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(72) Inventor: Ramasco, Carlo
21018 Sesto Calende(Varese) (IT)

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(74) Representative: Marchitelli, Mauro et al
c/o JACOBACCI & PERANI S.p.A.
Corso Regio Parco, 27
10152 Torino (IT)

(71) Applicant: SANT'ANDREA NOVARA S.p.A.
I-28100 Novara (IT)

(54) A method of combing textile fibres and a combing machine for implementing the method

(57) In a rectilinear combing machine, the head (62) of a tuft of fibres is first combed by means of a circular comb (38) whilst the tuft of fibres is held by a nipper (24). A step for extracting fibres and combing the tail of the tuft is then carried out, in the course of which the fibres

are taken over by a pair of detaching rollers (58) and are passed through a straight comb (30). A feed stroke carried out simultaneously with the extraction step is brought about by the advance of the detaching rollers (58) in the opposite direction to the direction for detaching the fibres.

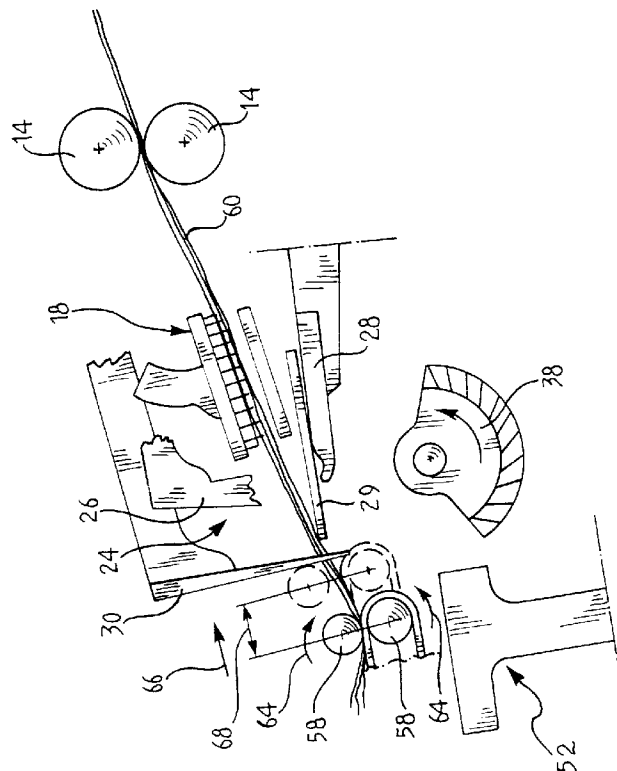


FIG. 4

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Description

The present invention relates to a method of combing textile fibres and to a combing machine for implementing the method.

More precisely, the invention relates to the field of the combing of fibres, particularly woollen fibres, carried out by means of rectilinear combing machines. Rectilinear wool-combing machines, also known as Heilman combing machines, have been known for a very long time and, over the years, their general operating principle has remained almost unchanged but progressively they have been developed to increase their production capacity and the quality of the combed sliver. Essentially, a rectilinear combing machine comprises the following elements:

- a feed device comprising an array of needles or gill for advancing the sliver to be combed along the working path,
- a circular comb for cleaning the front portion or head of the tuft of fibres,
- a nipper formed by an upper jaw and a lower jaw which clamp the tufts of fibres between them during the head-cleaning step,
- a straight comb for cleaning the rear portion or tail of the tuft of fibres, and
- an extractor for taking over successive tufts of fibres, causing them to pass through the straight comb in order to comb the tails of the various tufts.

In modern combing machines, the extractor is constituted by a detaching carriage including a pair of contra-rotating detaching rollers for gripping the fibres and a rubber or synthetic leather belt on which the sliver of combed fibres is formed by the partial superposition of successively detached tufts.

The working cycle of a rectilinear wool-combing machine is intermittent, since it operates upon the principle of the production of a sliver of combed fibres by the superposition of individually combed tufts. The operation of a rectilinear combing machine is therefore characterized by numerous members capable of reciprocating motion. In particular, the straight comb is movable between a raised, inoperative position and a lowered position in which it is thrust into the tuft to be combed; the nipper is raised and lowered periodically relative to the circular comb and also performs an opening and closing movement; the array of needles or gill can also perform an opening and closing movement in addition to an advancing movement between a retracted position and a forward position and vice versa, whilst the detaching carriage reciprocates between an open position and a closed position. All of these movements succeed one

another at a rate of more than two hundred strokes per minute so that it can be understood that, at high operating speeds, vibrations and disturbances occur which distort the required synchronism of the various movements and bring about a decline in the quality of the product.

New designs for rectilinear combing machines have to satisfy many requirements, such as a greater production capacity with improved quality of the combed sliver and a lower production cost, in order to achieve an ever greater reduction in the price difference between combed and carded yarns.

The object of the present invention is to satisfy the aforementioned requirements by the provision of a rectilinear combing machine which can operate at a considerably greater speed than known combing machines.

According to the present invention, this object is achieved by a method of combing textile fibres having the characteristics forming the subject of Claim 1, as well as by a rectilinear combing machine, the characteristics of which are defined in Claim 2.

For a better understanding of the innovative aspect of the present invention, it must be stated that, in rectilinear combing machines, the so-called feed stroke, that is, the approach movement which brings the detaching rollers and the ends of the fibres projecting from the straight comb into mutual engagement, is of fundamental importance. In conventional rectilinear combing machines, the feed stroke was brought about by the movement of the entire unit constituted by the straight comb, the array of needles, and the thrust plate or plate within the nipper towards the detaching rollers with the detaching carriage kept in a stationary position. The extent of the feed stroke is generally variable from 4 to 11 mm, according to the characteristics of the fibres. In conventional machines, the execution of this feed stroke involved the movement of large masses as well as the synchronized movement of several members each capable of its own independent motion.

