(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 747 308 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.12.1996 Bulletin 1996/50

(51) Int Cl.[6]: **B65H 18/26**, B65H 18/08, B65H 18/00

(21) Application number: **96830316.4**

(22) Date of filing: **04.06.1996**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GR LI NL PT SE

(30) Priority: **07.06.1995 IT FI950130**

(71) Applicant: **A. CELLI S.p.A**
55016 Porcari (Lucca) (IT)

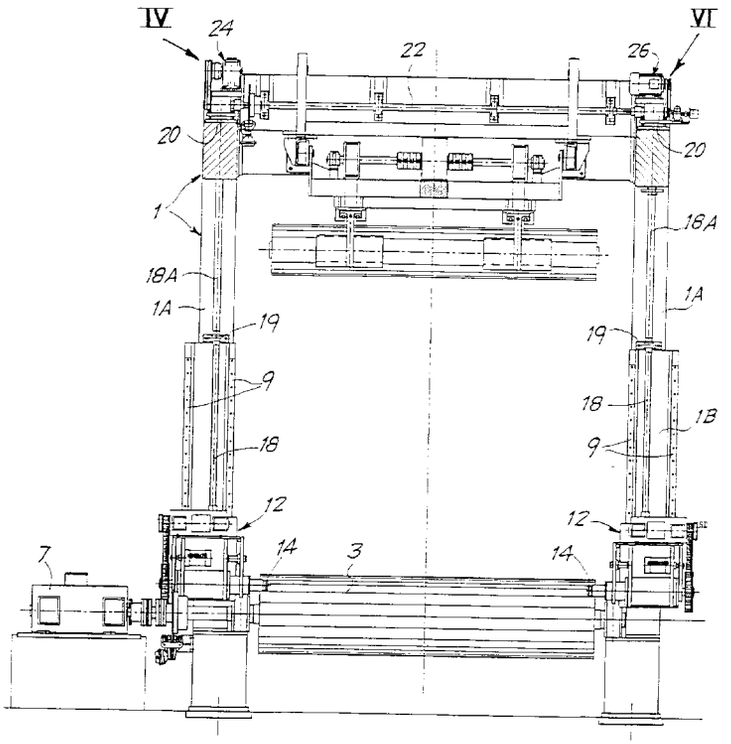
(72) Inventors:
- **Celli, Marco**
  55018 Segromigno Monte, Lucca (IT)
- **Celli, Piero**
  55016 Porcari, Lucca (IT)

(74) Representative: **Mannucci, Gianfranco, Dott.-Ing.**
Ufficio Tecnico Ing. A. Mannucci
Via della Scala 4
50123 Firenze (IT)

(54) Apparatus for winding lightweight web

(57) The apparatus serves for forming reels of lightweight paper intended for paper processing plant (rolls of toilet paper, paper towels and the like and for other products, such as nonwovens) where control of the density of the reel is critical. The tubular core or mandrel on which the paper is to be wound is held by driven mating centres 14 mounted on blocks 12 that travel up and down generally vertical guides 9; driven threaded columns 18 slowly raise the blocks 12 as a function of the instantaneous diameter of the developing reel. The load of the reel on the underlying rolls 3 is thus limited.

FIG. 2



EP 0 747 308 A1

Description

The invention relates to a special apparatus for solving the problem of how to produce regular, non-ovalized reels with uniform and limited compacting of the paper at all distances from the reel axis, in plant for winding lightweight paper web and forming reels intended for paper processing plant - for forming rolls of toilet paper, kitchen rolls (paper towels) and the like, or other products, such as nonwovens, and anywhere where control of the reel is critical - or for equivalent plants. Another object of the invention is to provide a compact apparatus capable of working even at very high speeds. These and other objects and advantages will be clear from the following text.

The present apparatus, comprising driven mating centres for the mandrel or tubular core on which the paper is to be wound and a pair of carrier rolls on which the developing reel rests, is characterized in that it comprises: carriages or blocks moving up and down generally vertical guides and carrying the mating centres and their drive motors; rigid mechanical means, such as driven threaded columns, for slowly raising said carriages or blocks; and a programme for the raising of the developing reel and for a consequent limiting of the load of the reel on the rolls, in order to give a generally constant load at the points of contact between the developing reel and the two carrier rolls.

In an advantageous embodiment, the mating centres are driven in such a way as to provide a speed of rotation that is dependent upon the instantaneous diameter of the developing reel and upon the speed of the feed of the paper (or the like) being wound, and a torque not exceeding a preset limit.

