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(71) Applicant: **Messersì Packaging S.R.L.**
60010 Barbara (AN) (IT)

(72) Inventor: **UBERTINI, Massimiliano**
I-60019 Senigallia (AN) (IT)

(74) Representative: **Lampis, Marco et al**
Dragotti & Associati Srl
Via Nino Bixio, 7
20129 Milano (IT)

(54) STRAPPING MACHINE WITH AN IMPROVED UNIT FOR MOVING THE STRAP

(57) A strapping machine comprises an outlet (10) for a strap to be wound around a product and a system (11) for delivering, recalling and tensioning the strap. This system (11) comprises a drive unit (13) for delivering and recalling the strap, having a first drive wheel (14) and a counter-pressure wheel (15) which rests, under the action of a spring member (20), against the first drive wheel (14) with the strap (12) arranged in between so as to guide it a first speed determined by the first drive wheel (14). A second tensioning drive wheel (16) is also provided and is normally kept spaced from the counter-pressure wheel (15) by means of a further spring member (17). The strap (12) passes around the drive wheel (16) directed from the drive unit (13) towards the outlet (10) of the strapping machine. Once a predefined tension value of the strap being recalled is exceeded, the second tensioning drive wheel (16) moves against the action of the further elastic member (17) and rests and pushes against the counter-pressure wheel (15) with the strap (12) arranged in between, so as to disengage the counter-pressure wheel (15) from the first drive wheel (14) and guide the strap (12) during tensioning at a second speed determined by the second drive wheel (16).

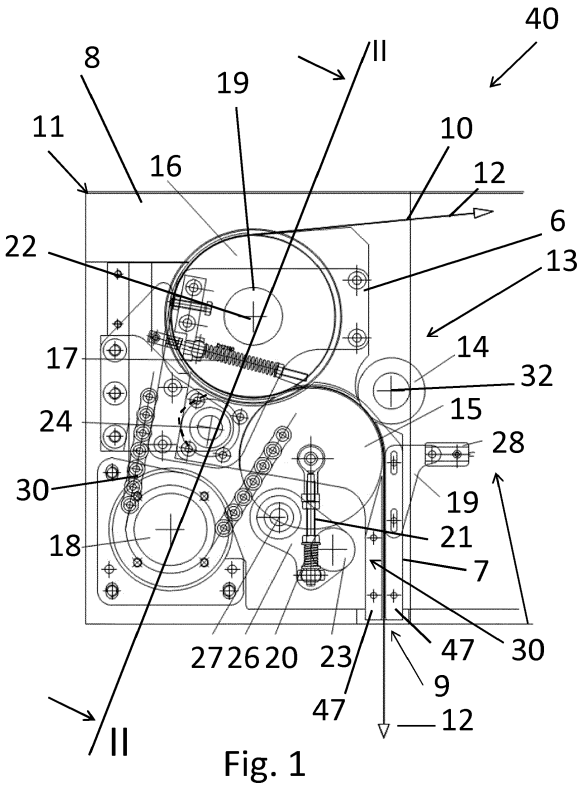

Fig. 1

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Description

[0001] The present invention relates to a strapping machine, namely a machine used to seal packages with a plastic tape of various thicknesses and widths, called a "strap" or "band". In particular, the invention relates to an innovative strap delivery, recall and pulling unit in the machine. More particularly, the invention relates to a mechanical system for changing automatically from the step for fast recall of the strap to the strap tensioning step.

[0002] In strapping machines the strap delivery, recall and tensioning unit is extremely important for determining the performance characteristics of the entire machine which may be obtained. Firstly, this unit is important for determining the speed with which most of the operations resulting in the formation of a strapped package may be performed. Secondly, the strap being recalled must not strike violently the product to be packaged so as to avoid damaging it and/or avoid being damaging itself on any corners or projecting parts of the package. Finally, any folding or bending of the strap which may be caused during the delivery or recall operations may produce a defect in the strap or, worse still, may result in jamming of the machine.

