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(54) **Method and apparatus for winding continuous web material into reels**

(57) Method for controlling the winding into reel (30) comprising the steps of providing a rotary winding cylinder (13); providing at least a support (3, 23) of a rod (2, 31); winding said web material around the rod (2, 31); detecting a contact pressure (p); correlating the detected value of contact pressure (P) to at least a characteristic winding parameter; and driving said support (3, 23) to obtain predetermined values of said parameter during the winding.

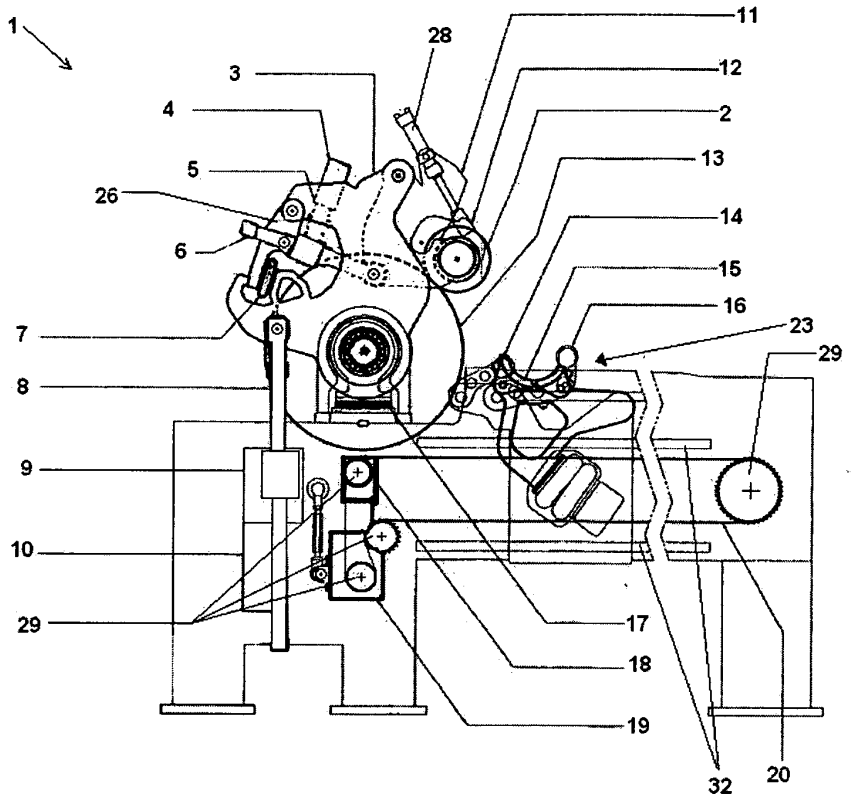

Fig.1

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Description

[0001] The present invention refers to a method and apparatus for winding continuous web material.

[0002] Winders are known in the art which comprise a motor-driven winding cylinder having hinged thereon a support so-called "primary arm" which bears a winding rod brought in contact with the cylinder.

[0003] The rod, as the winding is carried on, moves to a further support, so-called "carriage" or "secondary arm", on which a reel of web material is completed by winding, and which is intended for storage or subsequent work operations.

[0004] During the winding, the reel is kept pressed in contact with the cylinder and, depending on the value of contact pressure, there is determined the "squeezing", that is, the density and, thus the softness and quality of the reel in the course of formation.

[0005] The known winders further comprise kinematic chains for driving the primary arm and the secondary arm, which consist in general of a structure formed by pneumatic and hydraulic components connected to rigid bars or rods.

[0006] The known winders however are not without drawbacks.

[0007] A first drawback is given by the fact that, as the above said kinematic chains are made up not only of rigid elements but also of components that do not exhibit by themselves a rigid behaviour, the kinematic chain presents uncontrolled clearances and displacements of various entity. These clearances generate difficulties in the determination of the position of the winding rod and of the consequent pressure of contact thereof with the cylinder.

