotatable roller 58.

At this point, the cutting operation proper commences wherein motors 28, 46 and the motor, not shown, driving the camming device 31 are operated.

Motor 28 rotates pinion pulley 29, and hence cogged wheel 27 through the drive belt 30. The now turning pulley 27 causes the two gear wheels 26, and hence the screws 14, to also rotate. The joint rotation of the screws 14 produces, in turn, a joint traversing movement of the two carriages 15 and 21, because of said screws 14 being engaged with the nuts in the bushes 18 and 25 provided on said carriages. The carriages 15 and 21 run along their respective screws 14 and respective bars 13 in a straight direction designated "X" in Figure 1; as a result, the punch 16 and die 22, being carried on said carriages, will jointly traverse along said direction "X".

Motor 46 rotates pinion pulley 47, and hence

cogged pulley 48 through the drive belt 49. The rotation of the pulley 48 results in rotation of the shaft 45 with the bevel gears 44, and accordingly, joint rotation of bevel gears 43 and the screws 38. The joint rotation of the screws 38, in turn, causes the holder 39 to traverse, because of said screws 38 engagement with the nuts in the bushes 41 provided on the holder 39. The holder 39 will run along the screws 38 in a straight direction designated "Y" in Figure 1, perpendicularly to said direction "X"; consequently, the clamp 40, carried in the holder 39, will traverse along said direction "Y".

The motor driving the camming device 31 produces, as explained hereinabove, linear reciprocation of the connecting rod 35, and hence of the punch 16 attached to the head 37 carried on the connecting rod 35. In particular, the punch 16 is reciprocated between a top end-of-travel position where it is removed from the die 22, and a bottom end-of-travel position where it penetrates a bore 23 in the die 22. The die 23 may be rotated manually where required to bring to registry with the punch 16 another bore 23, because the former bore can no longer serve its function.

The clamp 40 takes the strip of sheet cardboard 56 to a location below the punch 16 which, on being moved, will perforate the cardboard. By combining the movement in direction "X" of the punch 16 and the die 22 with the movement in direction "Y" of the clamp 40, a succession of perforations can be made through the cardboard, wherein any following perforation would partly overlap the preceding perforation, said perforations lying along the profile pattern of the template sought and cutting it out.

At this stage, the motors 28, 46 are stopped, the clamp 40 is opened, and the cardboard is fed forward to make another template from a successive strip of cardboard 56, in accordance with the above explanation. Of course, a number of templates could be formed from one strip of cardboard 56.

The motors described in the foregoing are preferably controlled from an electronic microprocessor control unit.

The combination of the movement in direction "X" of the punch 16 and the die 22 with the movement in direction "Y" of the clamp 40 enables templates with any profile shape to be obtained.

By providing the holder means for the punch 16 and the die 22, respectively comprising the carriages 15 and 21, separate from each other the limitations inherent to the C-like structures mentioned in the introductory part can be overcome. In fact, on this machine 10, the cardboard sheet can be passed unrestrictedly between the punch 16 and the die 22 along its entire length and across its

full width, whereas with the C-like supporting structure, the cardboardsheet movements are constrained by the structure upright joining its two arms. Thus, the machine 10 can cut off cardboard sheets twice the size of those to be cut on machines the same size as this machine 10 but having a C-like structure.

By making the screws 14 and gear wheels 26 identical, a joint mechanical movement of the punch 16 and the die 22 can be provided of consistent great accuracy and reliability. The use of circulating ball bearings in the screw/nut fit further enhances this accuracy.

Furthermore, the movements of the carriages 15 and 21 are accomplished using few and inexpensive elements. The screws 14, additionally to performing the functions of drive members, also serve as guide members for the carriages 15 and 21.

The operation of the clamp 40 is also accurate, reliable, and straightforward, by virtue of the screws 38, the screw/nut fit with intervening circulating ball bearings, and the other drive members described.