The drives for raising the blocks and for the mating centres are programmed as a function of the apparent thickness of the paper of the web to be wound and of the progressively accumulated length of this web on the developing reel.

In practice the apparatus may comprise, for the two threaded columns for raising the carriages or blocks of the mating centres, a slow drive for winding and a fast drive for auxiliary manoeuvres.

Both the guides for the blocks and the threaded columns are advantageously of circulating-ball-bearing construction, in order to ensure the agility of manoeuvres even under heavy loads.

A clearer understanding of the invention will be derived from the following description and the accompanying drawing, the latter showing a practical non-restrictive example of the invention. In the drawing:

Fig. 1 shows a longitudinal section through a reel-forming plant in which the apparatus in question is used;

Fig. 2 is a sectional view generally on the plane marked II-II in Fig. 1;

Fig. 3 is a horizontal section generally on the plane marked III-III in Fig. 1;

Figs. 4 and 5 show a local detail indicated by the arrow IV in Fig. 2 but viewed in the opposite direction to that of Fig. 2, and a view on the plane marked V-V in Fig. 4;

Figs. 6 and 7 show a local detail indicated by the arrow VI in Fig. 2 in a diagrammatic view in partial section on the plane marked VII-VII in Fig. 6; and

Fig. 8 shows a diagram demonstrating the programming.

As shown in the drawing, 1 indicates a frame for the reel B forming station, which is followed by a unit for collecting the completed reels and passing them on. The lower part of the structure of the frame 1 contains two adjacent rolls 3 which provide a seat on which the developing reel B rests and is rolled, the reel being formed about a core or mandrel M which initially is in position M1 in Fig. 1 and gradually rises as the reel is formed with the feed of paper web N as the diameter of the reel gradually increases. When a reel is complete, equipment sketched in the drawing and of a type known per se is used to transfer the reel onto an inclined rolling surface 5 for removal and transfer to dwelling positions B1, B2 etc. The two rolls 3 are driven in some suitable manner by motors 7 that cause the rolls to rotate with a peripheral speed equal to the feed speed of the web N.

The weight of a developing reel would normally be borne entirely by the rolls 3, causing a changing degree of compression of the various layers of turns as a function of the progressively increasing diametrical dimension of the reel and hence of the steadily increasing load pressing down on the rolls and compressing the layers of paper. This condition is a precursor of other problems also, such as in particular a tendency of the reel to ovalize and other manifestations which may have repercussions arising from the great weight of the rotating reel and the possibility of vibration and other problems that can result from an imbalance of the load relative to the reel axis.

In order to avoid these and other problems, according to the invention the reel is at least in part supported not by the rolls 3 but by mating centres that engage the core on which the reel is forming and are preferably also driven.

As the drawing shows, along the posts 1A of the frame 1 and along the parallel auxiliary posts 1B are generally vertical guides 9 (which may be made in the form of circulating-ball-bearing guides) for the movement of two blocks 12 that travel on said guides and that carry the mutually opposing mating centres 14 designed to engage in rotation with the core M on which the reel B is formed. The blocks 12 are generally provided with their own motors 16, which are designed to turn their respective mating centres 14, the motors 16 being correlated for their rotation both with the peripheral speed of the rolls 3 and with the instantaneous height of the blocks 12, which is a function of the progressively in-

creasing diameter of the developing reel B. Along the guides 9 on each side of the frame 1, for each block 12 a respective threaded column 18 is provided which is suitably guided by its own brackets such as 19 acting also as section ends. Coupled to each column 18 are corresponding nuts attached to the blocks 12 so that the blocks move as their respective threaded columns 18 are rotated. The two threaded columns 18 are continued upwards by a section 18A to arrive at a system for driving said threaded columns 18, 18A, which is common to both threaded columns, these advantageously being of circulating-ball-bearing type. The columns 18, 18A pass into gearboxes 20, which are connected to each other by a horizontal transmission bar 22; said bar 22 traverses the frame 1 parallel to the axes of the rolls 3 in order to transmit the motion simultaneously to both threaded columns 18. The bar 22 and hence the threaded columns 18, 18A can be driven by a slow drive indicated generally at 24 (see also Figs. 4 and 5) and by a fast drive indicated generally at 26 (see also Figs. 6 and 7). The slow drive 24 comprises a geared-down motor 24A, with a dog clutch 24B whose teeth can skip when the driven side is moved faster than the output shaft of the geared-down motor, and a belt drive 24C to the transmission bar 22. The fast drive 26 comprises a motor 26A and a transmission 26B which turns the bar 22 at the opposite end from the drive 24C. When the movement is fast, the clutch 24B allows the components situated between the bar 22 and the output shaft of the geared-down motor 24A to be disengaged, so that said motor is not influenced by the greater speed imposed by the system 26.