[0008] Since the value of contact pressure initially preset cannot be maintained with accuracy during the winding, and since said pressure, as above mentioned, is a fondamental parameter for a successful winding, it is impossible to obtain a reel having the desired quality. This drawback is due to the fact that the known kinematic chains exhibit clearances (as they are not suitably rigid) and internal frictions, so that the movement of the rod away from the cylinder is not linear but in steps, and the pressure of contact, as a consequence, does not follow a predetermined pattern but is instead generally sinusoidal.

[0009] This first drawback is particularly significant when using winders for generating reels of tissue paper, inasmuch as the pressure of contact to be maintained between the reel in the course of formation and the winding cylinder has to follow, as much as possible, a predetermined pattern throughout the winding operation in order to achieve an appropriate softness.

[0010] A second drawback is given by the fact that the known winders are not capable of revealing possible winding faults which are likey to cause a reel's quality degree less than desired.

[0011] The object of the present invention is therefore to overcome the said drawbacks with a method and apparatus for winding continuous web material which allow controlling the winding's basic parameters.

[0012] According to the invention, this object is obtained with a method and apparatus for winding continuous web material, comprising active means for controlling the motion of the rod-holder support.

[0013] The technical characteristics of the invention, according to the above object, are clearly set forth in the appended claims, and the advantages thereof will result more evident from the detailed description that follows, with reference to the attached drawings, of an embodiment to be considered a non-limiting exemple thereof. In the drawings:

- Fig. 1 is a side view of a winder according to the present invention;
- Fig. 2 is a front view of the winder in Fig. 1;
- Fig. 3 is a front view of the winder shown in the preceding figures;
- Fig 4 shows in detail the kinematic chain interposed between the winding rod and the cylinder; and
- Figs. 5 to 8 show successive steps of the winding into a reel by means of the winder shown in the preceding figure.

[0014] With reference to the attached drawings, a winder 1 for reeling continuous web material from a feeding unit comprises a winding cylinder 13 having a motor-driven axis "X" fixed to the bedplate 27 which makes up the surface onto which the incoming web material slides.

[0015] The winder 1 according to the present invention further comprises supports 23, 3 for a first 31 and second 2 winding rods bringing a reel 30 in the course of formation into contact with the cylinder 13, and controlled actuator means 6, 20 for the adjustment on command of the distance of supports 3, 23 from the cylinder 13 during the winding of the reel 30.

[0016] In the described example, the winder 1 comprises also at least one sensor 17 for detecting a contact pressure "P", preferably a load cell located between the reel 30 and the cylinder 13, and a processing unit connected to the actuator means 6, 20 and to the sensor 17 to control the movement thereof in response to the value of pressure "P" detected by the same sensor 17 during the winding stage of reel 30.

[0017] Preferably, the actuator means 6, 20 are respectively made up of electro-mechanical jacks driven by brushless motors 4 via chains, belts or screws, driven by brushless motors 18.

[0018] Advantageously, the supports 3, 23 consist respectively of a primary arm 3 hinged to the axis "X" of cylinder 13 and connected to an oscillating arm 11 carrying the second winding rod 2, and of winding carriage 23 sliding relative to the cylinder 13 along straight guides 32 and carrying the first winding rod 31. It is understood that in place of the carriage 23 it is possible to provide a "secondary arm" of a type known in the art and, therefore,

not to be described herein in greater detail.

[0019] In this configuration, the primary arm 3 and the oscillating arm 11 are connected to each other by an electro-mechanical jack 6 engaged to an equalizer 26 and a hinge "c".

[0020] Advantageously, the oscillating arm 11 comprises also a locking clamp 12 operable by a cylinder-piston means 28 fixed to the same arm 11 to retain the second winding rod 2.

[0021] The primary arm 3 is moved by an electro-mechanical jack 8 driven by one or more brushless motors 10 connected to at least one reducer 9.

[0022] In a preferred embodiment, the sensor 17 which detects the pressure "P" may be in the form either of a toroidal load cell, disposed on the axis "X" of the winding cylinder 13, or of a plate-like load cell disposed on the bedplate 27 or simply on the supports 3, 23.