The bearing deck 57, which defines a cutting plane, would unwind from the roller 58 as the clamp 40 moves away from the punch 16 and the die 22, and wind back onto the roller 58 as the clamp 40 moves closer to the punch 16 and the die 22. This bearing deck 57 is quite effective to support the cardboard sheet during the perforation step and to prevent cardboard cuttings from falling to the lower portion of the machine.

Variations of and/or additions to what has been described hereinabove may be made.

The holding means comprising the carriages 15 and 21 may be replaced with equivalent holding means adapted to hold the punch and die and to be driven synchronously.

The synchronized drive means for the carriages 15 and 21, comprising motor 28, pinion pulley 29, drive belt 30, cogged wheels 26, 27, screws 14, and carriage bushes 18, 25, may also be replaced with equivalent drive means using drives with equivalent functions, although the embodiment herein described and illustrated shows to be specially advantageous, as explained in the foregoing.

The drive screws 14 and their gear wheels 26 may be sized (thread pitch, number of the teeth on the gears, diameters, etc.) differently from each other, provided that they can produce a joint movement of the punch and the die.

Conceivably, the two carriages could be driven by means of two separate motors, and the joint movement of the carriages achieved by means of position sensors supplying the control unit with information about the carriage positions, thereby

his unit can control the operation of the two motors in a suitable way to synchronize the movements of the two carriages.

The same considerations apply, as regards support and motion, to the clamp for the cardboard sheet.

The rollable bearing deck 57 may be replaced with a fixed table, although the rollable one is apt to simplify the machine construction.

The machine motors need not be electric ones, and they could be hydraulically, pneumatically, or otherwise operated.

The machine of this invention can cut templates for any applications off a sheet of any material, such as sheet plastics or metal in addition to cardboard.

The punch and die may be replaced with any other tool and mating tool effective to cut through sheet material.

Claims

1. A machine for cutting templates off a sheet material, which employs for the cutting a tool (16) and a mating tool (22) jointly movable across a cutting plane in the nip whereof the sheet material (56) to be cut is fed, characterized in that the tool (16) and mating tool (22) are mounted on separate holding means (15,21), and that synchronized motion drive means (14,18,25-30) control the joint movement of said holding means (15,21). 25
2. A machine according to Claim 1, wherein the holding means comprise two carriages (15,21) adapted to perform a linear traversing movement along one direction, one carriage (15) holding the tool (16) and the other (21) the mating tool (22), and wherein the drive means comprise two parallel drive screws (14), each threaded through a corresponding nut in a bush (18;25) of a respective carriage (15;21) and both driven synchronously. 40
3. A machine according to Claim 2, wherein the two screws (14) are connected through two gear wheels (26), each unitary with a respective screw, which enmesh with each other, one of said gear wheels (26) being driven rotatively by a motor (28). 45
4. A machine according to Claim 3, wherein the screws (14) and gear wheels (26) are identical.
5. A machine according to Claim 2, wherein each screw (14) and its corresponding nut in the bush (18;25) engage with each other with the interposition of balls circulating in a closed loop path within the bush. 55
6. A machine according to Claim 2, wherein each carriage (15;21) is guided by its respective drive screw (14) and a guide bar (13) lying parallel to the screw (14).
7. A machine according to Claim 1, comprising a clamp (40) which picks up the sheet material (56) during the cutting operation and moves it relatively to the tool (16) and the mating tool (22) in order to cut off the template. 10
8. A machine according to Claim 2, comprising a clamp (40) adapted to perform linear traversing movements along a perpendicular direction to the running direction of the carriages (15,21), which clamp picks up the sheet material (56) for cutting and moves it relatively to the tool (16) and the mating tool (22) in order to cut the template. 15
9. A machine according to Claim 8, wherein the clamp (40) is mounted on a holder (39) having two bushes (41) with internal nuts whereof two further drive screws (38) are threaded which lie parallel and are driven synchronously. 20
10. A machine according to Claim 9, wherein said further drive screws (38) are operated through a single motor (46) and respective drives (43-45, 47-49).
11. A machine according to Claim 8, wherein said clamp (40) comprises a fixed jaw (51) and a moving jaw (52), motive means (50) being arranged to drive the moving jaw (52) between a position away from the fixed jaw (51) for releasing the sheet material (56) and a closed position against the fixed jaw (51) for picking up the sheet material (56). 30
12. A machine according to Claim 8, comprising a flexible deck (57) for supporting the sheet material (56) which is anchored with one end on a stationary portion of the machine at the location of the tool (16) and mating tool (22) and is wound with the other end around a rotatable roller (58) movable with the clamp (40). 35
13. A machine according to Claim 1, wherein the tool is a punch (16) and the mating tool is a die (22). 40