[0003] One possible solution in the strapping machines according to the prior art is to performing delivery and recall of the strap around a product to be strapped by means of at least one pair of wheels (a drive wheel and counter-pressure wheel) which push (during delivery) and pull (during recall) the strap at high speeds (for example, within a range 4 to 7 m/s) so as to reduce the working time needed to process the single product to be packaged, and a second device which performs tensioning of the strap at a slow speed.

[0004] The contact pressure between the drive wheel and the counter-pressure wheel must therefore be adjusted so as to allow the drive wheel to pass lightly over the strap. When the counter-pressure wheel stops, an electric sensor detects the stoppage thereof. The various systems for subsequently tensioning the strap to a desired value are than activated by means of this signal.

[0005] This solution, however, is complex, costly and may result in possible jamming due, among other things, to the difficulty of suitably synchronizing the transition between the various steps.

[0006] The object of the present invention is to provide a strapping machine provided with a simplified system for changing from the recall speed to the tensioning speed (which may also be 40 times less than the recall speed) and for speeding up the working cycle.

[0007] In view of this object, the idea which has occurred is to provide a strapping machine as claimed in Claim 1. This machine comprises an outlet for a strap to be wound around a product and a strap delivery, recall and tensioning system, and said system comprises: a drive unit for delivering and recalling the strap, composed of a first drive wheel and a counter-pressure wheel which rests against the first drive wheel with the strap arranged in between under the action of a first spring member; a second tensioning drive wheel which is kept spaced from the counter-pressure wheel by means of a second spring member and around which the strap passes directed from the drive unit towards the outlet of the strapping machine; and a mechanical system for changing from the recall step to the strap pulling step, comprising the second tensioning drive wheel which, when a predetermined tension value of the strap is exceeded during recall of the strap guided by the first drive wheel at a first speed, is pulled by the strap so as to move against the action of the second spring member and pushed against the counter-pressure wheel with the strap arranged in between so as to displace the counter-pressure wheel, disengage the counter-pressure wheel from the first drive wheel and pull the strap during tensioning at a second speed slower than the first speed.

[0008] Further characteristic features and advantages of the invention will emerge from the description hereinbelow of a number of preferred embodiments thereof provided by way of a non-limiting example with reference to the accompanying drawings. In these drawings:

- Figure 1 shows a schematic front view of the strap delivery, recall and tensioning system according to the invention;
- Figures 2 shows a partial schematic view, along the line II-II of the front view of Figure 1, which highlights a tensioning drive wheel, rotation of which is guided by a free wheel connected by means of a chain to a speed reduction unit;
- Figure 3 is a schematic and partial rear view of the system according to Figure 1, showing an end-of-travel mechanism of the tensioning device and movement transmission system.

[0009] With reference to the figures, a strapping machine (indicated generally by 40) comprises a reel (for simpler illustration not shown in the figures) which feeds a strap 12 to the machine, a system 11 for delivering, recalling and tensioning the strap 12 and strap gripping, welding and cutting units (not shown in the figures). The gripping, welding and cutting units are substantially known per se and may be imagined by the person skilled in the art. They will therefore not be further described or illustrated.

[0010] The figures in fact show and describe the part of the machine which is usually called the "strapping head".

[0011] Figure 1 shows in greater detail the system 11 for delivering, recalling and tensioning the strap 12. This system comprises an inlet 9, to which the strap 12 is fed by the feeder reel, and an outlet 10, from where the strap is directed towards a packaging zone where the pack to be wound with the strap is arranged. During delivery, the strap enters via the inlet 9 and passes into a delivery and recall drive unit 13 of the system 11. It then travels along the periphery of a second tensioning drive wheel 16 which

is kept detached from the counter-pressure wheel 15 by means of a spring member 17, creating an arc which may be equal, for example, to about 180° along its path, until it exits from the outlet 10 towards the product to be strapped. The drive unit 13 comprises a first delivery and recall drive wheel 14 and a counter-pressure wheel 15 between which the strap passes, so that usually the counter-pressure wheel rests against the drive wheel with the strap arranged in between.

[0012] The first drive wheel 14, which with its rotation defines a first speed for delivering and recalling the strap 12, has preferably its axis of rotation 32 fixed and secured to the frame 8 of the strapping machine.

