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(54) **Device to control the feeding of the strap in a strapping machine**

(57) Device to control the feeding of the strap in a strapping machine, comprising at least one fast driving wheel (4) and one slow driving wheel (2) which are mounted on fixed axes, the strap (R) being guided on the periphery of both said driving wheels, and wherein pressure means (5 and 14) are provided to press the strap (R) against the periphery of one and/or the other of said driving wheels, so as to ensure feeding thereof, said pressure means being mounted on an oscillating sector (8) which is operated in response to tensioning of the strap; on said oscillating sector (8) there is also mounted a strap transmission wheel (13), located at a distance from said pressure means, which imparts on the oscillating sector (8), according to the tension of the strap (R), an oscillation such as to transfer the contact pressure of the strap from the fast driving wheel (4) - for the fast recovery step - onto the slow driving wheel (2) - for the slow tightening step - merely through the alternative action of said pressure means.

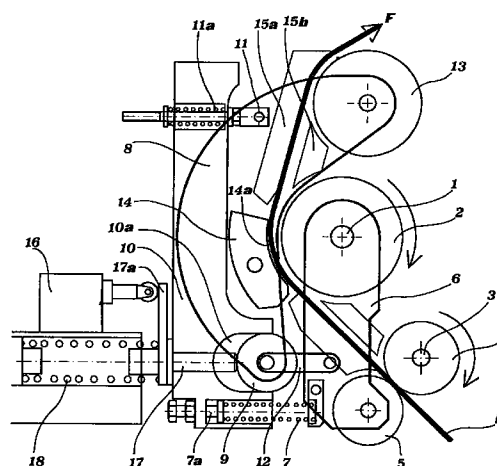


Fig. 2

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Description

The present invention concerns a strapping machine and, more particularly, a device to control the feeding of the strap, allowing a more precise and rapid control of the strap stopping or speed-changing function during its recovery, that is, closing and tightening of the strap around the packed product to be fastened.

As known, machines of this type comprise drive means which draw the strap from a reel, launch it into a special guide track around the product to be packed, and then recover it - after its leading end has been blocked or clamped - so as to wind it around the product with a preset tension. Further means then provide to tie and cut the strap after its windup.

It is also known that the modern packing technique requires, on one hand, short operating times and thus high strap launching and recovery speeds and, on the other hand, the possibility to regulate the tensioning of the strap to a wide extent, these two requirements often being scarcely compatible.

A strapping machine which tries to satisfy these requirements is described, for example, in the Italian Patent No. 1.135.722, filed on March 24, 1981, by the same Applicant, to which reference is made herein for a better understanding of the present invention. This machine has turned out to be more than satisfactory for many years, but it is no longer apt to fully satisfy the present requirements of packing speed.

One of the problems arising with the increase of the strap feeding speed is to obtain its instant and prompt stopping at the end of the launching stroke and, respectively, at the end of the recovery stroke.

Especially during fast recovery of the strap, the inertia of the machine parts and thus the effect of residual drag of the strap resulting therefrom, causes an undesired tightening thereof around the product to be packed, at a tension higher than that expected, which may often cause damage to said product.

These problems have already been solved in the strapping machine described in the Italian Patent Application No. MI92A 002957 filed on 23rd December 1992, and in the EP-A1-0603868 filed on 22nd December 1993, both in the name of the same Applicant. This strapping machine provides very high performances with a perfectly regular and very precise working, but it also involves very high production costs.

Other strapping machines are known from DE-4014307, US-3526187, US-5379576 and US-4516488.

The object of the present invention is to thus realize a strapping machine which enables, with a simpler and more economic structure, to perfectly control the tensioning of the strap, during its recovery, and then the stopping thereof, so that the packed product may be fastened with a perfectly registered tightening. In a strapping machine of the general type described heretofore, said object is reached by means of the characteristics indicated in Claim 1.

Further characteristics and advantages of the

strapping machine according to the invention will anyhow be more evident from the following detailed description of a preferred embodiment thereof, given by way of example and illustrated on the accompanying drawings, in which:

Fig. 1 shows, very diagrammatically, a strapping machine according to the invention;

Fig. 2 shows the strap driving unit of the strapping machine, during launching of the strap;

Fig. 3 shows the same unit of fig. 2, during fast recovery of the strap;

Fig. 4 shows the same driving unit, during the speed-changing steps; and

Fig. 5 shows the same driving unit, during slow recovery, that is, during tightening of the strap around the product being packed.