[0023] Advantageously, the supports 3 also comprise a protective elastic element 7, preferably disposed between one end of the equalizer 26 and an abutment 25 formed directly on a predetermined region of the primary arm 3.

[0024] Advantageously, the elastic element 7 is an air spring, the use of this type of eleastic element allowing the user to exactly establish the rigidity thereof by increasing or reducing the internal pressure of the same spring 7.

[0025] The winding carriage 23 further exhibits driving means consisting of a drive chain 20 and a plurality of sprockets 29 - preferably connected to a brushless motor 18 and its relevant reducer 19 - to move the carriage 23 from the position of reel 30 formation by winding to the position in which the transfer of the reel 30 to a subsequent operating station, such as a stocking unit, takes place.

[0026] In particular, the carriage 23 is divided into three reciprocating parts, ensuring the locking and unlocking of the winding rod on which the reel 30 is formed: a front peg 14, a rear peg 16 and a braking peg 15.

[0027] In operation, the front peg 14 engages the rod during the changeover of reel's loading/unloading, while the peg 16 engages the rod during the winding.

[0028] With reference to Figs. 2 and 3 a winder 1 is shown, according to the present invention, exhibiting at least a torsion bar 21 disposed below the winding cylinder 13 which performs function of ensuring a sinchronized motion of both arms 3 and carriages 23.

[0029] To this end, provision is preferably made for two torsion springs, the first of which for the arms 3 and the second for the carriages 23.

[0030] Alternatively, the synchronization function may be achieved by means of suitably brusheless motors associated with each jack 8, and a brushless motor 18 associated with carriage 23.

[0031] Shown with reference to Figs. 5-8 are the subsequent steps for the operation of a winder according to the present invention.

[0032] In particular, Fig. 5 shows the step in which a reel 30 carried by the carriage 23, and being near to the end of winding, is moved away from the cylinder 13 thereby generating a gap between the same cylinder 13 and the carriage 23.

[0033] At the same time, the oscillating arm 11, on which the second rod is mounted, moves close to the winding cylinder 13 to "launch" the rod at the appropriate winding speed.

[0034] Fig. 6 shows a successive operating step in which, after having put the second rod 2 in contact with the winding cylinder 13 to generate the predetermined contact pressure "P", the winding of a fresh reel (30) is started.

[0035] Concurrently to the beginning of the winding on rod 2, there is occurs also the return in place of carriage 23 which has just released the full reel - the latter to be delivered, for example, to a storage unit located downstream of the same winder 1.

[0036] Between the step shown in Fig. 5 and the one shown in Fig. 6, the changeover of the reel, that is, the transfer of web material from the reel 30 in the course of formation to the second rod 2, takes place in a traditional manner that need not to be described in detail.

[0037] Fig. 7 shows the step in which the reel 30 in the course of formation is transferred from the oscillating arm 11 to the winding carriage 23.

[0038] This handover step takes place as a consequence of the approach of second winding rod 2, carrying the fresh reel 30 in the course of formation, to the winding carriage 23.

[0039] The primary arms 3, as they are driven into rotation by the actuators 8, transfer the reel 30, being wound around rod 2, onto the same horizontal plane of carriage 23. Once the rod is engaged by the carriage 23, the clamp 12 for the handover of reel 30 to the same carriage 23 is actuated.

[0040] Subsequent to the step of engagement of rod 2 onto the carriage 23, the clamp 12 opens up and the arms 3 return to the vertical position again by the action of jacks 8.

[0041] Shown with reference to Fig. 8 is the final winding step, in which the reel 30 continues to have material wound thereon until its completion on carriage 23 by maintaining the pressure "P" on the cylinder 13.

[0042] Also taking place during this final step is the return of the oscillating arm 11 to the raised position above the cylinder 13, ready to move again close to cylinder 13 after the second rod 2 has been driven into rotation or "launched" at the winding speed.

[0043] Taking place concurrently to the beginning of winding on rod 2, is the unloading of the full reel by the carriages 23 which, upon completion of unloading, go back to the rod 2 to take over the latter which has thereon the new reel 30 in the course of formation.