[0013] The counter-pressure wheel 15 is movable in a direction transverse to its axis of rotation so as to be able to move away from the first drive wheel 14 and is pushed into contact with the first drive wheel 14 by a second spring member 20. The second spring member 20, for example, is mounted on a rod 21 which connects the axis of the wheel 15 to an articulated joint supported by a lever 26 pivoted at 27. Guiding means (not shown) define the direction (for example, substantially vertical direction) along which the wheel 15 may move when moving away from the drive wheel 14.

[0014] The second tensioning drive wheel 16 is pivotably mounted at 22 on a first lever 6 pivoted on a pin 24 so as to be also movable in a direction transverse to its axis of rotation 22.

[0015] In Figure 1, but in greater detail in Figure 2 also, it is possible to see how the tensioning drive wheel 16 is advantageously connected by means of a free wheel 19 (in a free direction of the wheel 16 which is anti-clockwise in Figure 1) to a rotational motor 18, for example also by means of a suitable transmission as will become clear below.

[0016] The rotational motor 18 may operate continuously the free wheel 19 at a second speed (less than that produced by the strap driving movement of the drive wheel 14) in the opposite direction to the direction of delivery of the strap 12. Consequently, as will become clear below, the motor 18 may suitably drive at the second slower speed the second tensioning drive wheel 16 when it is not rotationally driven at a fast speed by the strap pulled during recall by the wheel 14. It should be noted that the strap 12 is not braked by the second tensioning drive wheel 16 during the recall step, since the strap 12 in this condition is biased so as to remain on the outside of the tensioning drive wheel 16, without any or with only limited contact thereon.

[0017] Both the first drive wheel 14 and the second tensioning drive wheel 16 may be operated by the same rotational motor 18 by means of two suitable transmissions which are able to achieve the desired two different speeds of these wheels and therefore of the strap driving speed. For example, as can be clearly seen from a comparison of Figures 2 and 3, the motor 18 may have on its shaft a pulley 43 which drives a toothed belt 44 which causes rotation of the first drive wheel 14. The toothed belt 44 may also operate an input pulley 46 of a reduction unit 33. The reduction unit 33 has preferably an output with a gearwheel 42 which via the transmission chain 30 operates a gearwheel 41 which causes rotation of the free wheel 19. Both or either one of the chain and reduction unit may be present, depending on the desired transmission ratios and/or the relative positions of the various components to be operated.

[0018] As can be understood from Figure 1, after the delivery step during which the drive wheel 14 is made to rotate by the motor rapidly in the clockwise direction, the recall step starts and during this step the motor 18 reverses the direction of rotation such that the first drive wheel 14 reverses the direction of rotation and, together with the counter-pressure wheel 15, recalls the strap 12 from outside through the outlet 10. In this condition, the strap 12 comes into contact with the second tensioning drive wheel 16 because the second tensioning drive wheel 16 is located upstream of the first drive wheel 14 and the counter-pressure wheel 15 which, instead, are situated downstream of the recall operation. During recall, a step which is therefore performed at the first speed higher than the second speed and determined by the drive wheel 14, the free wheel 19 allows the second tensioning drive wheel 16 to be disengaged from the rotational motor 18 and to rotate fast at the recall speed determined by the first drive wheel 14.

[0019] When the strap, during the recall step, comes into contact with the strapped product, the tension of the strap 12 starts to act on the wheel 16, tending to displace it against the action of the spring member 17 (lowering it as shown in Figure 1). For example, in the embodiment shown, the lever 6 on which the second tensioning drive wheel 16 is mounted - the latter rotating rapidly at the first speed, driven by the strap 12 which is pulled in turn by the first driving wheel 14 - is biased so as to rotate on the pin 24 in the clockwise direction until it comes into contact with the counter-pressure wheel 15. At this point, the counter-pressure wheel 15, under the pressure exerted by the second tensioning drive wheel 16, overcomes the thrust of the second spring member 20 and is detached from the first drive wheel 14. The strap 12, at this point, is pressed between the second tensioning drive wheel 16 and the counter-pressure wheel 15 and, since first drive wheel 14 is no longer acting on the strap, the action of the free wheel 19 is triggered and this engages the wheel 16 and thus causes this second tensioning drive wheel 16 to rotate at the predefined second speed (for example determined by the speed reduction unit 33 and the corresponding transmission which connects it to the motor), resulting in driving of the strap being recalled at a speed slower than the first speed (for example determined by the rotational motor 18 and by the corresponding belt transmission 44), but with a greater driving torque produced by the different transmission ratio.