As shown diagrammatically in fig. 1, a strapping machine generally comprises a guiding channel C for the strap, forming a closed-ring path - through which is moved the product P to be fastened (shown only by a dash-and-dot line) - and a strapping head T, which mainly includes a strap driving unit T1 (to launch the strap along the path C and recover the same) and a strap welding unit T2 to weld the ends of the strap.

The working of a machine of this type includes - as described more clearly in the patents cited further above - the following steps: a strap launching step, in which the strap is caused to pass through the welding unit T2, and slide along the channel C (for example, in the anticlockwise direction indicated by the arrows in fig. 1) up to reaching again the welding unit T2; at this point, the end of the strap is temporarily blocked by a gripper; a strap recovery step then starts and continues until the strap has been properly tightened around the product P; the final step consists in welding the two ends of the strap and in cutting the same.

In particular, the object of the invention is the strap launching and recovery unit T1 which, as pointed out further above, forms the most critical part of the machine. According to the invention, and as shown in fig. 2, said unit comprises a drive shaft 1, rotating clockwise at low speed - hereinafter, the clockwise direction will be that indicated by the rotation arrow referring to the shaft 1 in fig. 2 - and being active during slow recovery of the strap. On the drive shaft 1 there is mounted a driving wheel 2, by way of a so-called "freewheel" mechanism, which allows to draw the strap only in an anticlockwise direction.

A second drive shaft 3 is rotated at high speed and carries, keyed thereon, a fast driving wheel 4; said shaft 3 is active both during the launching step, with a clockwise rotation (see arrow in fig. 2), and during the fast recovery step, with an anticlockwise rotation (see arrow in figs. 3 and 4).

Preferably, the shafts 1 and 3 are driven by a single motor, which drives the shaft 1 through a reduction gear, and thus at low speed but with a high drawing force, and

which directly drives the shaft 3, whose wheel 4 rotates at high speed but with less drawing force.

A pressure wheel 5 cooperates moreover with the driving wheel 4, to ensure drawing of the strap R interposed between said wheels.

The pressure wheel 5 is mounted freely rotating on a shaft supported by an arm 6 which is mounted oscillating on the same axis of the shaft 1; a spring 7 imparts onto the arm 6 a thrust, which can be regulated by way of an adjusting element 7a, and which determines the pressure of the wheel 5 against the wheel 4.

To the side of the arm 6 and of the wheel 2 there is mounted oscillating an arched sector 8; said oscillation is obtained (between two guiding sides, not shown), on one side by pivoting the lower end of the sector 8 onto the axis of a roller 9, which is in turn guided so as to slide horizontalwise into a groove 10a of a fixed support 10 of the unit T1, and on the other side by anchoring the upper end of the sector 8 onto a bracket 11, also sliding horizontalwise along the support 10, in opposition to the spring 11a. A link rod 12 forms an articulated connection between the axis of the roller 9 and the oscillating arm 6.

A transmission wheel 13 is mounted freely rotating at the upper end of the sector 8. Furthermore, substantially at the centre of the sector 8 there is fixed a pressure pad 14, whose arc-shaped surface 14a is centred on the axis of the shaft 1 and thus runs parallel to the periphery of the wheel 2; the surface 14a facing the wheel 2 is perfectly smooth, to act as an anti-friction surface for the purpose better specified hereunder. A guide 15a-15b, is moreover fixed to the sector 8 for the function indicated hereinafter.

Finally, a microswitch 16 is mounted on the fixed support 10, said microswitch being operated by a rod 17, 17a, moved by the roller 9 in opposition to the adjustable spring 18.

The aforescribed strapping head works as follows:

a) During the launching step (fig. 2), the strap R - driven by the wheels 4 and 5 - is drawn in the direction of the arrow F towards the surface 14a of the pressure pad 14 fixed to the sector 8; from here, it is deviated towards the guide 15a-15b and then towards the channel C (fig. 1), in a substantially known manner. During this step, the strap always remains properly spaced both from the wheel 2 and from the wheel 13.

b) During the fast recovery step (fig. 3), the strap R - still driven by the wheels 4 and 5, but this time in a direction F' opposite to the previous one - gets in contact with the wheels 2 and 13, which are driven into a fast rotation due to friction of the strap R. Thanks to the freewheel mechanism, the wheel 2 is apt to rotate at high speed, even if its shaft 1 rotates at low speed.

