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(54) **Device for opening signatures**

(57) An opening station (120) for signatures (110) each having a lip with a first end and a second end comprises means (203, 209-215) for supplying the signatures (110) in succession along a supply axis (206) at a predetermined supply speed, first opening means (218a-218d, 221a-221d) for opening each signature (110) in the middle, in the vicinity of the first end of the lip, and second opening means (254a, 254b) for open-

ing the signature (110) in the middle, along the lip; the opening station (120) includes means (245, 248a, 248b) for moving the second opening means (254a, 254b) transverse the supply axis (206) with a velocity having a component along the supply axis (206) substantially equal to the supply speed, the second opening means (254a, 254b) sliding along the lip of the signature (110) from the first end to the second end.

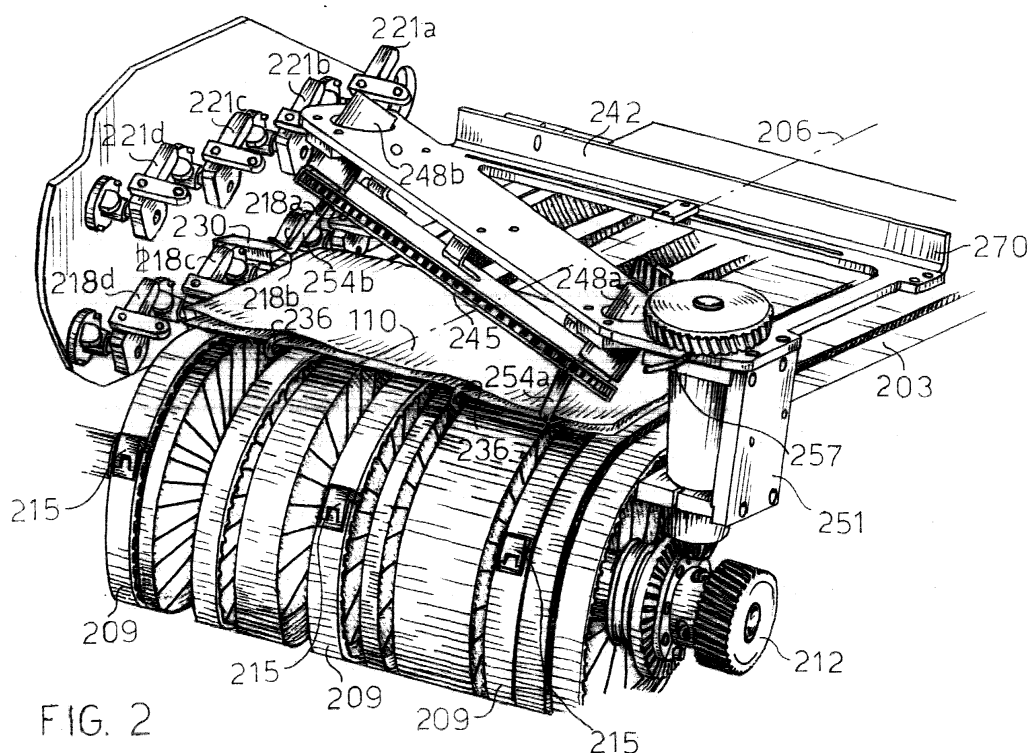


FIG. 2

Description

[0001] The present invention relates to an opening station for signatures.

[0002] Signatures are commonly used for producing books. A signature is constituted by a large printed sheet which is folded one or more times (so as to form the pages of the book). A last fold defines a back of the signature, and an edge opposite the back defines a lip (or front) of the signature; the back is connected to the lip by means of an upper edge (where the reading of the page starts) and a lower edge, which define a head and a foot of the signature, respectively. The signature has one or more lower and upper layers, according to the number and type of folds performed.

[0003] In order to form a sewn book, the signatures (of which there are a predetermined number) are sewn together in the vicinity of the back by means of a suitable machine. The signatures are folded and piled up together so that the sewing machine requires a station which opens the signatures in the middle before sewing.

[0004] The opening station is typically constituted by a series of suction cups which lift the various (upper and lower) layers of the signature in sequence until its middle is reached; at this point, the signature is then dropped astride a saddle which transports the signature towards a sewing station.