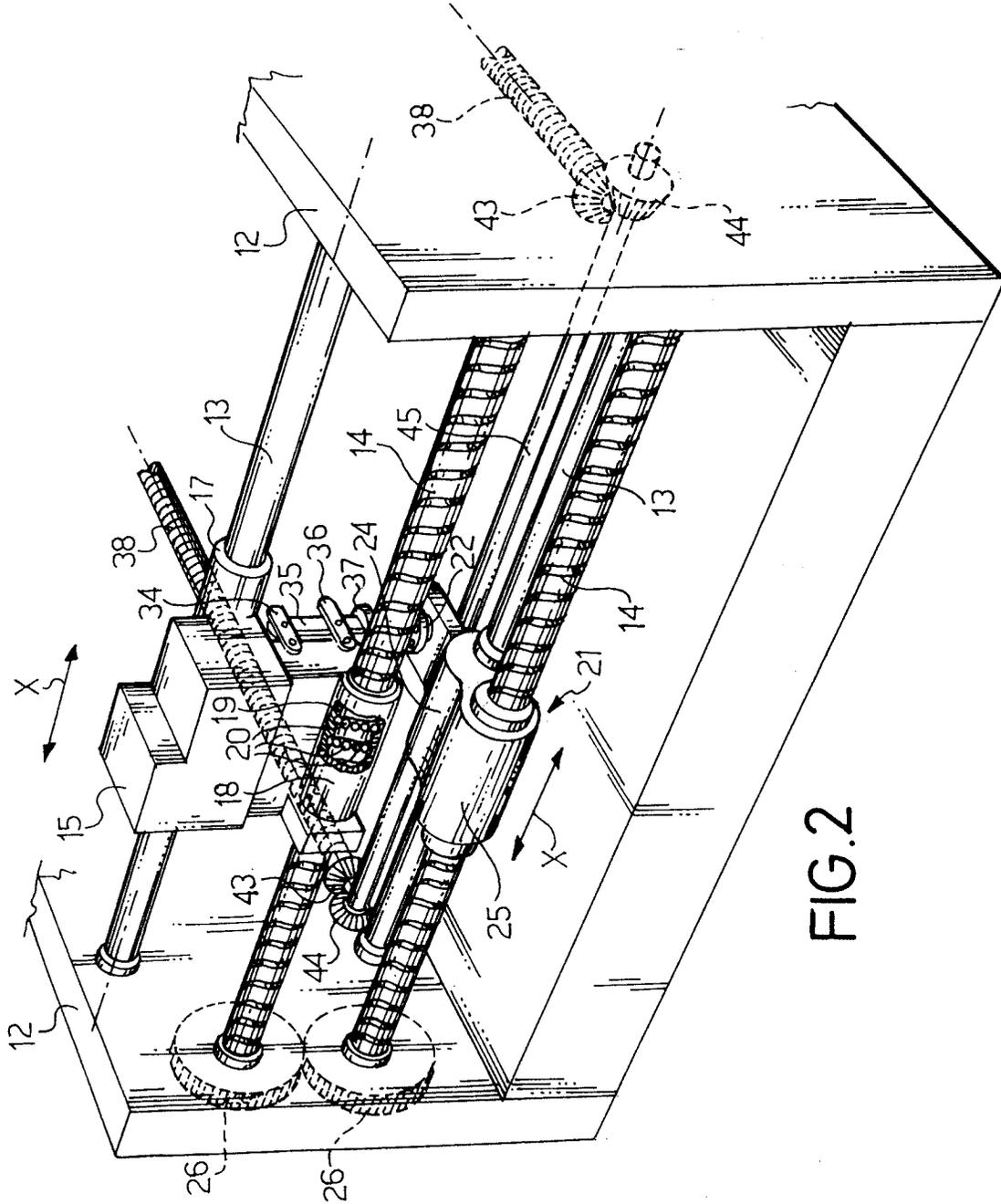


FIG.2

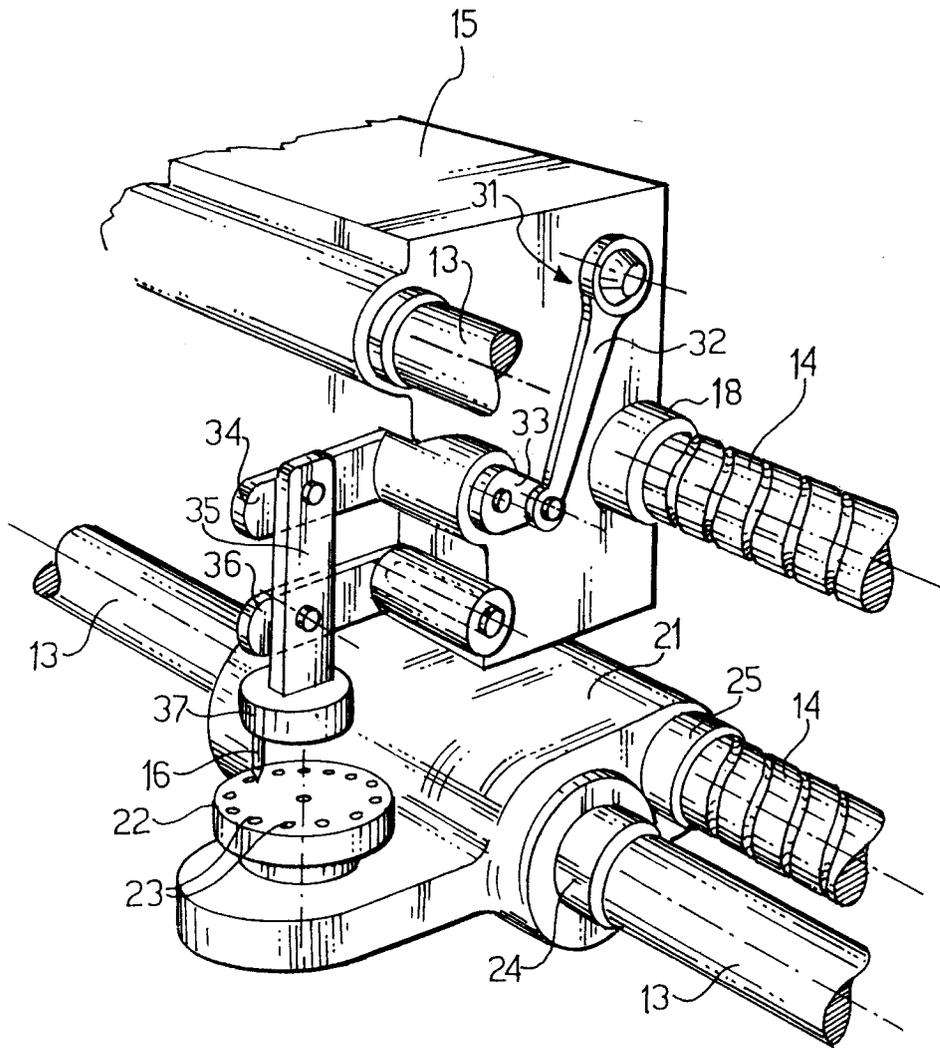


FIG.3

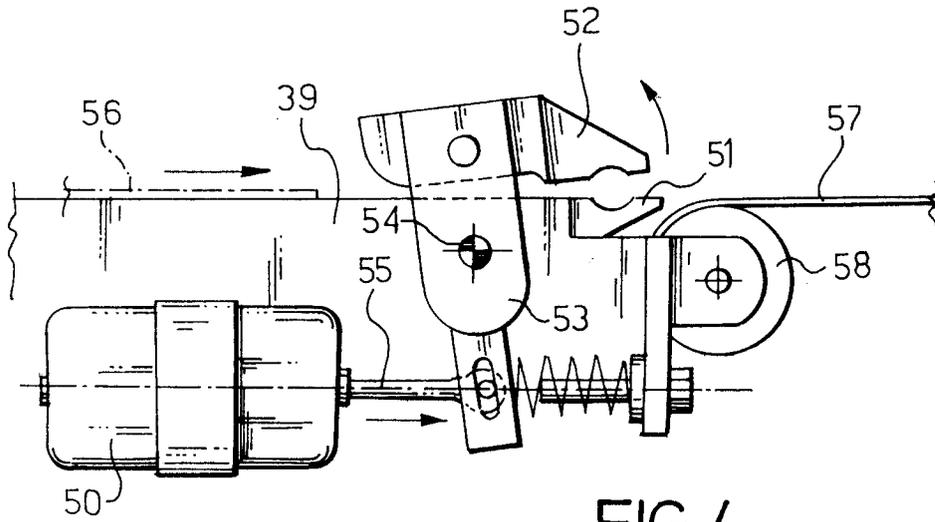


FIG. 4

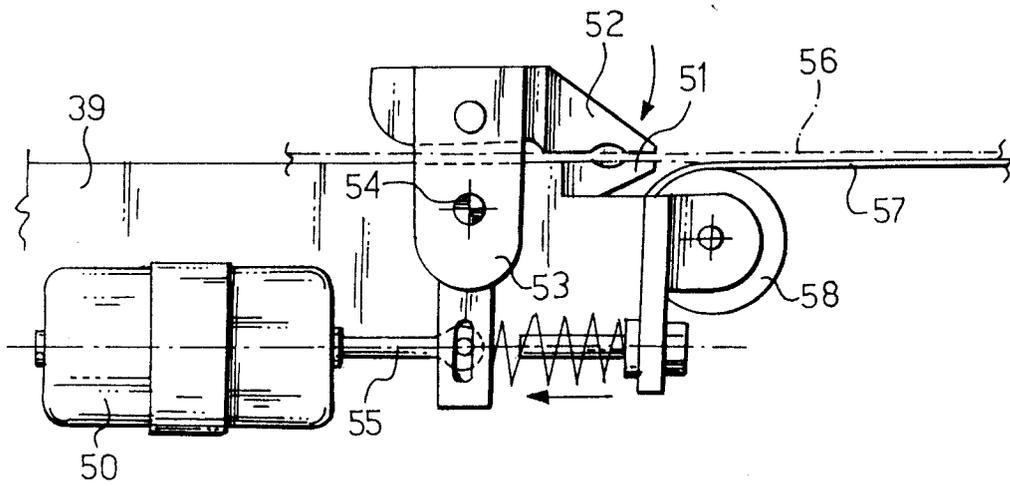


FIG. 5



| 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) |
| X Y | DE-A-4 011 665 (KABUSHIKI KAISHA) * the whole document * --- | 1,7-13 2-6 | B26F1/38 A43D8/02 |
| Y | US-A-4 380 944 (GERBER, RICH) * column 4, line 1 - line 19 * --- | 2-6 | |
| X | DE-A-4 029 866 (KABUSHIKI KAISHA) * the whole document * ----- | 1,7-13 | |
| | | | TECHNICAL FIELDS SEARCHED (Int. Cl.5) |
| | | | B26F A43D B26D |
| The present search report has been drawn up for all claims | | | |
| Place of search THE HAGUE | | Date of completion of the search 08 JANUARY 1992 | Examiner SUENDERMANN R. O. |
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