[0044] According to a further aspect of the invention, a method for controlling the winding of a reel 30 of web material comprises the steps of:

- providing a rotary winding cylinder 13;
- providing at least one support 3, 23 of a rod 2, 31 for the winding of the material;
- winding the material around the rod 2, 31 which rotates on support 3, 23 by the contact of a reel of material in the course of formation 30 with the winding cylinder 13;
- detecting, during the winding, a contact pressure "P" between the reel 30 in the course of formation and the winding cylinder 13;
- correlating the detected value of contact pressure "P" with at least a parameter, for example the softness or density of the web material, characteristic of the winding of reel 30;
- moving the support 3, 23 relative to cylinder 13 in response to the detected value of pressure "P" to obtain predetermined values of said parameter during the winding.

[0045] Advantageously, in the above described method, the detection step is performed by one or more load cells 17 responsive to the contact pressure "P" between the reel 30 and the winding cylinder 13.

[0046] The present invention obtains important advantages.

[0047] A first advantage lies in the fact that the high rigidity of the rod-holder supports 3, 23 for the movement of the winding rod 2, 31, makes it possible to accurately control, by means of the load cells 17 and data-processing unit, some parameters of basic importance for a successful winding, such as the pressure of contact between the winding cylinder 13 and the reel 30 in the course of formation, and the rate of increase of diameter of reel 30 in the course of formation, for example.

[0048] The winder 1 according to the present invention, therefore, makes it possible to control the above parameters during all the main steps of the winding operation.

[0049] In fact, the load cells 17 allows controlling the pressure "P" between the winding cylinder 13 and the reel 30 in the course of formation when the latter is at the beginning of winding, that is, when the web material begins to be wound up around the second rod 2, as well as when the winding is about to be completed on the rod 31 located on the carriage 23 which moves away from the cylinder 13 to allow the tearing of same material.

[0050] By a continuous control of these parameters it is possible to obtain the said main object, that is, causing the contact pressure "P" between the reel 30 in the course of formation and the cylinder 13 to follow a preset pattern, thereby obtaining a web material having the desired softness.

[0051] It will be appreciated that the thus conceived invention is suited for industrial application, numerous modifications and variants being possible within the scope of the inventive idea, and all the parts being possibly replaced with technically equivalent elements.

Claims

1. Method for controlling the winding into a reel (30) of web material comprises the steps of:

   providing a rotary winding cylinder (13);
   providing at least one support (3, 23) of a rod (2, 31) for the winding of the material;
   winding the material around the rod (2, 31) rotating on the support (3, 23) by the contact of a reel of material (30) in the course of formation with the winding cylinder (13);
   detecting, during the winding, a contact pressure (P) between the reel (30) in the course of formation and the winding cylinder (13);
   correlating the detected value of contact pressure (P) with at least a parameter characteristic of the winding into reel (30);
   moving the support (3, 23) relative to cylinder (13) in response to the detected value of pressure (P) to obtain predetermined values of said parameter during the winding.

2. Method according to claim 1, wherein said detection step is carried out by means of one or more load cells (17) responsive to the contact pressure (P) btween said reel (30) and said winding cylinder (13).

3. Method according to claim 1 or 2, wherein the movement of said support (3, 23) is revealed by a control unit for processing detected values of said pressure (P).

4. Method according to any of the preceding claims, wherein said suport (3) is a primary arm (3) connected to the cylinder (13) and driven by a controlled actuator (8).

5. Method according to claim 4, wherein said actuator (8) is an electro-mechanical jack driven by at least a brushless motor (5).

6. Method according to any of the preceding claims 1 to 3, wherein said suport is a winding carriage (23) movable with respect to the cylinder (13) via chains (20) driven by at least a motor brushless (18).

7. Method according to any of the preceding wherein said parameter is the softness of the reel of web material.

8. Method according to any of the preceding wherein said parameter is the winding density of the web material onto the reel.