The slow drive system 24 is coordinated by a program which influences the various controls as a function of the instantaneous diameter of the developing reel B; consequently said drive 26 can turn the threaded columns 18, 18A in such a way as gradually to raise the blocks 12 in step with the increasing diameter of the developing reel, so that the load of the reel on the rolls 3 is limited to a preset value that is below a certain limit. In the same way the programme causes the mating centres in the mandrel or core of the developing reel to rotate with an angular speed suitable for the instantaneous diametrical dimension of the developing reel. In this way the rigid assembly by which the developing reel is supported and moved is synchronized.

The programme can be run in particular so that the mating centres are rotated to produce a constant torque in addition to the speed of rotation that is dependent upon the instantaneous diameter of the developing reel.

Fig. 8 is a diagram explaining the principle of the raising programme. Between the centres of the cross-sections of the carrier rolls 3 of radius r and of the developing reel Bx of radius R is defined an isosceles triangle with base 2a, height H and inclined sides R+r. R and H increase as a function of the number n of turns and hence of the number n of the thicknesses s of the wound product N, so that R=ns. The value of H which is obtained by programming the raising of the blocks 12, is given by $H= (r+R)^2 - a^2$.

The programme for controlling the threaded columns 18 is therefore very easy to work out.

It is useful to provide a safety mechanism to stop the machine in the event of an excessive load on the threaded columns 18. This can be provided by load cells measuring the axial load on the columns, with some means of monitoring to ensure that the load does not exceed a preset limit.

It will be understood that the drawing shows only an example given purely by way of a practical demonstration of the invention, it being possible for the invention to be varied as regards shapes and arrangements without thereby departing from the scope of the concept underlying said invention.

The presence of any reference numerals in the accompanying claims is purely for the purpose of facilitating the reading of the claims with reference to the description and drawing and does not limit the scope of protection represented by the claims.

Claims

1. Apparatus for winding lightweight web and forming reels intended for paper processing plant - for forming rolls of toilet paper, kitchen rolls (paper towels) and the like - comprising driven mating centres for the tubular core or mandrel on which the paper is to be wound and a pair of carrier rolls under the developing reel; which apparatus is characterized in that it comprises: carriages or blocks (12) travelling on generally vertical guides (9) and carrying the mating centres (14) and their drive motors (16); rigid mechanical means, such as driven threaded columns (18), for slowly raising said carriages or blocks; and a programme for the raising of the developing reel and for a consequent limiting of the load of the reel on the underlying rolls, in order to give a generally constant load at the points of contact between the developing reel and the two carrier rolls.

2. Apparatus according to Claim 1, characterized in that the mating centres (14) are driven in such a way as to provide a speed of rotation that is dependent upon the instantaneous diameter of the developing reel and upon the speed of the feed, and a torque not exceeding a preset limit.

3. Apparatus according to Claim 1 or 2, characterized in that the drives (24) for raising the blocks (12) and (16) for mating centres (14) are programmed as a function of the apparent thickness of the paper of the web to be wound and of the progressively accumulated length of this web.

4. Apparatus according to at least one of the previous claims, characterized in that it comprises, for the two threaded columns (18) for raising the carriages or blocks (12) of the mating centres, a slow drive (24) for winding and a fast drive (26) for auxiliary manoeuvres.

5. Apparatus according to at least one of the previous claims, characterized in that the guides (9) for the blocks (12) and the threaded columns (18) are of circulating-ball-bearing construction.

6. Apparatus according to at least one of the previous claims, characterized in that it comprises means for monitoring the axial load on the threaded columns, such as load cells or the like, in order to stop the machine in the event of excessive load.

7. Apparatus for winding lightweight web; the whole as described above and as depicted by way of example in the accompanying drawing.