[0020] The change in speed may occur very rapidly (approximately a few milliseconds), owing to the fact that,

at a speed of the strap equal to a few metres per second, only a very small displacement of the second tensioning drive wheel 16 and the counter-pressure wheel 15, for example about 1 mm, is needed, in order to disengage the wheel 14 and engage the wheel 16, and the impact of the strap 12 on the strapped product is absorbed by the spring member 17 and by the spring member 20.

[0021] The more the strap 12 is pulled, the greater is the movement of the second tensioning drive wheel 16 and the counter-pressure wheel 15 which thus continue to be displaced against the action of the associated spring members. In the structure shown, as a result of this biasing action, the counter-pressure wheel 15 moves against the spring member 20 along the rod 20. It should be noted that advantageously the contact arc formed by the strap on the second tensioning drive wheel 16 becomes relatively large (for example greater than 180°) and therefore the grip of the strap in the pulling system is suitably ensured.

[0022] In order to interrupt the tensioning action of the strap when a desired tension is reached, a suitable stop device 30 is provided, said device being sensitive to the displacement of the wheels 15 and 16 due to tensioning of the strap.

[0023] Figures 1 and 3 show a preferred embodiment of this tensioning stop device 30. During pulling, the displacement of the counter-pressure wheel 15 operates finally the stop device 30 which terminates the strapping operation. Preferably, the stop device 30 comprises a roller 23, which is suitably positioned underneath the counter-pressure roller 15 so as to be displaced (against the action of an associated spring member 25) by the thrust of the counter-pressure wheel 15 after a predetermined displacement thereof, so as to allow operation of a stop microswitch 28 which interrupts the pulling action (for example stopping the motor).

[0024] The roller 23 may be mounted for its movement (transverse to its axis of rotation) on a third lever 26 pivoted on a rotatable pin 27 on which a fourth lever 29 is in turn fixed (Figure 3). Advantageously, by means of the pin 27, the two levers 27 and 29 perform an integral movement about the axis of the pin 27 determined by the thrust of the counter-pressure wheel 15 on the roller 23. When there is no thrust, the levers 26 and 29 (and consequently the roller 23) are kept in position by the thrust exerted by a third spring member 25.

[0025] In order to operate the switch 28 a second lever 7 may be provided and may be advantageously pivoted on the pin 24 so as to be integrally connected to the first lever 6 on which the second drive wheel 16 is mounted. Under the thrust of the strap being tensioned on the second drive wheel 16, the second lever 7 continues to be made to rotate about the pivot 24 until it operates the switch 28, while the roller 23, in turn, moves against the action of the third spring member 25, said action being transmitted via the pivot from the fourth lever 29 to the third lever 26. Advantageously, the resistance produced by the third spring member 25 is greater than that of the second spring member 20 so as to allow the spring member 20 to reach the end of its travel path. The final tensioning action on the strap is therefore advantageously adjusted substantially by the spring member 25 alone. Moreover, the load of the spring member 25 can be advantageously adjusted by means of a compression knob 31 so as to obtain the desired tensioning of the strap during pulling.

[0026] Essentially, during pulling, the counter-pressure roller 15, pushed downwards by the tension of the strap, at a certain point during the movement comes into contact with the roller 30, thus causing rotation of the levers 26 and 29 against the action of the spring member 25, which is suitably adjusted. The movement against the action of the spring member 25 finally causes operation of the microswitch when the correct strap tension is reached.

[0027] Advantageously, operation of the microswitch occurs owing to the fact that a locating element 19 is positioned on the second lever 7 and, upon reaching a predefined position, operates the microswitch 28.

[0028] The lever 7 may also have guiding elements 47 which guide the strap towards the wheel 15.

[0029] At this point the strap tensioning step is stopped.