9. Winder (1) for winding into reels of a continuous web material from a feeding unit, comprising:

a winding cylinder (13) having a motor-driven axis (X), fixed to a bedplate (27), said cylinder (13) exhibiting a surface of contact with the incoming web material;
at least a winding support (3, 23) having a rod (2, 31) disposed thereon which moves a reel (30) in the course of formation into contact with said cylinder (13);
remote-controlled actuator means (6, 20) for adjusting the distance of said support (3, 23) from said cylinder (13) during the winding of the reel (30);
at least a sensor (17) responsive to a contact pressure (P) between said reel (30) and said cylinder (13);
a processing unit connected to the actuator means (6, 8) and sensor (17) to drive the movement of said actuator means (6, 8) in response to the value of pressure (P) detected by the sensor (17) during the step of winding said reel (30).

10. Winder according to claim 9, wherein said actuator means (6) are electro-mechanical jacks driven by brushless motors (4, 10).

11. Apparatus according to claim 9 or 10, wherein said support (23) is a winding carriage (23) sliding on guides (32) and carrying said first winding rod (31).

12. Apparatus according to claim 11, wherein said winding carriage (23) is made to slide on said straight guide (32) by a drive chain (20) connected to at least a brushless motor (18) and at least a reducer (19).

13. Apparatus according to claim 11 or 12, wherein said winding carriage (23) comprises a front peg (14), a rear peg (16) and a braking peg (15) which reciprocate to lock/unlock on command the winding rod (31).

14. Apparatus according to claim 9 or 10, wherein said support (3) comprises a primary arm (3) hinged on the axis (e) of cylinder (13) and an oscillating arm (11) carrying said second winding rod (2).

15. Apparatus according to claim 14, wherein said primary arm (3) and said oscillating arm (11) are connected to each other by an electro-mechanical jack (6) engaged to an equalizer (26) and a hinge (c).

16. Apparatus according to claim 14 or 15, wherein said oscillating arm (11) comprises also a locking clamp (12) operable by a cylinder-piston means (28) fixed to the same arm (11) to retain the second winding rod (2).

17. Winder according to any of the preceding claims 14 to 16, wherein said primary arm (3) is moved by an electro-mechanical jack (8) driven by one or more brushless motors (10) connected to one or more reducers (9) .

18. Winder according to any of the preceding claims 9 to 17, wherein said sensor (17) responsive to the pressure (P) is a toroidal load cell coaxial with the winding cylinder (13).

19. Winder according to any of the preceding claims 9 to 17, wherein said sensor (17) is a flat load cell disposed on the bedplate (27) of the cylinder.

20. Winder according to any of the preceding claims 9 to 17, wherein said sensor (17) is a load cell operatively connected to said support (3, 23).

21. Winder according to any of the preceding claims 9 to 20, wherein said motorization of said winding cylinder (13) is provided by one or more brushless motors.

22. Winder according to any of the preceding claims 9 to 21, wherein said support (3, 23) further comprises a protective elastic element (7).

23. Winder according to claim 22, wherein said elastic element (7) is an air spring.

24. Winder according to claim 22 or 23, wherein said elastic element (7) is interposed between an end of said equalizer (26) and an abutment (25) formed directly on a predetermined region of the primary arm (3).

25. Winder according to any of the preceding claims further comprising at least a torsion bar (16) for synchronizing the motions of arms (3) and/or supports (23).

26. Winder according to any of the preceding claims further comprising brushless motors driven for synchronizing the motions of arms (3) and/or supports (23) .

27. Winder according to any of the preceding claims, wherein said rod-holder support (23) consist of secondary arms which are moved by at least an electromechanical jack driven by one or more brushless motors and possibly connected by torsion bars.

28. Winder according to any of the preceding claims, wherein said oscillating arms (11) are connected by at least a torsion bar for synchronizing the motions of same arms (11).