Tests carried out by the Applicant have shown that the way in which the feed stroke is executed represents a critical aspect for the purposes of increasing the speed, and hence the production capacity, of the combing machine.

In the machine according to the invention, the feed stroke is performed by the detaching carriage, which is moved in the opposite direction to the direction for detaching the fibres during the detachment of the tufts and the combing of the tails of the tufts of fibres. The gill, the straight comb, and the plate within the nipper can thus be kept in stationary positions during the time taken for the detaching carriage to perform the feed stroke. During the combing of the tails, the number of members in motion and the magnitude of the masses to be moved is substantially reduced. This enables the working rate of the machine to be increased considerably without problems of vibrations which could impair the quality of the product.

Further characteristics and advantages of the present invention will become clear in the course of the following detailed description, given purely by way of non-limiting example, with reference to the appended drawings, in which:

Figure 1 is a schematic side view of a rectilinear combing machine according to the present invention,

Figures 2-5 are schematic views showing the operating sequence of the machine according to the invention, and

Figures 6 and 7 are schematic perspective views showing the drive mechanism of the detaching carriage.

With reference initially to Figure 1, the rectilinear combing machine 10 comprises a base 12 carrying two or three contra-rotating feed rollers 14 which feed a sliver of fibres to be combed in the direction indicated by the arrow 16. Downstream of the feed rollers 14 is an array of needles or gill 18, through which the sliver to be combed extends. The gill 18 is formed in a manner well known in the field of rectilinear combing machines and is connected to the base of the machine 12 by means of a crank mechanism 20, which imparts two distinct movements to the gill 18, that is, an opening and closing movement and an advancing and retracting movement along the line of advance of the sliver to be combed, indicated by the double arrow 22.

The gill 18 starts its working cycle in a configuration in which it is closed and in the forward position. Starting from this configuration, the gill 18 opens and is retracted and, at this stage, the feed rollers 14 do not rotate so that the sliver to be combed remains stationary relative to the base of the machine. Upon completion of the retraction stroke, the gill 18 closes and advances and the feed rollers rotate in synchronism with the forward stroke of the gill 18 to advance the sliver. When the forward position has been reached, the gill 18 remains stationary for a period of time during which the detachment and combing of a tuft takes place in the manner which will be described below. At the end of the pause in the forward position, the gill 18 recommences the cycle which is repeated at a frequency of the order of 250 strokes/minute.

Downstream of the gill 18, there is a nipper 24 constituted by an upper jaw 26 and a lower jaw 28. In operation, the lower jaw 28 is stationary and the upper jaw 26 can open and close in synchrony with the movement of the gill 18 and the other members of the machine. A plate 29 within the nipper is situated above the lower jaw 28 and is movable between a retracted position and a forward position.

Downstream of the nipper 24, the machine has a straight comb 30 carried by an arm 32 which is pivoted

on the base 12 at the point indicated 34. The straight comb 30 is capable solely of downward and upward movement in the senses indicated by the double arrow 36.

5 Beneath the nipper 24, there is a circular comb 38 rotatable about an axis 40 in the sense indicated by the arrow 42. The circular comb 38 is intended to clean the heads of the tufts which are held by the nipper 24. As is well known in the art, the circular comb 38 removes the shorter fibres and impurities from the head of the tuft (the portion of the sliver which projects from the nipper 24). To operate effectively, the circular comb 38 has to be cleaned constantly, for which a brush 44, contra-rotating relative to the circular comb 38, is provided. The brush 44 in turn is cleaned by a so-called doffer 46 which cooperates with a flapping detachment comb 48.

10 An important feature of the machine according to the invention is that the circular comb 38 is constituted by a body shaped as a circular sector, unlike known solutions where the circular comb was constituted by a cylindrical roller having a sector provided with combs. Owing to the particular shape of the circular comb of the machine according to the invention, upon completion of the action of the circular comb on the head of the tuft, there is no obstruction beneath the lower jaw 28 of the nipper 24 so that the detaching carriage 52 can approach and the straight comb 30 can be thrust downwardly without the need for the operation to raise the nipper 24, which was necessary in conventional combing machines. The fact that the lower jaw 28 of the nipper 24 remains stationary during the operation of the machine achieves a considerable simplification since, in conventional combing machines, it was necessary not only for the nipper, but also for the gill, the plate within the nipper, and the straight comb to be capable of a raising and lowering movement.

20 The nipper 24 is connected to the base 12 of the machine by means of a carriage 31 which is pivoted on the base 12 at the point indicated 33. In operation, the carriage 31, like the lower jaw 26, remains in a stationary position. The carriage 31 is articulated on the base 12 by means of an adjustable eccentric which permits a height adjustment of the nipper relative to the circular comb 38. The distance between the mouth of the nipper 24 and the circular comb can be varied between approximately 0.6 and 2 mm by means of the eccentric 33, according to the type of fibre to be processed.

30 A unit 50 for extracting the combed sliver, disposed in front of the nipper 24, comprises a detaching carriage 52 pivoted on the base 12 at the point indicated 54. The detaching carriage 52 is movable in the sense indicated by the double arrow 56 between an open position and a closed position in which it is at the farthest point and at the nearest point relative to the nipper 24, respectively. The detaching carriage 52 comprises a pair of contra-rotating detaching rollers 58, between which a rubber belt 60, on which a sliver of combed fibres is formed by partial superposition of a series of tufts, is interposed.