[0005] In some cases, the signatures (once folded) are subjected to a punching operation, for example, to define easily removable corners of the pages (as in a diary). The punching operation creates greater adhesion between the sheets of the signature so that the signature may not open fully when it falls on the saddle. Failure of the signature to open causes jamming of the opening station and a consequent need to interrupt the operation of the entire sewing machine; this leads to a considerable reduction in the productivity of the machine.

[0006] Various solutions have been proposed to try to solve this problem. A known solution consists of fanning the signatures before inserting them in the sewing machine. Alternatively, the signatures are passed between two rollers which rotate at slightly different speeds so as to create relative sliding between the sheets of the signature.

[0007] A disadvantage of both of the solutions described above is that they are not very reliable since they do not ensure that the signatures open in every case. Moreover, the signatures are generally piled up together when they are loaded into the sewing machine; the weight of the overlying signatures may therefore completely cancel out any result achieved previously.

[0008] A different known solution consists of the provision of an anvil disposed between the opening suction cups and the saddle; the anvil has a length equal to that of the lips of the signatures and extends perpendicular to an axis of supply of the signatures. Once the signature has been opened (at least partially) by the suction cups,

the anvil is urged towards the lip of the signature and is then immediately retracted.

[0009] This known solution is also rather unreliable since the anvil may not be fully inserted in the signature. Moreover, it is necessary to maintain a slow speed of supply of the signatures to allow the anvil to be retracted from the signature before the signature falls onto the saddle; this leads to low productivity of the sewing machine.

[0010] The object of the present invention is to overcome the above-mentioned drawbacks.

[0011] To achieve this object, an opening station for signatures as set out in the first claim is proposed.

[0012] Briefly, the present invention provides an opening station for signatures each having a lip with a first end and a second end, the opening station comprising means for supplying the signatures in succession along a supply axis at a predetermined supply speed, first opening means for opening each signature in the middle, in the vicinity of the first end of the lip, and second opening means for opening the signatures in the middle, along the lip, the opening station including means for moving the second opening means transverse the supply axis with a velocity having a component along the supply axis substantially equal to the supply speed, the second opening means sliding along the lip of the signature from the first end to the second end.

[0013] The present invention also proposes a sewing machine comprising the opening station and a corresponding method of opening the signatures.

[0014] Further characteristics and the advantages of the opening station for signatures according to the present invention will become clear from the following description of a preferred embodiment thereof, given by way of non-limiting example, with reference to the appended drawings, in which:

Figure 1 is a sewing machine in which the opening station of the present invention can be used,

Figure 2 shows the opening station in schematic form.

[0015] With reference in particular to Figure 1, this shows a sewing machine 100 for book signatures. The sewing machine includes a supply hopper 105; a pile of signatures 110 is loaded into the supply hopper 105 with the back and the head of each signature 110 facing downwards and to the left, respectively. An extraction pincer 115 takes the signatures 110 in succession from the bottom of the pile and supplies them to a station 120 (described in detail below) which opens each signature 110 in the middle. The signatures 110 are deposited astride a saddle 125 (with the back in an upper position); the saddle 125 transports the signatures 110 to a double re-forming station 130 which presses the back of each signature 110. The signatures 110 are then transferred to a movable saddle of a sewing station 135. The signatures 110 of one block, constituted by a predeter-

mined number of signatures 110 (according to the size of the book), are sewn together in the vicinity of their backs by means of a continuous thread. Once a last signature 110 of the block has been sewn, the thread is cut and the block of signatures 110 is transferred to a holder 140 (in order to be supplied to further machines which complete the production of the book). The operation of the sewing machine 100 is controlled by an electronic logic unit programmable by means of a control panel 145.

[0016] Similar considerations apply if the sewing machine has a different structure, for example, if it has a series of trays for the pre-loading of the signatures, a belt for distributing the blocks of signatures, an applicator for applying an adhesive strip around the backs of the signatures of each block, etc; the opening station of the present invention may in any case also be used in other applications, for example, in a machine which opens the signatures in the middle in order to insert loose sheets, etc.