FIG.1

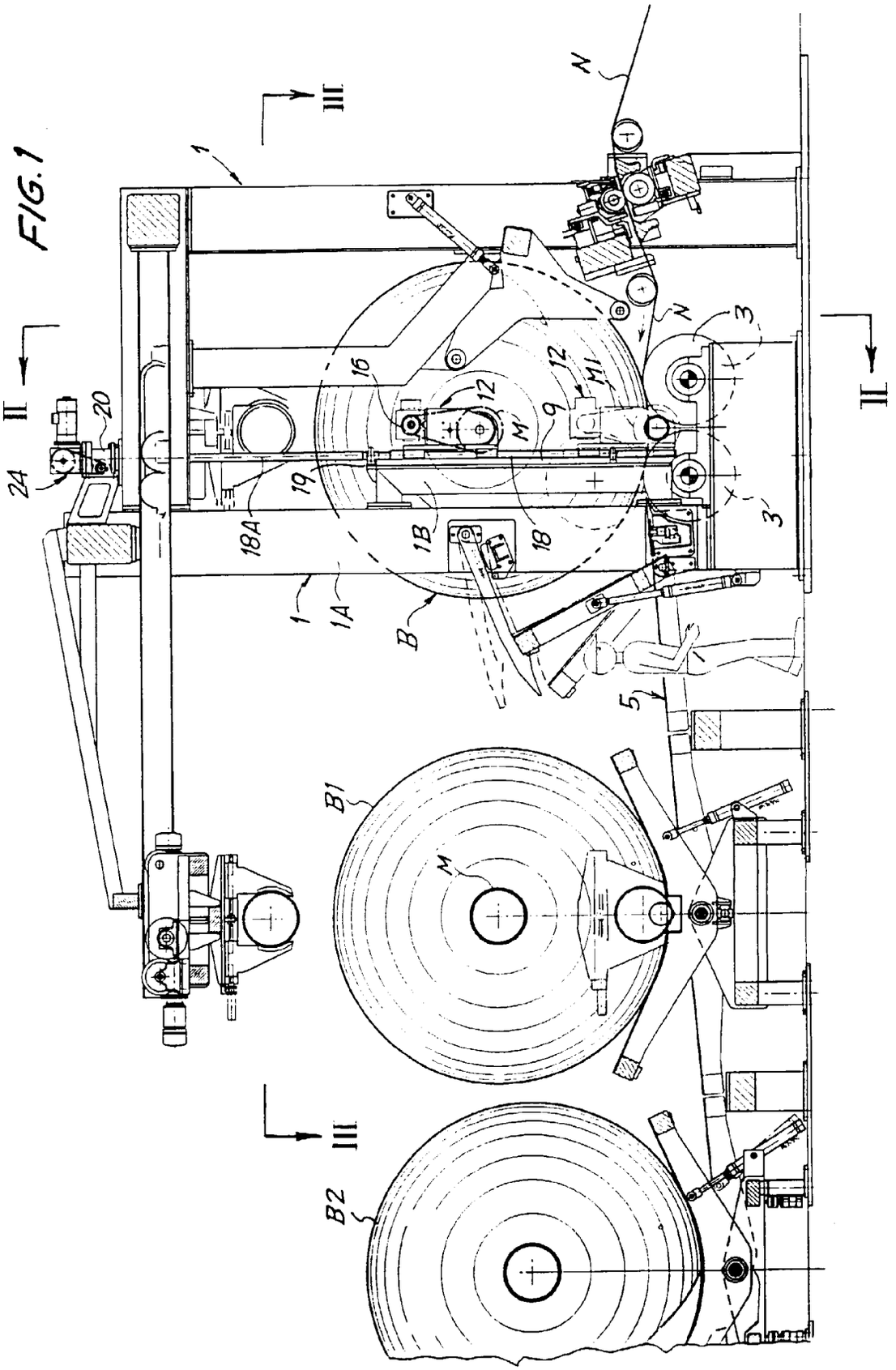


FIG. 2