A particularly important adjustment in combing machines is that of the gauge. This adjustment determines the length of the fibres which are discarded and consequently the minimum length of the fibres of the combed sliver. The gauge adjustment consists of a variation of the distance between the tip of the upper jaw 26 and the point at which the fibres are gripped by the detaching rollers 58 and is carried out according to the average length of the fibres to be processed. In conventional combing machines, this adjustment is typically considered a laborious operation.

In the machine according to the invention, a mechanism 71 which connects the nipper 24 to the base 12 is provided for adjusting the gauge. The adjustment mechanism 71 comprises a connecting rod 73, the ends 75 and 77 of which are articulated, respectively, to the nipper 24 and to the base 12. One of the articulation points 75, 77 is in the form of an adjustable eccentric. The longitudinal position of the nipper 24 relative to the base 12 is varied by means of the adjustable eccentric 75 or 77 and the gauge adjustment is carried out particularly easily and quickly.

A further innovative aspect of the machine according to the present invention lies in the operating sequence and, in particular, in the way in which the feed stroke is carried out, as will be described below with reference to Figures 2-5.

In the configuration shown in Figure 2, the sliver 60 to be combed is clamped between the upper jaw 26 and the lower jaw 28 of the nipper 24. The head of a tuft of fibres projecting from the nipper 24 is indicated 62. In this first stage of the working cycle, the straight comb 30 is in its inoperative, raised position, the detaching carriage 52 is open, the plate 29 within the nipper is retracted and the feed rollers 14 are stationary. The gill 18 is open and is performing the retraction movement, and the circular comb 38 is combing the head 62.

In the next stage, shown in Figure 3, the circular comb 38 has completed the combing of the head 62 and is no longer in engagement with the fibres. The upper jaw 26 of the nipper 24 is open and the gill 18, which starts in its retracted position, is closed and advances, causing the sliver 60 to advance. At the same time, the feed rollers 14 rotate and the plate 29 within the nipper moves towards its forward position. The straight comb 30 continues to remain in the raised position, and the detaching carriage 52 is moving towards its closed position. The detaching rollers rotate in the senses indicated by the arrows 63 and bring about a partial retraction of the tuft previously detached. During this stage, the speed of the detaching rollers decreases to zero simultaneously with the completion of the rapid closure stroke of the detaching carriage 52.

In the next stage, shown in Figure 4, the nipper 24 is still open and the gill 18 has completed its forward travel and remains stationary in the forward position and in the closed condition. The feed rollers 14 are stationary and the plate 29 within the nipper is in the forward po-

sition. The circular comb 38 continues to rotate and is still in a position such as not to interfere with the sliver.

The detaching carriage 52 is at the end of its rapid closure stroke in a position such that the detaching rollers 58 engage the free end of the sliver 60. The detaching rollers 58 start to rotate in the senses indicated by the arrows 64 and start to detach a tuft from the sliver 60. The tuft which is detached is partially superposed on the tuft detached during the previous cycle. At the moment when the detaching rollers 58 start to grip the end of the sliver 60, the straight comb 30 is thrust into the sliver so as to comb the tail of the tuft of fibres which is detached by the detaching rollers 58. At this point, the detaching carriage 52 has completed its rapid closure stroke and starts a slow feed stroke in the opposite direction to the direction for detaching the fibres.

In Figure 4, the direction of the feed stroke is indicated by the arrow 66 and the extent of this stroke is indicated 68. The extent of the feed stroke 68 may vary from 4 to 11 mm, according to the characteristics of the fibres and, in normal cases, may be about 6 mm. During the time taken for the detaching carriage 52 to perform the feed stroke 68, all of the other members of the machine are stationary, except for the circular comb 38, the brush and the doffer which continue to rotate without, however, affecting the working zone. The gill 18, the straight comb 30, and the plate 29 within the nipper thus all remain stationary until the detaching rollers 58 reach the position schematically indicated by broken lines in Figure 4, which represents the end of the feed stroke of the detaching carriage 52.

In the next stage shown in Figure 5, the detaching carriage 52 has reached the end of the slow feed stroke and starts the opening stroke in the direction indicated by the arrow 70. The detaching rollers 58 continue to rotate in the sense 64, slowing down until they stop. During this stage a tuft of fibres is detached from the remainder of the sliver. The tail of the tuft which is detached is combed by passing through the straight comb 30.

When the detaching carriage 52 starts its opening stroke, the plate 29 within the nipper starts to retract, the upper jaw 26 of the nipper 24 starts to close, and the machine returns to the initial configuration shown in Figure 2 in order to start the combing of a new tuft.

The main difference between the machine according to the present invention and conventional rectilinear combing machines is that the feed stroke is performed by the detaching carriage, whereas the unit comprising the gill, the straight comb, and the plate within the nipper remains stationary. In conventional machines, the elements constituting this unit moved simultaneously towards the detaching carriage in order to feed the tuft to the detaching rollers.

This difference reduces the moving masses, preventing vibration phenomena from arising at high speeds. A machine which can operate at much higher speeds and which therefore has a greater production

capacity is thus obtained without, however, compromising the quality of the combed sliver.

The mechanism which enables the detaching carriage 52 to perform the rapid opening and closure strokes and a slow feed stroke will now be described with reference to Figures 6 and 7.