[0017] With reference now to Figure 2, the opening station 120 comprises an inclined plane 203 having a downwardly curved upper end; the signatures 110 slide upwards on the plane 203 along a supply axis 206 (constituted by a longitudinal axis of the sliding plane 203). A set of conveyor belts 209 (three belts in the example shown in the drawing) is associated with the sliding plane 203. Each conveyor belt 209 is stretched between a respective pulley and a respective idle wheel (not shown in the drawing); the pulleys associated with the conveyor belts 209 are mounted on a shaft 212 driven by an electric motor (not shown in the drawing). Each conveyor belt 209 has a series of respective pincers 215 (for example, ten pincers) which are distributed uniformly along the belt; each pincer 215 is aligned with the corresponding pincers of the other conveyor belts 209, perpendicular to the supply axis 206.

[0018] A battery of lower rotary opening heads 218a, 218b, 218c and 218d and a battery of upper rotary opening heads 221a, 221b, 221c and 221d (each constituted by four opening heads in the embodiment shown) are disposed beside the sliding plane 203; a vacuum suction cup is mounted on each opening head. Both the lower opening heads 218a-218d and the upper opening heads 221a-221d are aligned with one another parallel to the supply axis 206. Each lower opening head 218a-218d and each upper opening head 221a-221d rotates about an axis (parallel to the sliding plane 203 and perpendicular to the supply axis 206) which is disposed below or above the sliding plane 203, respectively. A spreader wedge 230 is provided between the lower opening heads 218b and 218c (a similar wedge, not shown in the drawing, is provided between the lower opening heads 218a and 218b). The wedge 230, which is arranged with a longitudinal axis parallel to the supply axis 206 and a base facing forwards, moves transverse the supply axis 206. Gripping fingers 236 (two fingers in the embodiment shown in the drawing) are articulated in the

vicinity of the upper end of the sliding plane 203 (downstream of the opening heads 218a-218d and 221a-221d); each gripping finger 236 is constituted by a thin rearwardly-bent tube which emits an air-jet.

[0019] Similar considerations apply if the opening station has a different structure, for example, a different number of conveyor belts or of opening heads, if the opening heads are arranged differently (for example, with the opening heads aligned perpendicular to the supply axis), if the suction cups are replaced by devices with an electrostatic effect, with pressure-sensitive adhesive, etc.

[0020] In the opening station 120, in addition to the known structure described above, there is a support frame 242 for an endless chain 245. The chain 245 is stretched between two sprockets 248a, 248b. The sprocket 248a is connected to the drive shaft 212 by means of a geared transmission system 251, whereas the sprocket 248b is idle. The chain 245 forms a loop which extends transverse the supply axis 206 (obliquely) in a plane inclined to the sliding plane 203; in particular, the loop is constituted by a straight front portion and a straight rear portion (parallel to one another) connected by a left-hand arcuate portion and a right-hand arcuate portion.

[0021] The chain 245 transports two opening elements arranged in diametrically opposed positions along the chain 245; each opening element is constituted by a metal plate terminating in an end bent upwards to define a respective opening nail 254a or 254b (facing outwards relative to the loop formed by the chain 245). A thin tube 257 which emits an air-jet downwards, is disposed on the frame 242, in the vicinity of the right-hand connecting portion of the loop.

[0022] When the sewing machine is in operation, the signatures 110 are taken continuously from the supply hopper and deposited on the sliding plane 203. The drive shaft 212 moves the belts 209 at a constant speed (anticlockwise when viewed from the right-hand side). As soon as a set of pincers 215 reaches the signature 110 deposited on the sliding plane 203, each pincer 215 is closed onto the back of the signature 110. The signature 110 is thus thrust forwards along the supply axis 206 at a predetermined speed (for example, of the order of a few m/s, corresponding to an operating rate of a few hundreds of signatures per minute).

[0023] Normally, the opening heads 218a-218d, 221a-221d do not interfere with the signatures 110 supplied in succession onto the sliding plane 203. Each time it is necessary to use an opening head, for example, the first lower opening head 218a, a deflector plate (not shown in the drawing) is activated and bends a left-hand end of the lip of the signature 110, defined by the connecting point between the lip and the head, slightly towards the corresponding opening head. The suction cup of the opening head 218a is activated and engages a free surface of a first lower layer of the signature 110. Rotation of the opening head 218a causes a left-hand

end of the first lower layer to be pulled downwards, away from the remaining part of the signature 110. A separating finger (not shown in the drawing) is inserted between the first lower layer and the remaining part of the signature 110 (so as to keep the signature 110 open). The suction cup of the opening head 218a is then deactivated, releasing the first lower layer.