c) During the speed-changing step, followed by slow tightening, that is, at the moment in which the

strap starts to get in contact with the surface of the product having to be fastened, it is almost stopped against the product to be packed and it instantly becomes tensioned; by reaction, this produces a pressure on the only yielding surface, which is the wheel 13, causing this latter to move in the direction of the arrow S (fig. 4) and thereby causing the clockwise oscillation of the sector 8. One may easily imagine a sequence wherein:

- to start with, a very slight clockwise oscillation of the sector 8 is produced about the fulcrum formed by the axis of the roller 9, with compression of the spring 11a, until the surface 14a of the pad 14 bears against the periphery of the wheel 2. This produces the only effect to guarantee a perfect coupling between the strap R and the surface of the wheel 2, seen that the strap - which still moves fast, driven by the wheels 4 and 5 - is free to slide against the smooth surface 14a, with no friction, while it clings onto the friction surface of the wheel 2. Said oscillation - as can be easily understood - is very slight since, as the wheel 13 moves further in the direction S, under the pressure of the strap which is tightening around the product P to be fastened,
- a stronger oscillation is produced just after; in fact, as shown in fig. 5, as the pad 14 presses against the wheel 2, the sector 8 rotates about a new fulcrum formed by the actual pad 14. This leads the roller 9 to slide in a direction 5', always guided into the groove 10a, and to thus also draw the oscillating arm 6 by way of the link rod 12, against the action of the spring 7, into a clockwise rotation (arrow S') which leads the wheel 5 to move apart from the driving wheel 4. As the pressure wheel 5 moves away from the wheel 4, the drawing action on this latter ceases, while the pad 14 simultaneously keeps the strap R always perfectly adherent to the wheel 2; this latter, which is now driven by the shaft 1 through the operative freewheel mechanism, draws the strap at low speed up to tightening the product P with the desired strength;
- said strength is regulated by adjusting the resistance opposed by the spring 7 and by the contrast spring 18 of the microswitch 16; in fact as said resistance is overcome, the sector 8 further oscillates in a clockwise direction, always about the fulcrum formed by the pad 14, causing the roller 9 to move backward and press the rod 17-17a, which controls the closing of the microswitch and thereby stops the working of the machine.

It is appropriate to place in evidence a further important advantage of the control device according to

the invention, determined by the fact that the strap path on the driving and transmission wheels is fairly "smooth"; in other words, the strap is not forced - as it happens instead in prior art, especially US-4516488 and US-5379576 - to follow arc-shaped paths develop-
 ing through wide angles, which normally create the inconvenience that, in the event of a prolonged stop, the strap remains permanently deformed, with subsequent risk of jamming when the machine starts working again.

Another considerable advantage lies in the fact that the rotation axes of the wheels 2 and 4 are fixed, whereby the motors driving the shafts 1 and 3 do not have to be mounted on oscillating or otherwise movable structures, to the full advantage of structural simplicity.

It is anyhow understood that the invention is not limited to the particular embodiment described heretofore, which merely forms a non-limiting example of its scope, but that many modifications can be introduced, all within reach of a technician skilled in the art, without thereby departing from the protection scope of the present invention.