The opening and closure of the detaching carriage 52, like the movements of all of the members of the combing machine, are brought about by the main shaft 80 of the machine 10. An eccentric disc 82 keyed to the main shaft 80 engages a connecting rod 84. In the configuration of Figure 6, the connecting rod 84 is in its bottom dead centre position which corresponds to the closure position of the detaching carriage 52. In the configuration of Figure 7, the connecting rod 84 is in its top dead centre position and this configuration corresponds to the open position of the detaching carriage 52. The connecting rod 84 is articulated on a pin 86 carried by a rocker 88. The rocker 88 is connected, by means of a link 90, to an operating lever 92 of the detaching carriage 52.

Also keyed to the main shaft 80 is a cam 94 acted on by a roller 96 carried by an arm 98 fixed to an auxiliary shaft 100. A crank 102, keyed to the auxiliary shaft 100, is articulated to the other end of the rocker 88. The arm 98 cooperates with a spring 104 which keeps the roller 96 in engagement with the cam 94. The cam 94 is divided into two sectors having radii of curvature R and R1. During the rotation of the cam 94 through 360°, the arm 98 remains stationary for 280°, whereas for the subsequent 90° it is lowered, following the reduction in the radius from R1 to R. During the rotation of the main shaft through 270°, corresponding to the cam sector with the profile R1, the operating lever 92 of the detaching carriage 52 performs a rapid opening stroke and a rapid closure stroke of amplitude α . The oscillation α corresponds precisely to the rapid opening stroke and to the rapid closure stroke of the detaching carriage.

During the subsequent rotation of the main shaft 80 through 90°, the crank 102 moves through an angle β , moving the fulcrum of the rocker 88. This brings about an additional movement of the operating lever 92 of the carriage, of amplitude β 1. The additional oscillation β 1 is performed at a relatively slow speed. The oscillation of amplitude β 1 of the lever 92 corresponds to the feed stroke of the detaching carriage 52. The amplitude of the feed stroke can be varied by the replacement of the cam 94 with a cam with a different profile.

Claims

1. A method of combing textile fibres, particularly for combing woollen fibres, comprising:

- a step in which the head (62) of a tuft of fibres is combed by means of a circular comb (38) whilst the tuft of fibres is held by a nipper (24),

and

- a step in which fibres are extracted and the tail of the tuft is combed, in the course of which the fibres are taken over by a pair of detaching rollers (58) and are passed through a straight comb (30),

in which a feed stroke, in which a relative movement towards one another takes place between the straight comb (30) and the detaching rollers (58), is performed simultaneously with the extraction and tail-combing step,

characterized in that the feed stroke is brought about by an advance of the detaching rollers (58) in the opposite direction (66) to the direction for detaching the fibres.

2. A rectilinear combing machine, particularly for woollen fibres, comprising:

- a nipper (24) including an upper jaw (26) and a lower jaw (28),

- an array of needles or gill (18) movable to and fro between a retracted position and a forward position in order to advance a sliver (60) of fibres to be combed,

- a circular comb (38) for combing the head (62) of the tufts of fibres held by the nipper (24),

- a straight comb (30) situated downstream of the gill (18) and movable between an inoperative, raised position and a lowered position in which it combs the tails of the tufts of fibres,

- a detaching carriage (52) movable to and fro between a closed position and an open position, in which it is close to and removed from the straight comb, respectively, and

- a pair of detaching rollers (58) carried by the detaching carriage (52) for detaching tufts of fibres from the sliver, causing them to pass through the straight comb (30),

characterized in that the detaching carriage (52) is arranged to perform a feed stroke towards the straight comb (30) during the step in which the detaching rollers (58) detach the tufts.

3. A rectilinear combing machine according to Claim 2, characterized in that the detaching carriage (52) performs the feed stroke whilst the gill (18) is stationary in its forward position.

4. A rectilinear combing machine according to Claim

2, characterized in that the detaching carriage (52) performs the feed stroke whilst the straight comb (30) is stationary in its lowered position.

5. A rectilinear combing machine according to Claim 2, characterized in that, in operation, the lower jaw (28) of the nipper (24) remains stationary whereas the upper jaw (26) can perform an opening and closing movement. 5
6. A rectilinear combing machine according to Claim 2, characterized in that the circular comb (38) is constituted by a body shaped as a circular sector. 10
7. A rectilinear combing machine according to Claim 2, characterized in that the gill (18) completes its forward stroke before the detaching carriage (52) starts the feed stroke. 15
8. A rectilinear combing machine according to Claim 2, characterized in that the detaching carriage (52) has a relatively rapid opening and closure stroke and a relatively slow feed stroke. 20
9. A rectilinear combing machine according to Claim 2, characterized in that it comprises a drive mechanism for the detaching carriage (52), including a connecting rod (84) driven by the main shaft (80) and connected to a lever (92) for operating the detaching carriage (52) by means of a rocker (88), the rocker (88) having an end pivoted about an axis which is moved in order to perform the feed stroke. 25 30
10. A rectilinear combing machine according to Claim 9, characterized in that the fulcrum of the rocker (88) is moved by means of a mechanism operated by a cam (94) carried by the main shaft (80). 35
11. A rectilinear combing machine according to Claim 2, characterized in that it comprises a gauge-adjustment mechanism (71) interposed between the nipper (24) and the base (12) of the machine. 40
12. A rectilinear combing machine according to Claim 11, characterized in that the gauge-adjustment mechanism (71) comprises a connecting rod (73), the ends (75, 77) of which are articulated to the nipper (24) and to the base (12), respectively, at least one of the ends (75, 77) having an adjustable eccentric, the operation of which brings about the variation of the distance between the nipper (24) and the base (12). 45 50