[0024] If the signature includes two lower layers, the same operation is repeated with the opening head 218b (on the other hand, the opening head 218b is kept inactive if the signature 110 comprises only one lower layer). In particular, the suction cup of the opening head 218b engages a second lower layer of the signature 110 and pulls it downwards so as to open the signature 110 in the middle, in the vicinity of the left-hand end of the lip. The wedge 230 is then moved towards the right so as to be inserted between the two halves of the signature 110.

[0025] The drive shaft 212 moves the sprocket 248a (clockwise when viewed from above), by means of the geared transmission system; the chain 245, and hence also the opening nails 254a, 254b, consequently move in synchronism with the belts 209, at a constant speed. The geared system 251 has a transmission ratio such that the opening nails 254a, 254b move (along an operative portion of the loop constituted by the rear straight portion) with a velocity having a component along the supply axis 206 equal to the speed of supply of the signatures 110.

[0026] As soon as the signature 110 passes the opening head 218b, the nail 254a (once the left-hand connecting portion of the loop has been passed) is inserted between the two halves of the signature 110 (opened out by the wedge 230). The nail 254a moves (along the rear straight portion of the loop) at the same speed as the signature 110, along the supply axis 206; the movement of the nail 254a relative to the signature 110 consequently has solely a translational component (towards the right), perpendicular to the supply axis 206. Whilst the signature 110 advances on the sliding plane 203, the opening nail 254a therefore slides along the lip of the signature 110 from the left-hand end to a right-hand end (defined by the point of connection between the lip and the foot). Once the nail 254a emerges from the signature 110, the tube 257 emits an air-jet which urges the upper half of the signature 110 downwards. At the same time, the other nail 254b is brought into the vicinity of the opening head 218b so as to be ready to act on the next signature 110.

[0027] The suction cup of the last upper opening head 221d engages a free surface of an upper layer of the signature 110 and pulls it upwards so as to keep the signature 110 open in the middle. The gripping fingers 236 are then pivoted rearwardly and are inserted between the two halves of the signature 110 thus opened. The gripping fingers 236 restrain the lower half of the signature 110 and at the same time emit an air-jet which urges the upper half of the signature 110 upwards. Finally, the

signature 110 is dropped astride the saddle for transportation towards the sewing station (by simultaneous opening of the pincers 215 and forward pivoting of the gripping fingers 236).

[0028] Similar considerations apply if the signatures are supplied at a different speed, if the chain rotates in the opposite direction (with the operative portion of the loop constituted by the front straight portion), etc. More generally, the opening station includes first opening means for opening each signature in the middle, in the vicinity of a first end of the lip, and second opening means for opening the signature in the middle, along the lip; means are also provided in the opening station of the present invention for moving the second opening means transverse the supply axis with a velocity having a component along the supply axis substantially equal to the supply speed, so that the second opening means slide along the lip of the signature from the first end to a second end.

[0029] The opening station according to the present invention is extremely reliable since the opening nails ensure perfect opening of the signatures in each case.

[0030] This solution is particularly advantageous when the signatures are subjected to punching operations (although its use in other situations is not excluded). In this case, the signatures may in fact not be opened fully by the opening heads, because of the strong adhesion between the sheets; in fact it should be noted that an angle of opening of the signatures must be kept to a limited value in order not to risk tearing the sheets in the portions weakened by the punching operation. On the other hand, the opening nails cut any point of adhesion between the two halves of the signature along the lip.

[0031] Moreover, the structure of the present invention enables a fast signature supply speed to be maintained, ensuring high productivity of the sewing machine.

[0032] The particular embodiment of the opening station described above offers further advantages. For example, the loop structure is extremely simple, the chain 245 ensures good reliability whilst the two opening nails 254a, 254b enable a very compact structure to be achieved. Moreover, the air-jet which urges the upper half of the signature downwards prevents any possible interference of the signature with the opening nail along a non-operative portion of the loop (distinct from the rear straight portion) and the geared transmission system 251 ensures perfect synchronism between the belts 209 and the opening nails 254a, 254b.