Claims

1. Device to control the feeding of the strap in a strap-
 ing machine - of the type comprising at least one
 fast driving wheel (4) and one slow driving wheel
 (2), the strap (R) being guided on the periphery of
 both said driving wheels, and wherein pressure
 means are provided to press the strap (R) against
 the periphery of one and/or the other of said driving
 wheels, so as to ensure feeding thereof, said pres-
 sure means being moved by an oscillating sector
 (8) which is operated in response to tensioning of
 the strap,
 characterized in that,
 - said fast driving wheel (4) and said slow driving
 wheel (2) are mounted on fixed axes and
 rotated by respective drive shafts (3 and 1)
 which are always active;
 - said slow driving wheel (2) is mounted on the
 respective drive shaft (1) through a freewheel
 mechanism;
 - said pressure means comprise a first and a
 second pressure element, mounted on said
 oscillating sector (8) and apt to press said strap
 (R) into contact with said fast driving wheel (4)
 or, respectively, with said slow driving wheel
 (2); and
 - on said oscillating sector (8) there is also
 mounted a strap transmission wheel (13),
 located at a distance from said pressure ele-
 ments and in a position such as to form an
 angle of deviation of the strap path, during the
 recovery step the strap (R) being in contact
 with said fast driving wheel (4), and the ten-
 sioning of the strap causing, by action on said
 transmission wheel (13), an oscillation of said
 sector (8) such as to transfer the contact pres-
 sure of the strap from the fast driving wheel (4)
 - for the fast recovery step - onto the slow driv-
 ing wheel (2) - for the slow tightening step -
 merely through the alternative action of said
 pressure elements.
2. Control device as in claim 1), wherein said first
 pressure element consists of a pressure wheel (5),
 mounted freely rotating on a movable shaft.
3. Control device as in claim 2), wherein said shaft of
 the pressure wheel (5) is supported by an arm (6)
 mounted oscillating about the fixed axis of the slow
 driving wheel (2).
4. Control device as in claim 3), comprising adjustable
 spring pressure means (7), acting on said oscillat-
 ing arm (6) so as to determine the drawing pressure
 of said pressure wheel (5).
5. Control device as in claim 4), wherein said oscillat-
 ing arm (6) is connected to said oscillating sector
 (8) by way of an articulated link rod (12).
6. Control device as in claim 5), wherein said oscillat-
 ing sector (8) is pivoted, at its end articulated on
 said link rod (12), onto the axis of a roller (9), which
 is slidable along a fixed guide groove (10, 10a).
7. Control device as in claim 6), wherein to said fixed
 guide groove there are associated stopping means,
 cooperating with said sliding roller (9) at the end of
 its travel.
8. Control device as in claim 7), wherein said stopping
 means consist of a microswitch (16) and of a rod
 (17-17a) operating this latter, to said rod there
 being associated adjustable spring means (18).
9. Control device as in claim 1), wherein said second
 pressure element consists of a pressure pad (14)
 fixed on said oscillating sector (8).
10. Control device as in claim 9), wherein said pressure
 pad (14) has an arc-shaped surface (14a), concen-
 tric and parallel to the peripheral surface of said
 slow driving wheel (2) and having a low coefficient
 of friction.
11. Control device as in claim 1), 5) or 10), wherein said
 transmission wheel (13) is mounted freely rotating
 at the end of said oscillating sector (8) opposite to
 that of articulation on said link rod (12).