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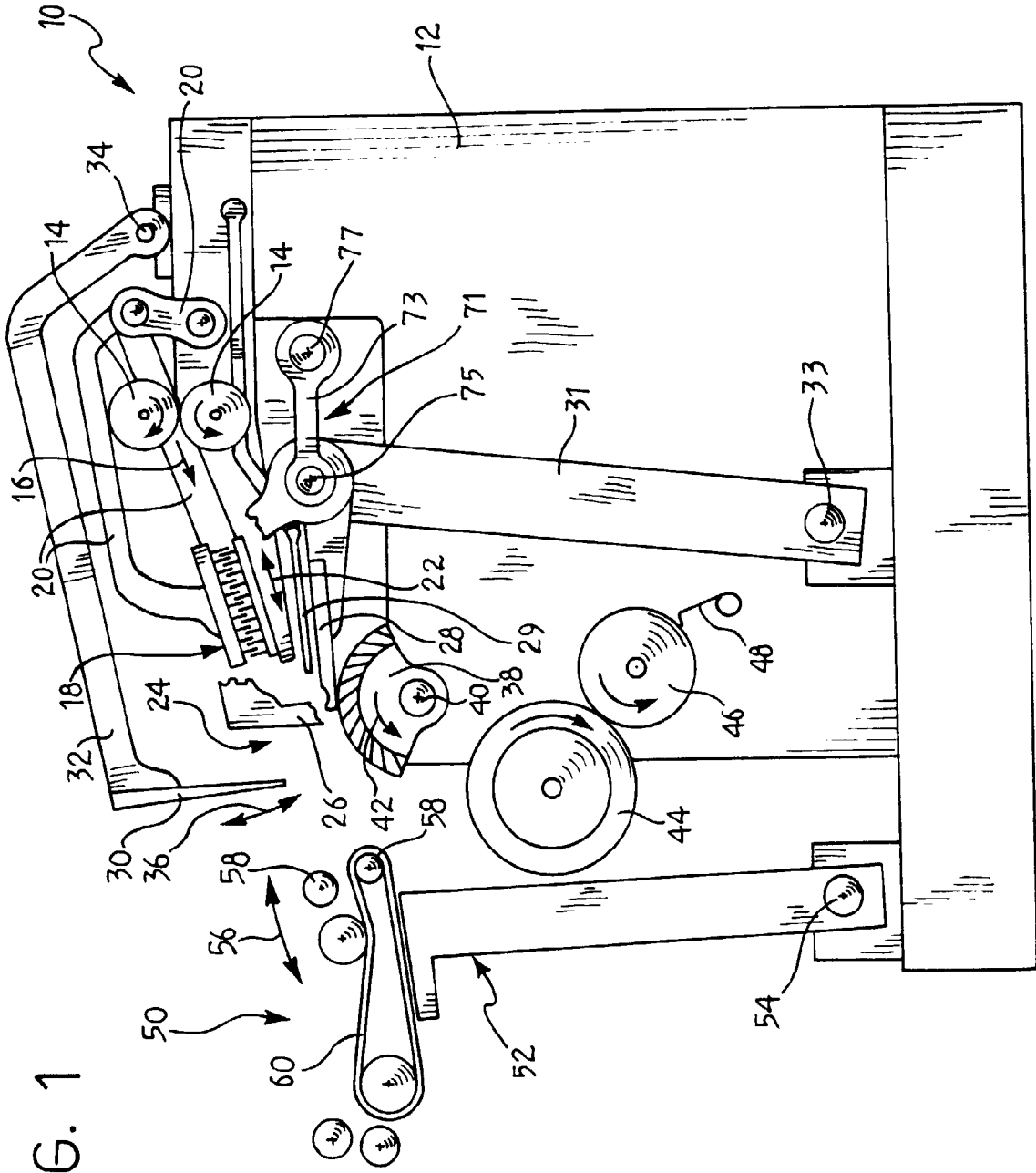