[0033] The particular arrangement of the chain with the respective opening nails is perfectly adapted to the structure of pre-existing opening stations. It should be noted that this makes it impossible to use opening heads which are not disposed upstream of the chain; this limitation does not, however, generally constitute a problem and is in any case amply compensated by the advantages achieved in terms of the size of the opening

station.

[0034] Similar considerations apply if a toothed belt (or another flexible transmission element which transports the opening nails) is used, if the opening nails are replaced by similar elements, if other equivalent means are provided for urging the upper half of the signature downwards or for connecting the chain to the drive shaft, if the chain extends from a different point downstream of one of the opening heads (for example, the first), at a different point upstream of the last opening head, etc.

[0035] The opening station of the present invention may, however, also be implemented with the chain arranged in a loop of a different shape (for example, a triangular loop with three opening nails), with a track for transporting the opening nails, with a different number of opening nails, or with the chain driven independently of the drive shaft. Alternatively, the chain is positioned differently, for example, upstream of the opening heads (if the opening heads are aligned perpendicular to the supply axis); in this situation, it is also possible to move a single opening nail alternately towards the left and towards the right along a straight track (which is rotated alternately clockwise and anticlockwise in order to position the opening nail in the vicinity of the lip of the signature).

[0036] Naturally, in order to satisfy contingent and specific requirements, an expert in the art may apply to the above-described opening station for signatures many modifications and variations all of which, however, are included within the scope of protection of the invention, as defined by the following claims.

Claims

1. An opening station (120) for signatures (110) each having a lip with a first end and a second end, the opening station (120) comprising means (203, 209-215) for supplying the signatures (110) in succession along a supply axis (206) at a predetermined supply speed, first opening means (218a-218d, 221a-221d) for opening each signature (110) in the middle, in the vicinity of the first end of the lip, and second opening means (254a, 254b) for opening the signature (110) in the middle, along the lip, **characterized in that** it includes means (245, 248a, 248b) for moving the second opening means (254a, 254b) transverse the supply axis (206) at a velocity having a component along the supply axis (206) substantially equal to the supply speed, the second opening means (254a, 254b) sliding along the lip of the signature (110) from the first end to the second end.
2. The opening station (120) according to Claim 1, further comprising a sliding plane (203) for the signatures (110), and wherein the moving means (245, 248a, 248b) move the second opening means

(254a, 254b) along a path in the form of a loop disposed in a plane inclined to the sliding plane (203), the loop comprising an operative portion and a non-operative portion for the second opening means (254a, 254b).

3. The opening station (120) according to Claim 2, wherein the moving means (245, 248a, 248b) include a flexible transmission element (245) which transports the second opening means (254a, 254b) along the loop.
4. The opening station (120) according to Claim 3, wherein the second opening means include a first opening element (254a) and a second opening element (254b) arranged in diametrically opposed positions along the flexible transmission element (245).
5. The opening station (120) according to Claim 4, wherein each opening element includes a nail (254a, 254b) facing outwards relative to the loop.
6. The opening station (120) according to any one of Claims 1 to 5, further comprising means (257) for urging a first half of the signature (110) towards a second half of the signature (110) in the vicinity of the second end of the lip.
7. The opening station (120) according to any one of Claims 1 to 6, wherein the first opening means include at least one plurality of opening heads (218a-218d, 221a-221d) aligned with one another along the supply axis (206), and wherein the moving means (245, 248a, 248b) extend between a position downstream of one of the opening heads (218b, 221b) and a position upstream of a last one of the opening heads (218d, 221d).
8. The opening station (120) according to any one of Claims 1 to 7, further comprising transmission means (251) for coupling the moving means (245, 248a, 248b) to the supply means (212).
9. A sewing machine (100) for signatures (110) comprising the opening station (120) according to any one of Claims 1 to 8, a sewing station (135) for sewing a predetermined number of the opened signatures (110) together, and means (125) for transporting the opened signatures (110) in succession from the opening station (120) to the sewing station (135).
10. A method of opening signatures (110) each having a lip with a first end and a second end, the method comprising the steps of:

supplying the signatures (10) in succession

along a supply axis (206) at a predetermined supply speed,
opening each signature (110) in the middle, in the vicinity of the first end of the lip, by means of first opening means (218a-218d, 221a-221d),
opening the signature (110) in the middle, along the lip, by means of second opening means (254a, 254b),

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characterized by the step of moving the second opening means (254a, 254b) transverse the supply axis (206) with a velocity having a component along the supply axis (206) substantially equal to the supply speed, the second opening means (254a, 254b) sliding along the lip of the signature (110) from the first end to the second end.