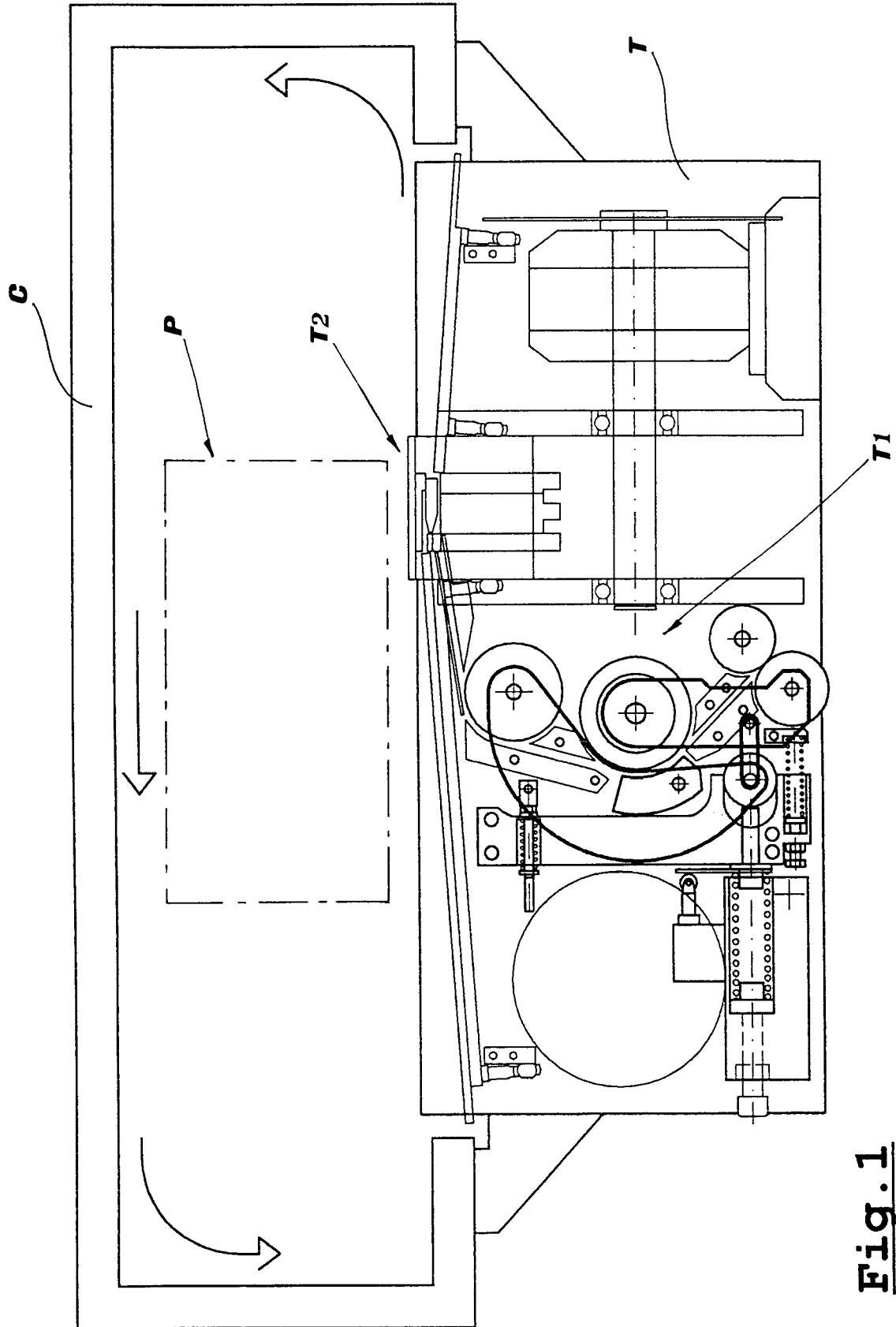


Fig. 1

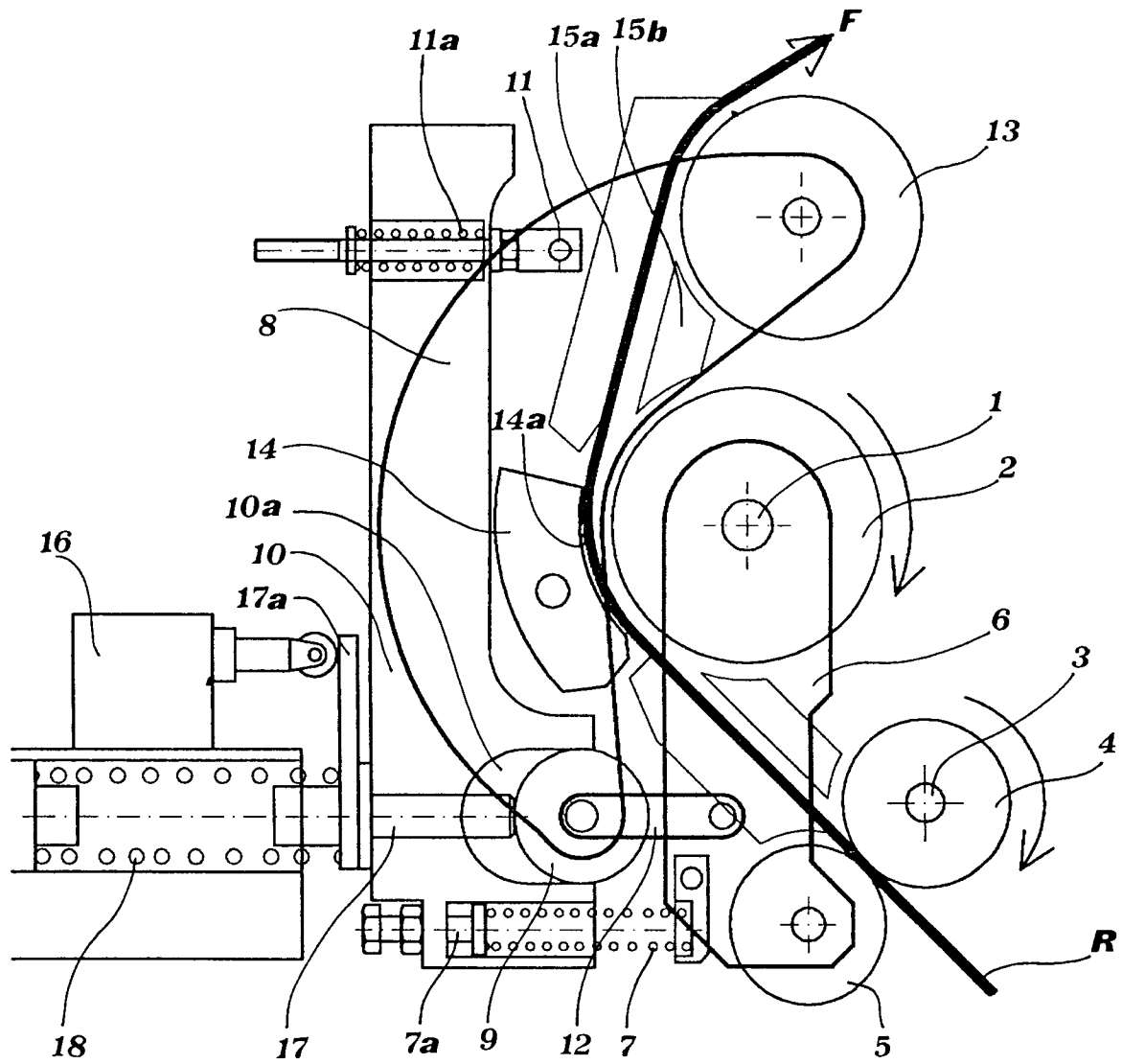


Fig. 2

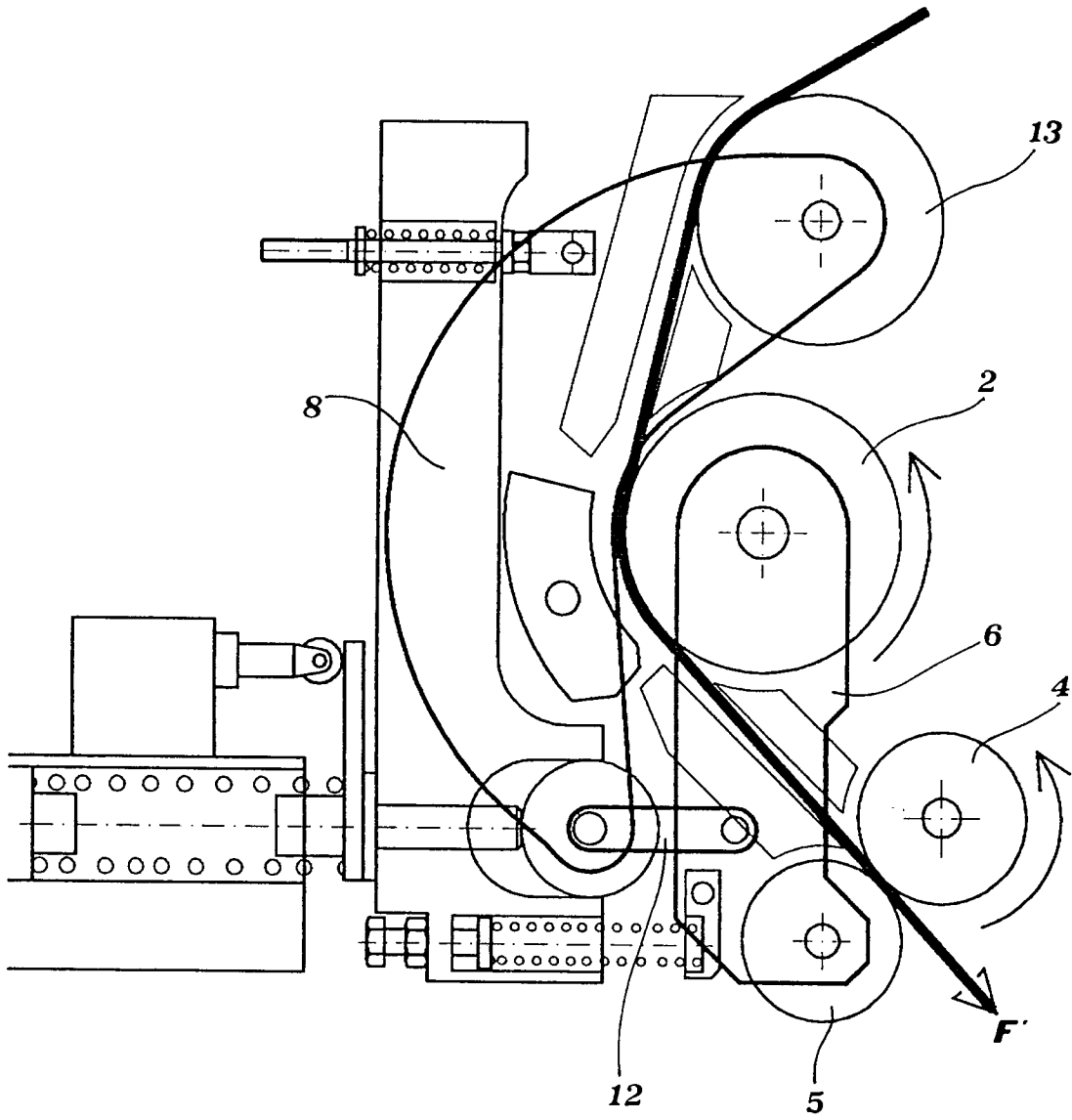


Fig. 3

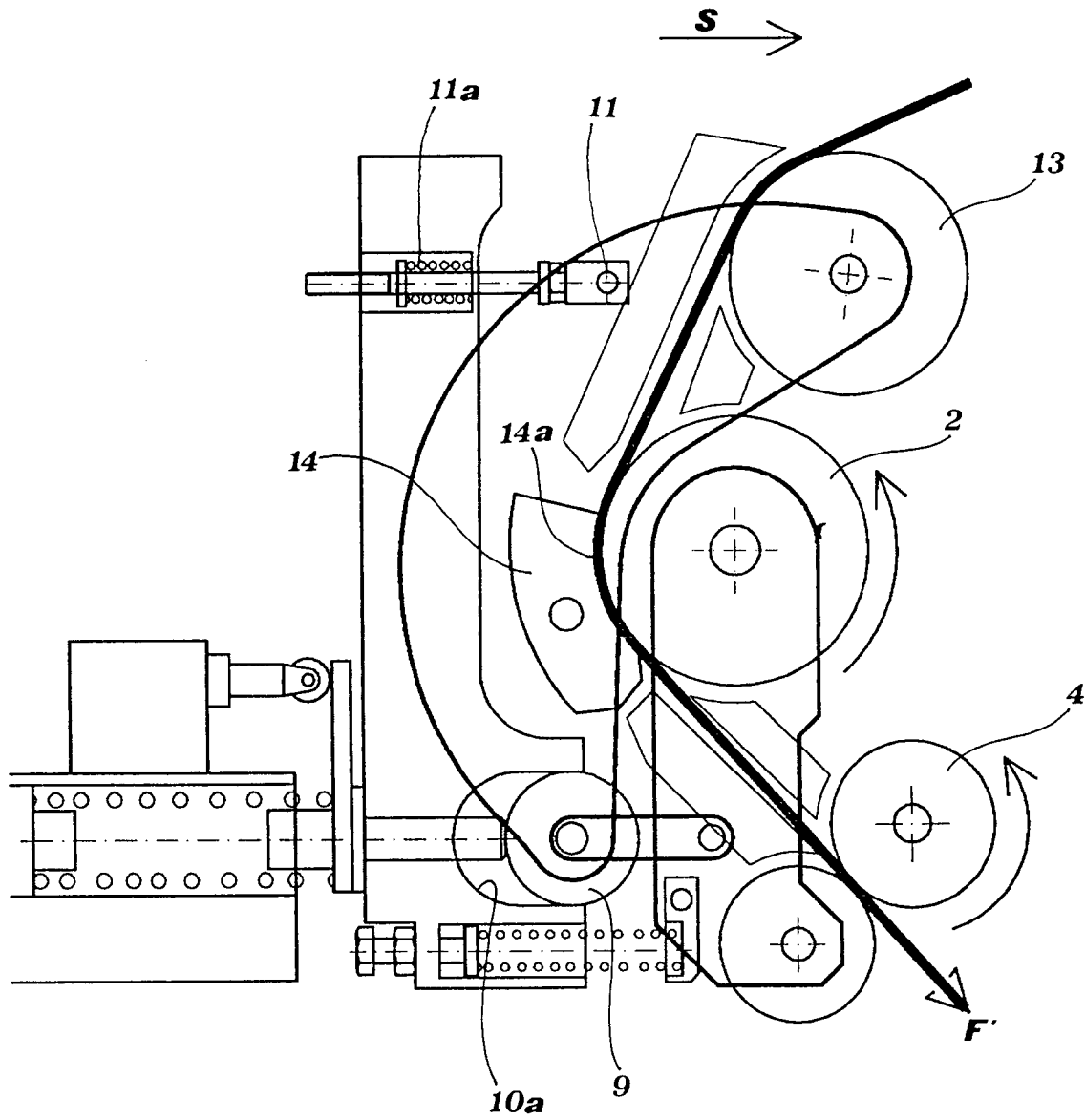


Fig. 4