FIG. 1

FIG. 2

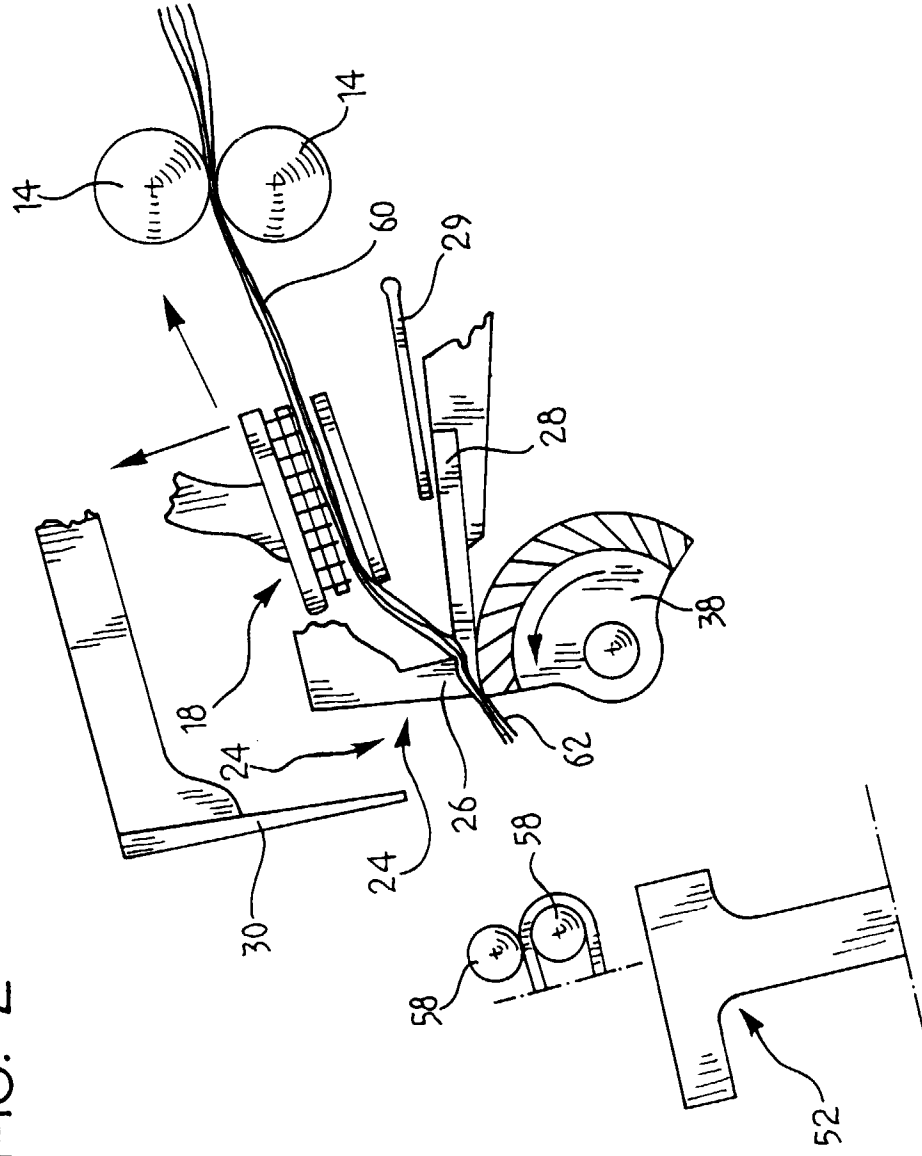


FIG. 3