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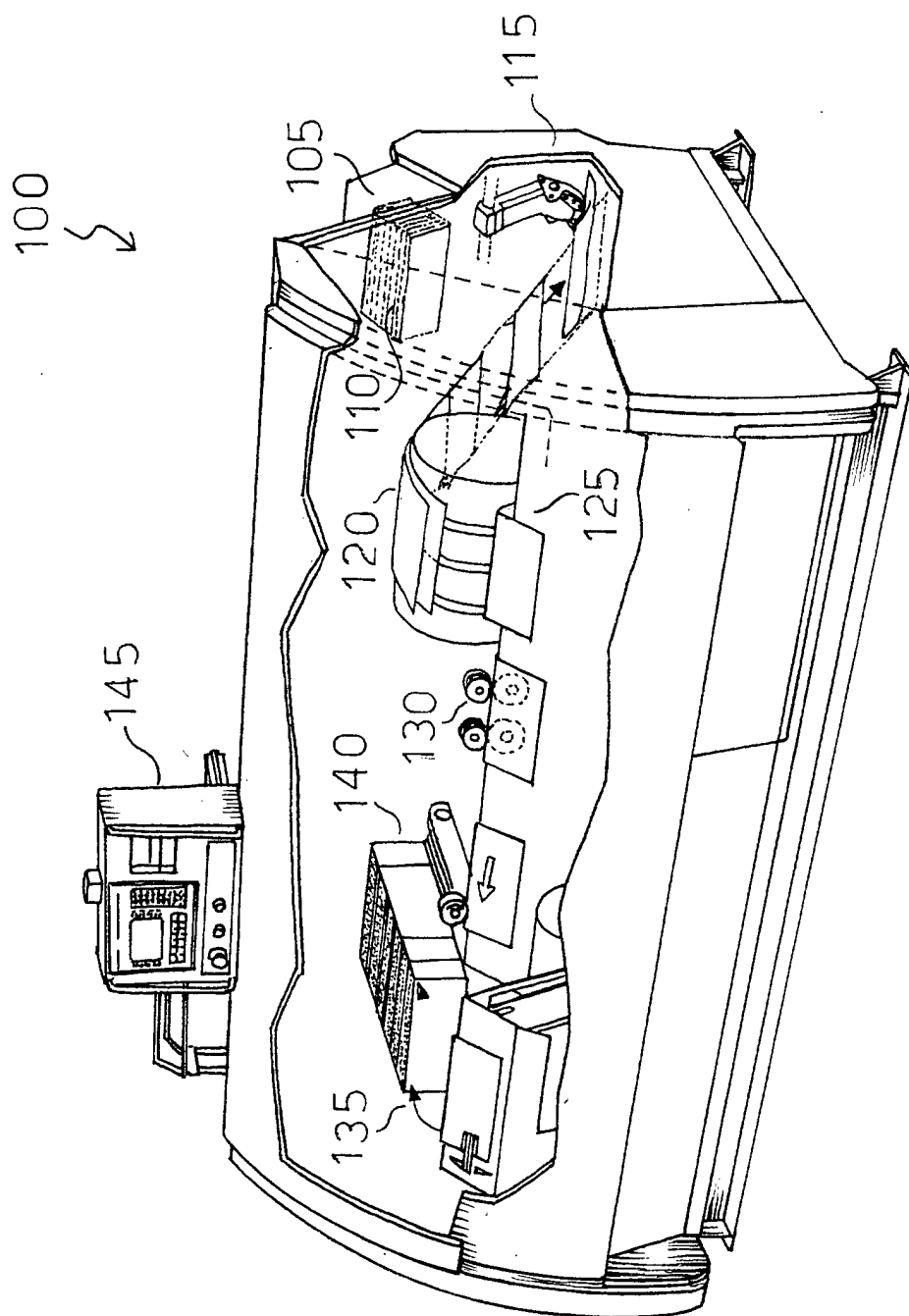