[0030] To summarize, when the correct tension of the strap is reached, by setting a load on the third spring member 25 by means of an adjustable tensioning element 31, the pulling cycle is terminated. The devices for welding and cutting the strap which has been closed around the package are then activated in a known manner (upon operation again, for example, of the microswitch 28). The machine is thus ready for a following strapping cycle, with a new delivery, recall and tensioning operation.

[0031] At this point it is clear how the predefined objects have been achieved, providing a totally mechanical system which is simple and reliable. It is also possible to use a single motor for delivering, recalling and tensioning the strap, changing automatically from the recall speed to the tensioning speed without using electromagnet coupling devices or cycle steps with system control cams or other devices which increase the complexity and the costs.

[0032] In addition to simple operation, the working cycle time is also substantially reduced.

[0033] Obviously, the above description of an embodiment applying the innovative principles of the present invention is provided by way of example of these innovative principles and must therefore not be regarded as limiting the scope of the rights claimed herein. For example, the support systems for the wheels which allow displacement thereof by the strap pulling action may be different from those shown. For example, suitably shaped sliding guides may be used. The machine may also comprise any other mechanism or accessory device known for these types of machines.

Claims

1. Strapping machine comprising an outlet (10) for a strap to be wound around a product and a system (11) for delivering, recalling and tensioning the strap, **characterized in that** said system comprises:

   - a drive unit (13) for delivering and recalling the strap, composed of a first drive wheel (14) and a counter-pressure wheel (15) which rests against the first drive wheel (14) with the strap (12) arranged in between under the action of a first spring member (20);
   - a second tensioning drive wheel (16) kept spaced from the counter-pressure wheel (15) by means of a second spring member (17), around which the strap (12) passes directed from the drive unit towards the outlet (10) of the strapping machine; and
   - a mechanical system for changing from a recall step to a strap pulling step, comprising the second tensioning drive wheel (16) which, when a predetermined tension value of the recalled strap guided by the first drive wheel (14) at a first speed is exceeded, is pulled by the strap so as to move against the action of the second spring member (17) and push against the counter-pressure wheel (15) with the strap (12) arranged in between so as to displace the counter-pressure wheel (15), disengage the counter-pressure wheel (15) from the first drive wheel (14) and pull the strap (12) during tensioning at a speed slower than the first speed, the second tensioning drive wheel (16) being connected to a rotational motor (18) via a free wheel (19) so as to allow the free rotation of the second drive wheel (16) under the action of the strap which is recalled by the drive unit (13) at the first speed and connect the second drive wheel to the motor (18) so as to rotate the tensioning drive wheel (16) at a second speed when there is no action of the first drive wheel (14) on the strap.

2. Strapping machine according to Claim 1, **characterized in that** the counter-pressure wheel (15) of the drive unit (13) is movable against the action of the first spring member (20) when the counter-pressure wheel (15) is pushed by the second tensioning drive wheel (16) so as to operate a device (30) for stopping the second tensioning drive wheel (16).

3. Strapping machine according to Claim 2, **characterized in that** the tensioning stop device (30) comprises:

   - a roller (23) movable against the action of a third spring member (25) under the thrust of the counter-pressure wheel (15).
   - a locating element (19) moving integrally with the movement of the second tensioning drive wheel (16); and
   - a microswitch (28) which is operated by the locating element (19) when the counter-pressure wheel (19) moves by a predetermined amount against the action of the third spring member (25) which pushes against the roller (23).

4. Strapping machine according to Claim 3, **characterized in that** the third spring member is adjustable so as to define the tension of the strap necessary for displacing the counter-pressure wheel which operates the microswitch (28).

5. Strapping machine according to Claim 1, **characterized in that** a chain transmission (30, 41, 42) and/or speed reduction unit (45) is present between the rotational motor (18) and free wheel (19).

6. Strapping machine according to Claim 1, **characterized in that** the first drive wheel (14) is also motor-driven by means of a connection to the rotational motor (18).

7. Strapping machine according to Claim 6, **characterized in that** the said connection of the first drive wheel (14) to the rotational motor (18) comprises a belt transmission (44).