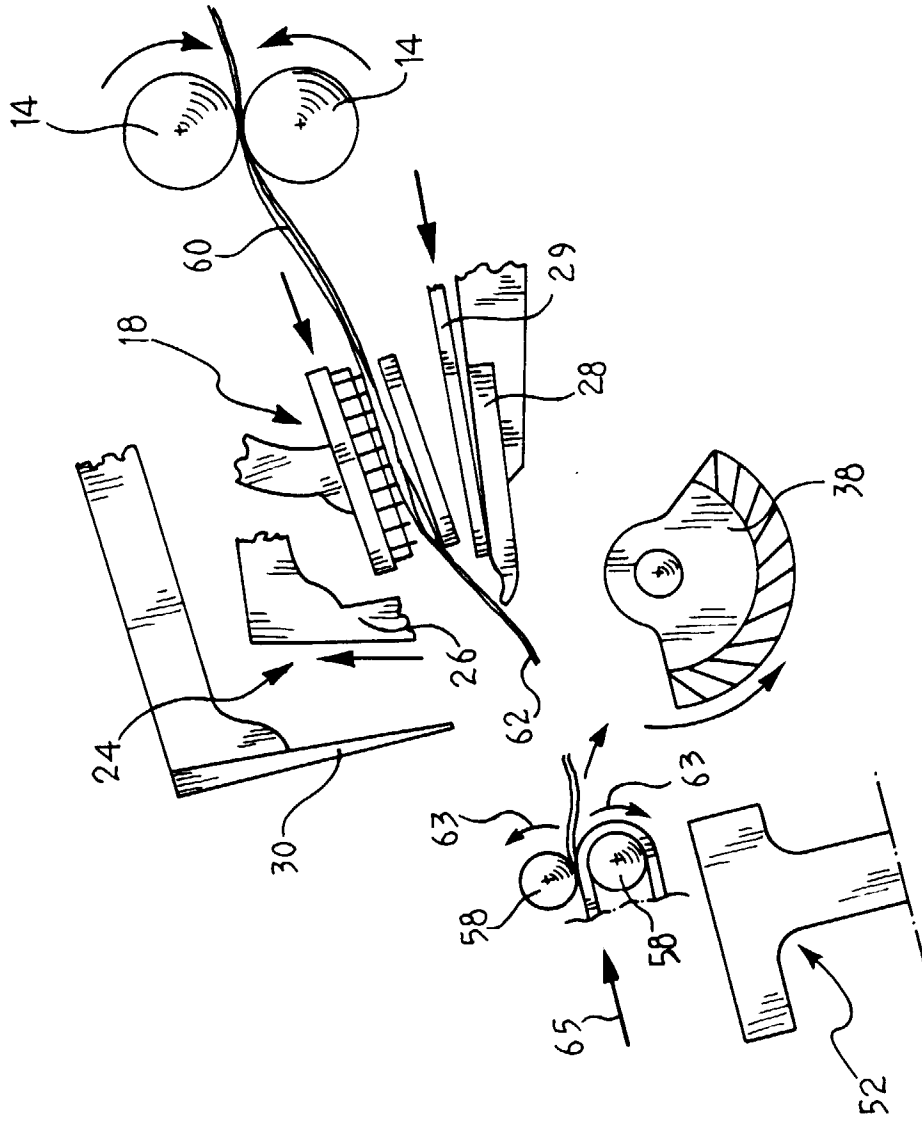
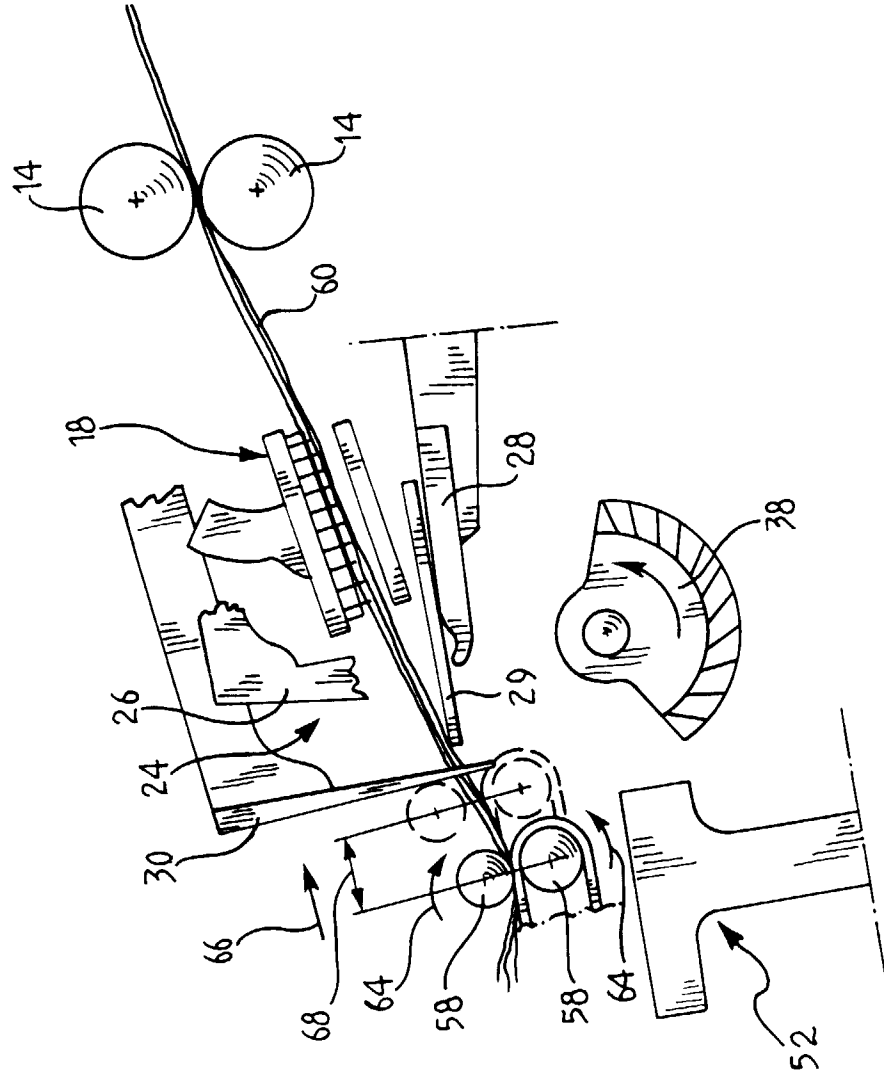