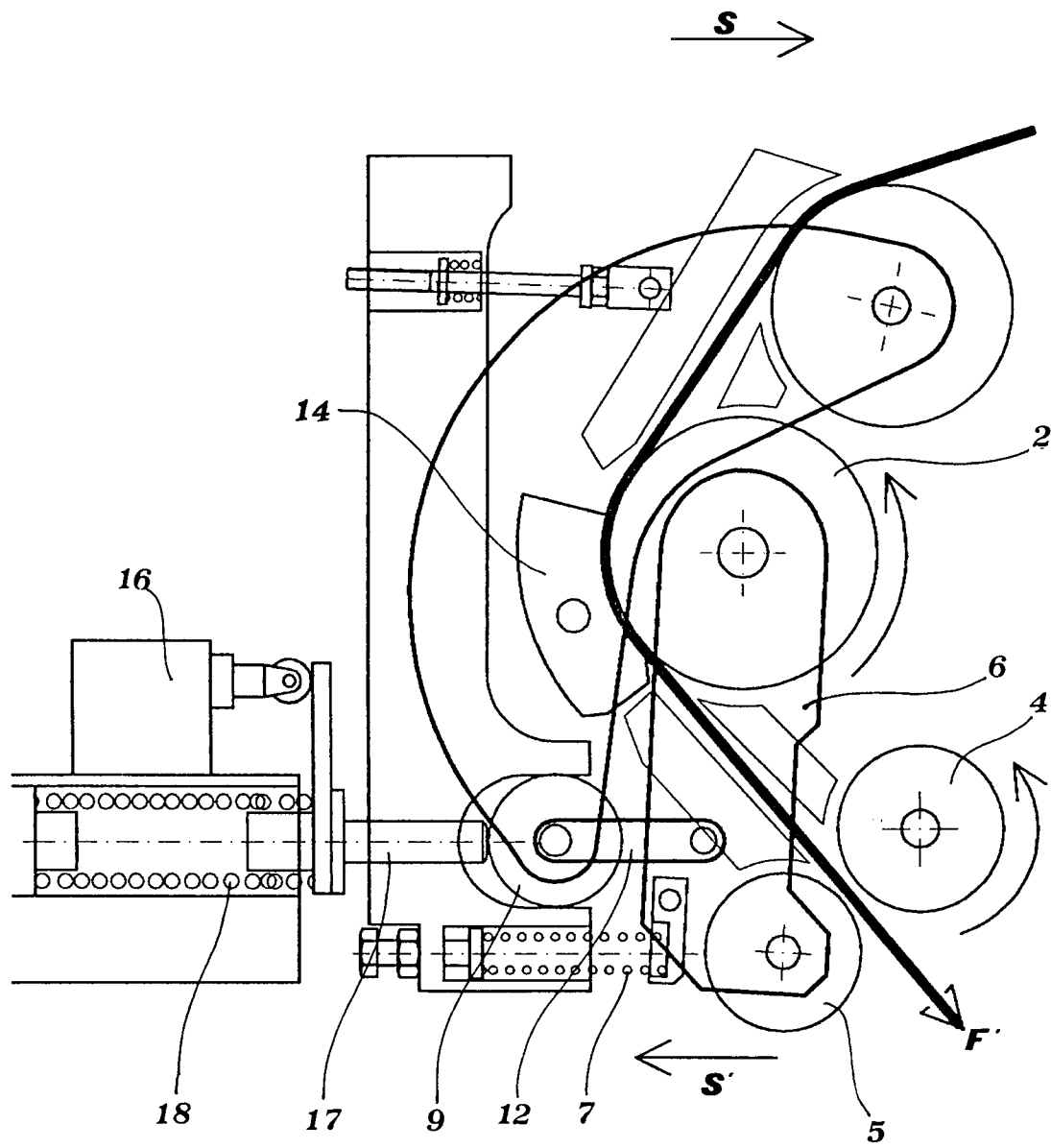


Fig. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 97 10 4393

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)
D,A	DE 40 14 307 A (RMO SYSTEMPACK) * column 3, line 66 - column 6, line 40; figures *	1-3,9,10	B65B13/22
D,A	US 3 526 187 A (A. GILLIARD) * column 3, line 41 - column 6, line 37; figures *	1-4	
D,A	US 5 379 576 A (STRAPACK) * column 10, line 57 - column 13, line 28; figures *	1,2	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B65B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		17 June 1997	Jagusiak, A
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			

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