8. Strapping machine according to Claim 6, **characterized in that** the said belt transmission (44) also passes via an input pulley (43) of the speed reduction unit (45).

9. Strapping machine according to Claim 1, **characterized in that** the second drive wheel (16) is supported by a first lever (6) pivotably mounted so as to be rotatable about an axis (24).

10. Strapping machine according to Claims 3 and 9, **characterized in that** the locating element (19) is mounted on a second lever (7) which is pivotably mounted about the same axis (24) about which the first lever (6) is pivotably mounted so as to move integrally with the movement of the second drive wheel (16).

11. Strapping machine according to Claim 3, **characterized in that** the roller (23) is supported by a third lever (26) which is pivotably mounted so as to be rotatable about a further axis (27) and on which the third spring member (25) acts.

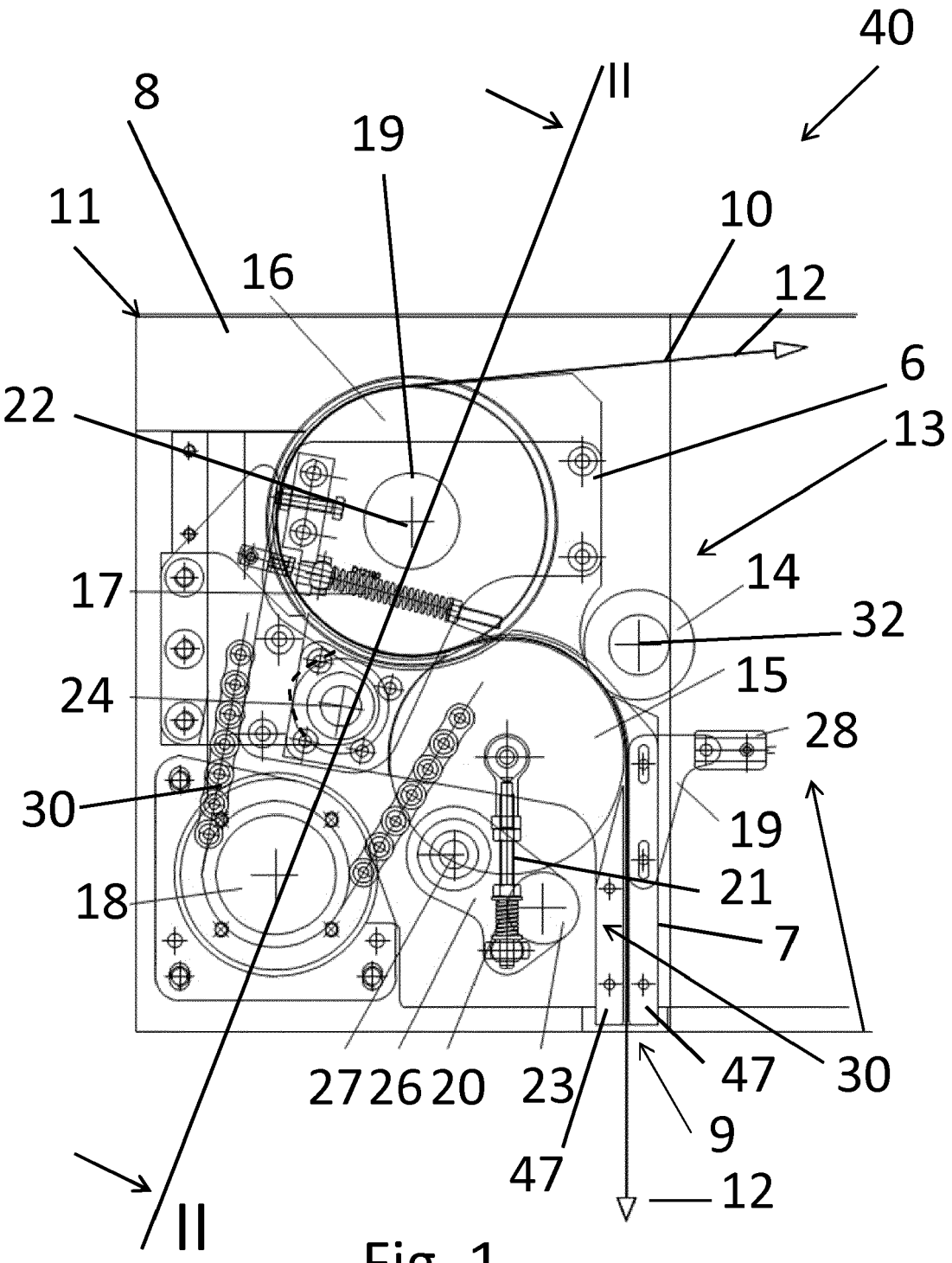
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Fig. 1