FIG. 4



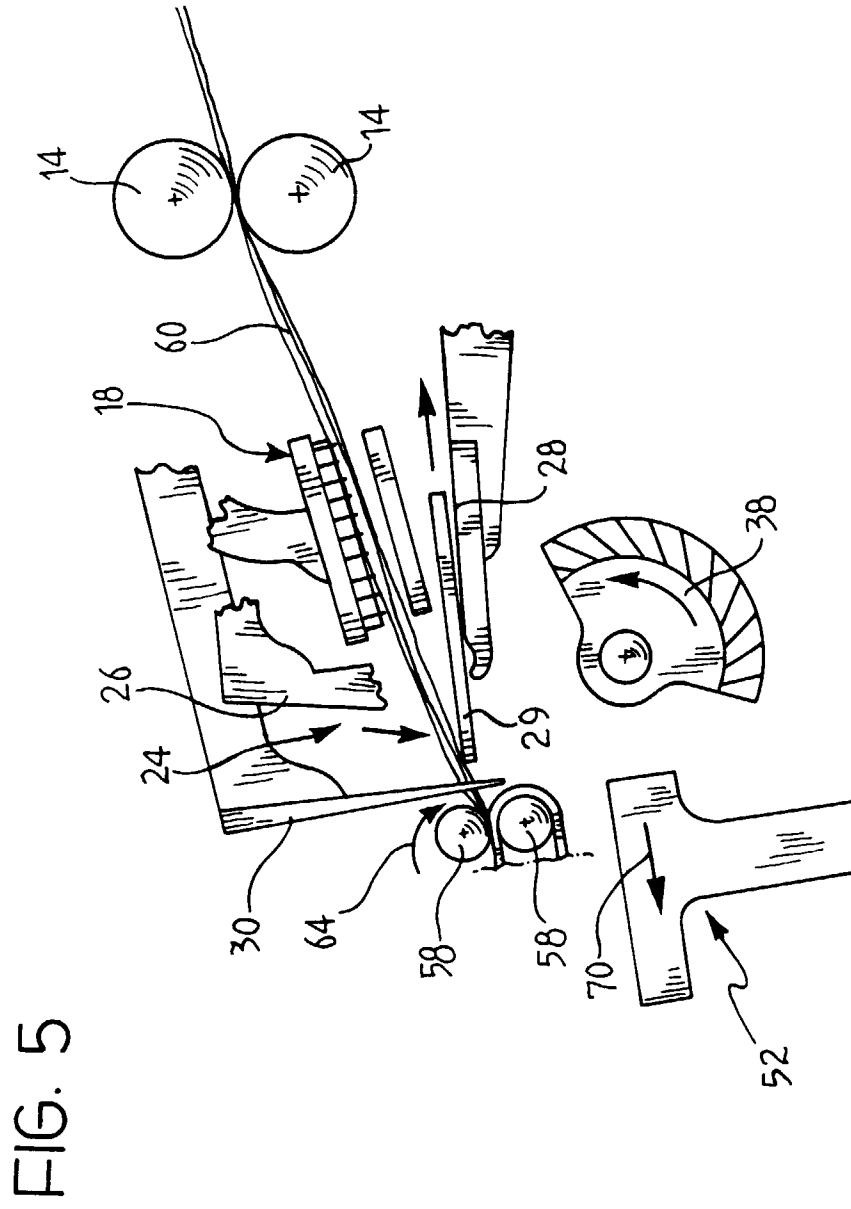
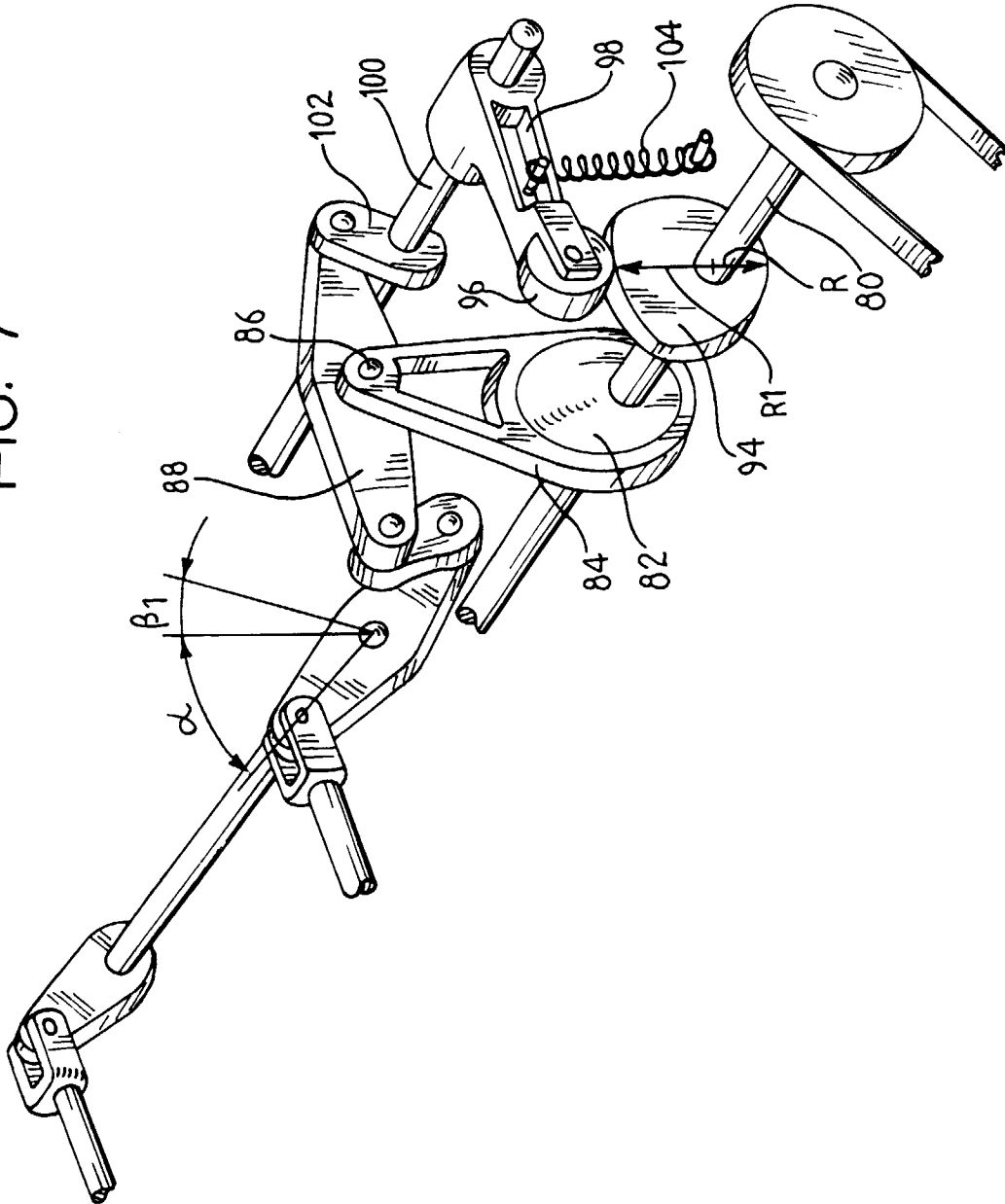


FIG. 7





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EUROPEAN SEARCH REPORT

Application Number
EP 96 11 4938

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.6)
X	GB-A-1 057 971 (N.SCHLUMBERGER & CIE) * page 1, line 29 - page 2, line 93; claims 3,10; figures 1,2 *	1,4	D01G19/26
Y	---	2	
A	---	3,5,6	
Y	FR-A-825 901 (NASMITH'S INVENTIONS LTD) * page 2, line 13 - page 3, line 82; claims 1,5; figures 1-4 *	2	
A	---	9	
X,P	EP-A-0 701 013 (MASCHINENFABRIK RIETER A.G.) * column 2, line 45 - column 6, line 27; claims 1,3; figures 1-5 *	1,9	TECHNICAL FIELDS SEARCHED (Int.Cl.6) D01G
A	GB-A-711 182 (T.M.M.(RESEARCH) LTD) * the whole document *	1	
A	PATENT ABSTRACTS OF JAPAN vol. 12, no. 237 (C-509), 6 July 1988 & JP-A-63 028918 (TOYOTA AUTOM LOOM WORKS LTD), 6 February 1988, * abstract *	1	

The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 19 December 1996	Examiner Munzer, E
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	
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