FIG. 1

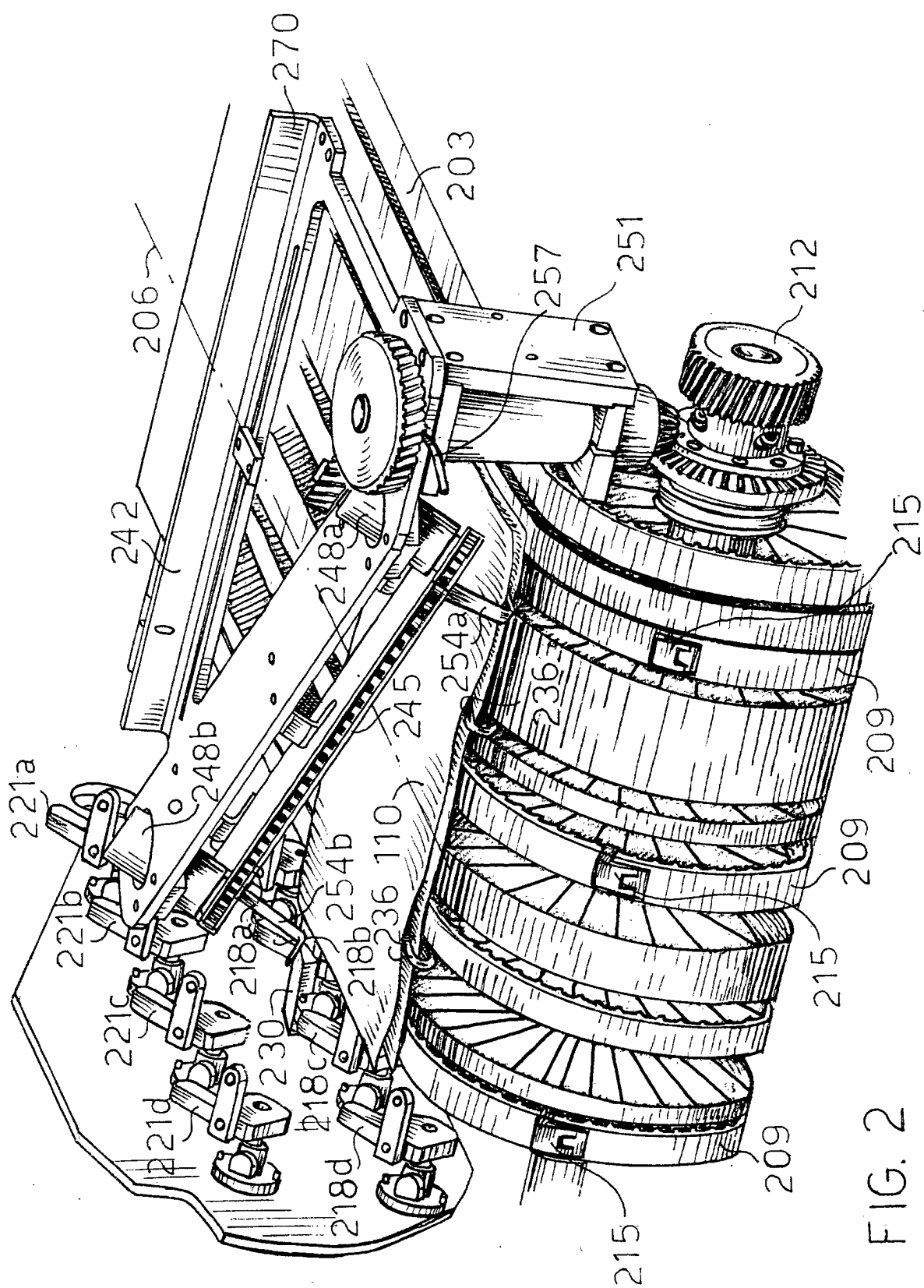


FIG. 2



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 83 0222

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.7)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		30 August 2000	Thibaut, E
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EP 00 83 0222

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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