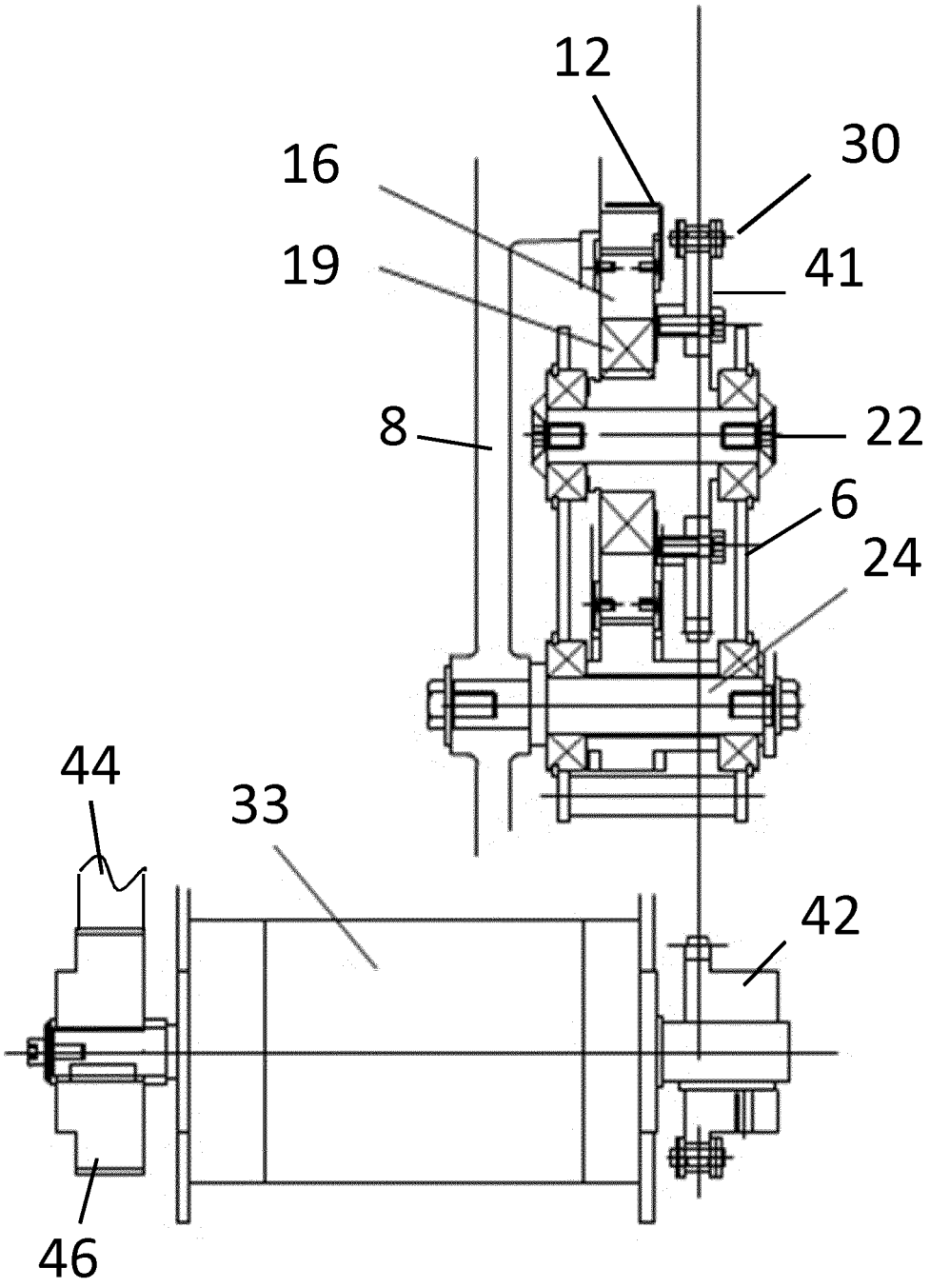

Fig. 2

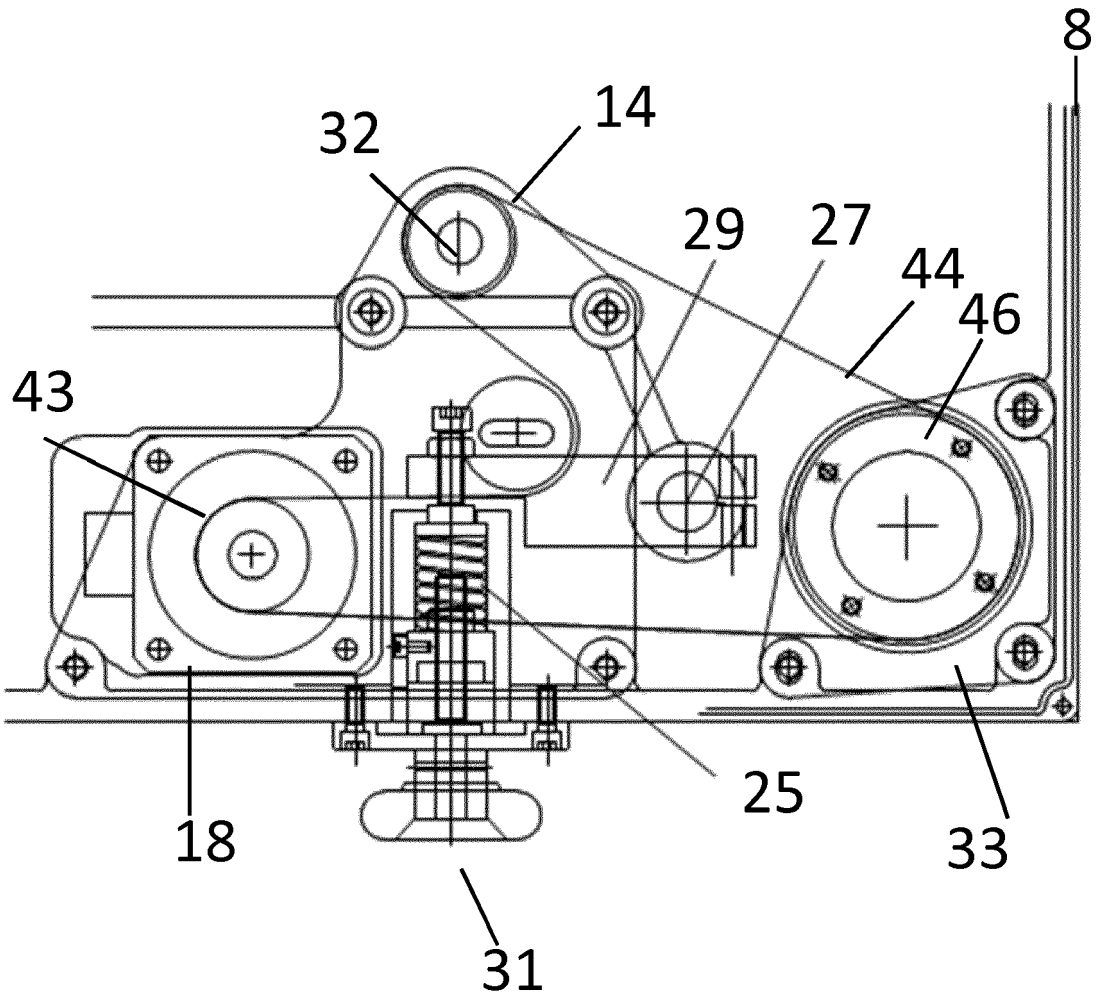

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
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B65B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 February 2018	Yazici, Baris

CATEGORY OF CITED DOCUMENTS

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