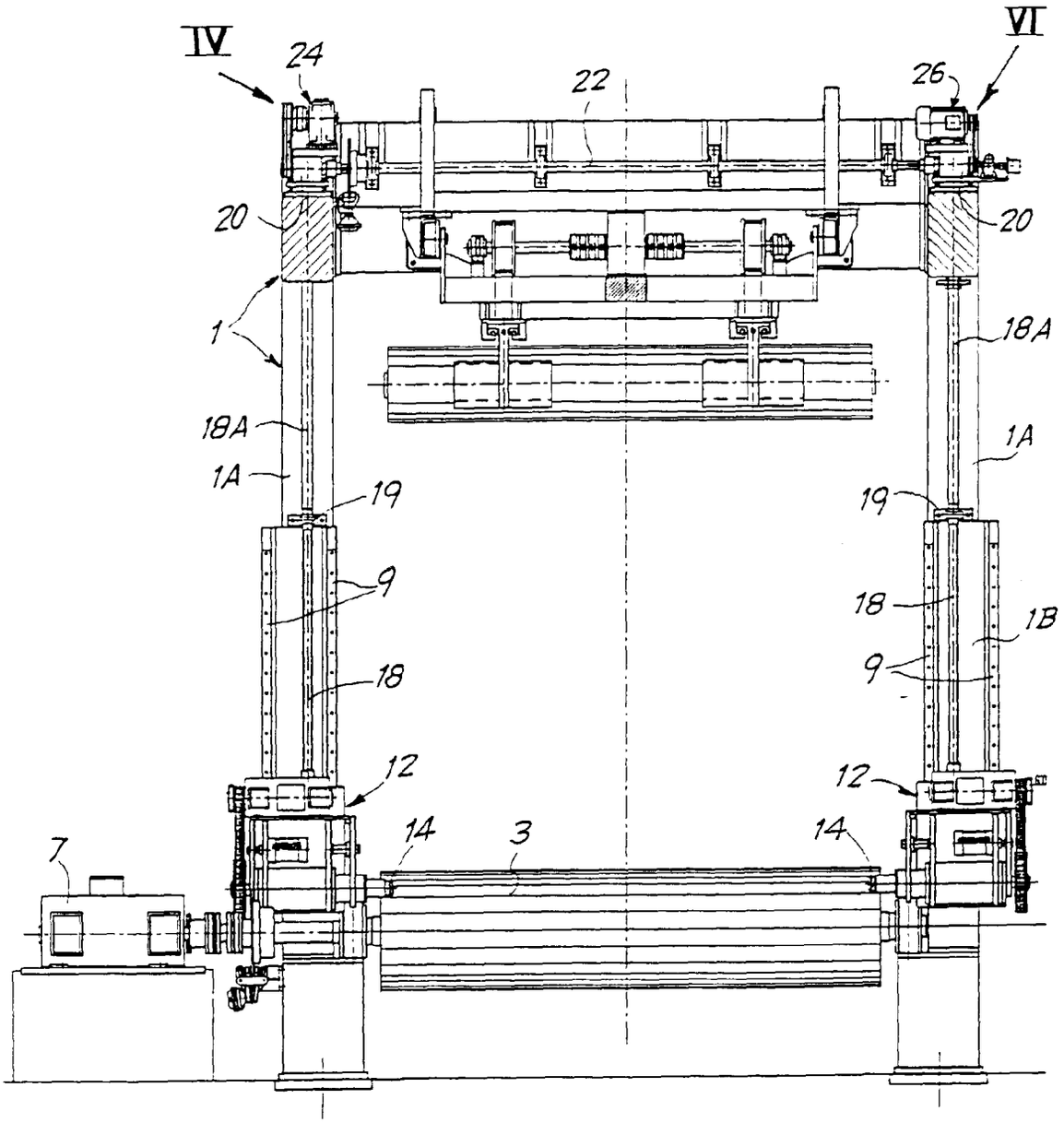


FIG.3

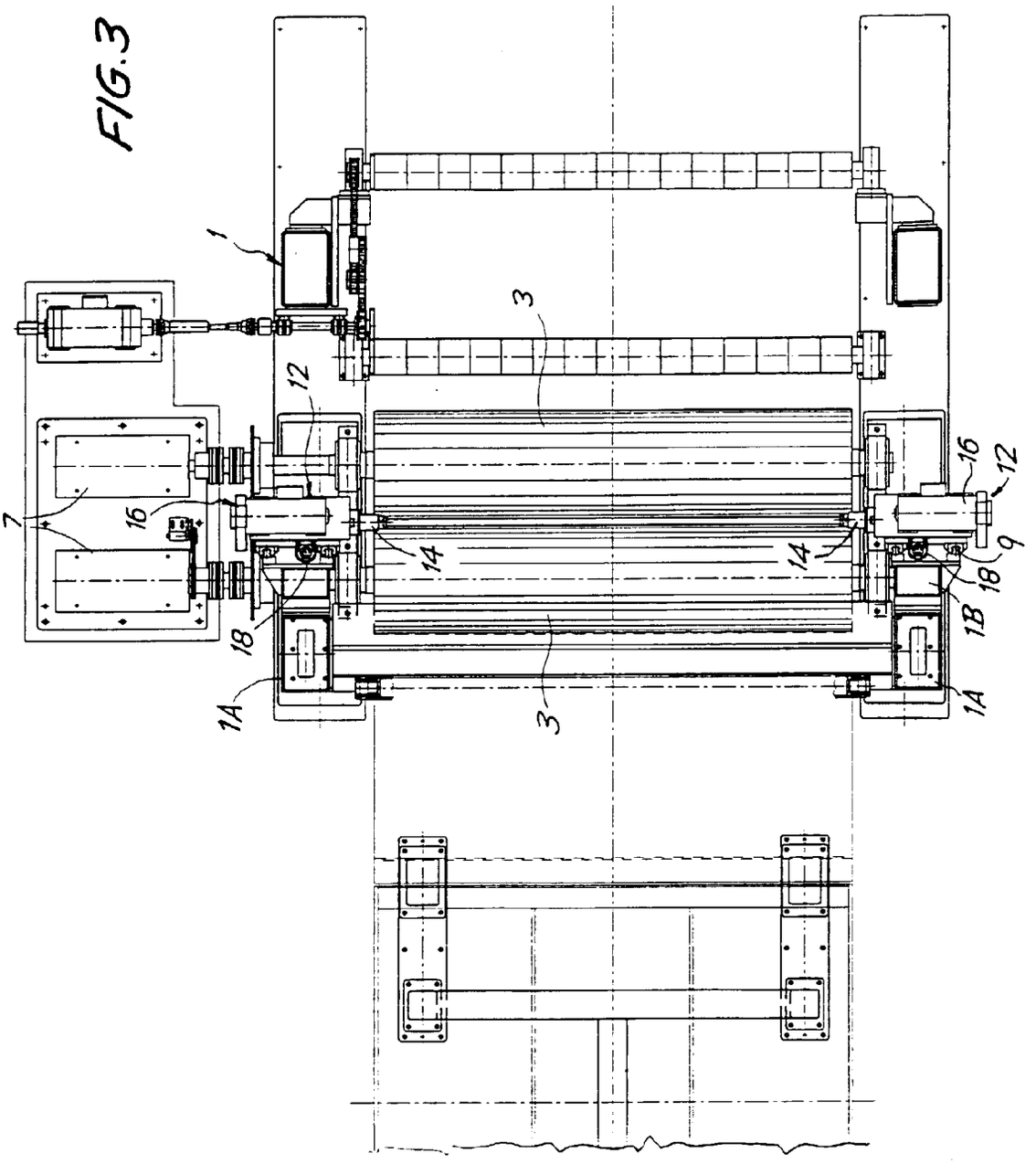
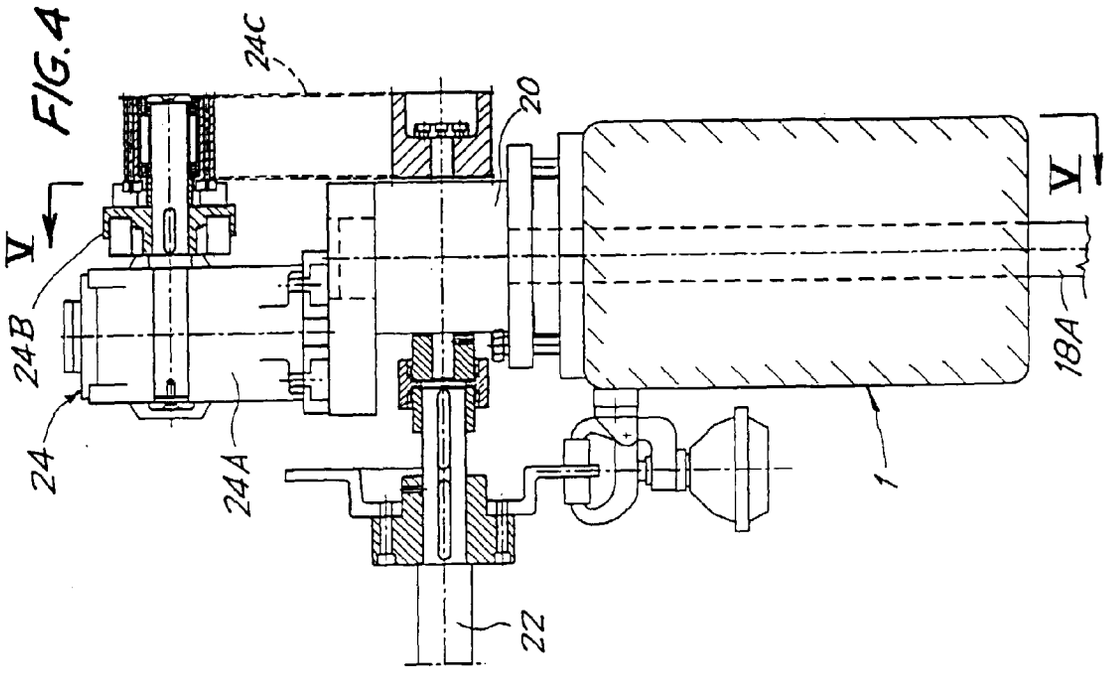


FIG.4



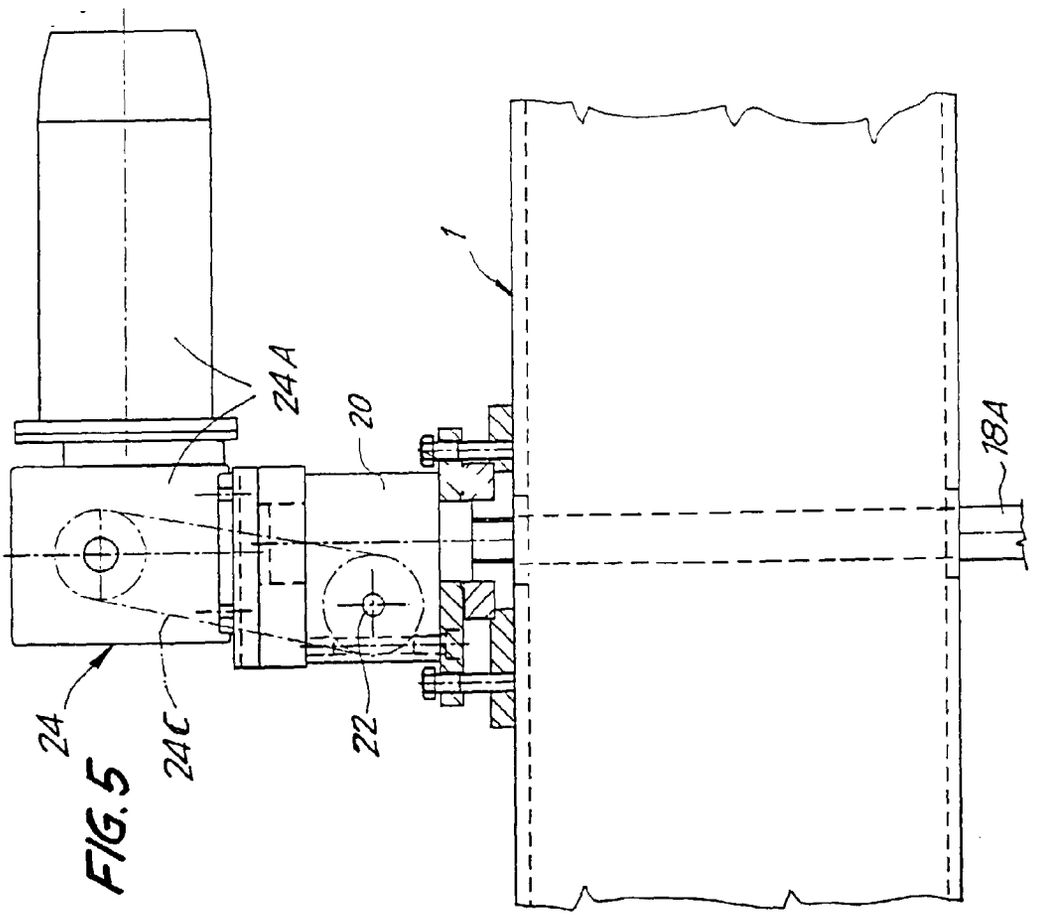


FIG.5

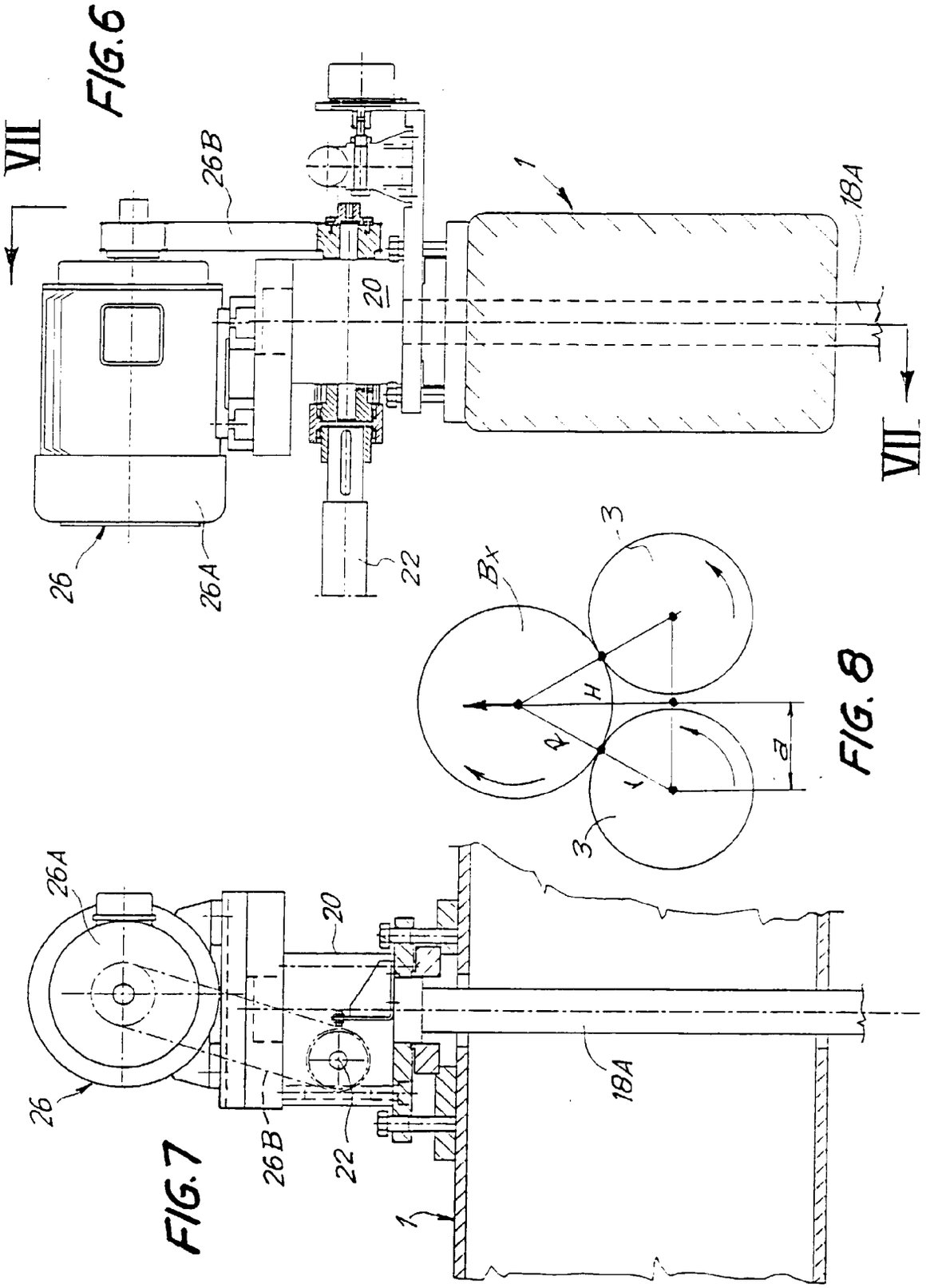


FIG.6

FIG.8

FIG.7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 83 0316

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)
A	EP-A-0 640 544 (BELOIT CORPORATION) * column 1, line 1 - line 34 * * column 3, line 17 - column 6, line 50; figures 1-3 *	1,2	B65H18/26 B65H18/08 B65H18/00
A	EP-A-0 330 257 (FORMIA NUOVA S.R.L.) * the whole document *	1,3-6	
A	US-A-3 306 547 (REID ET AL) * the whole document *	1,3-5	
A	GB-A-2 268 476 (SHIMIZU MACHINERY CO. LTD. ET AL) * the whole document *	1,3-5	
A	DE-C-38 36 367 (J.M. VOITH GMBH) * the whole document *	1,3-6	
A	US-A-4 025 009 (C. FINEO) * column 6, line 62 - column 8, line 40; figures 3-8 *	1,3-5	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 September 1996	Raven, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

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

EPO FORM 1503 03.82 (P04C01)