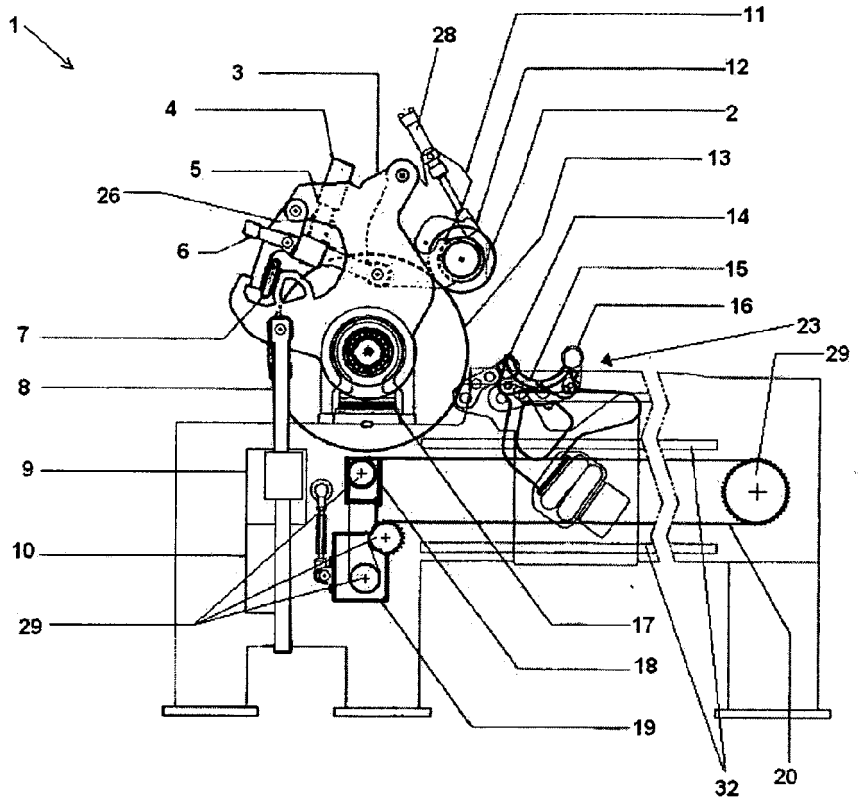
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Fig.1

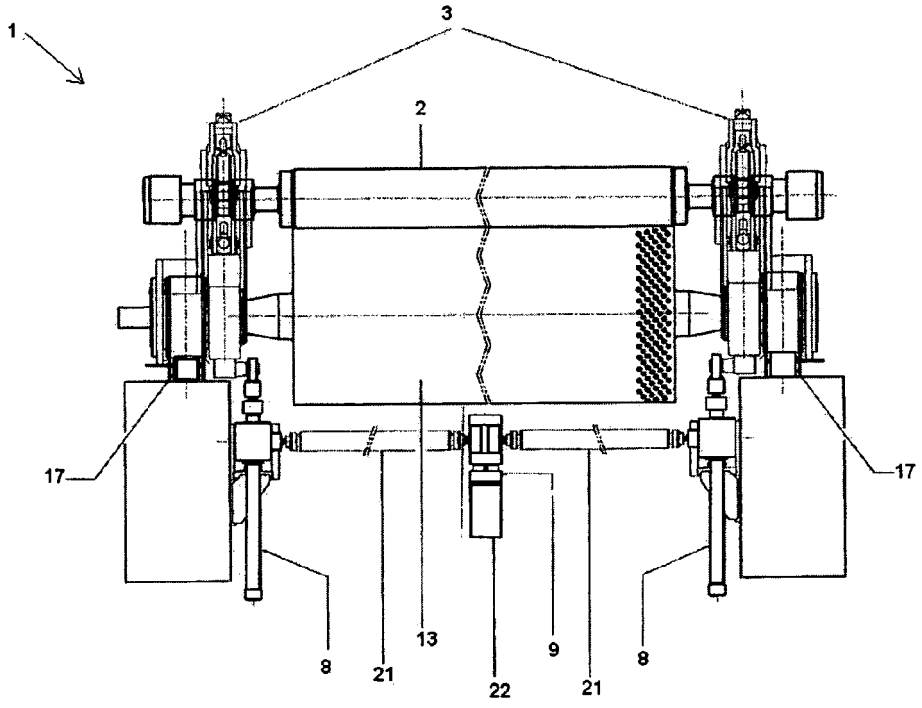
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Fig.2

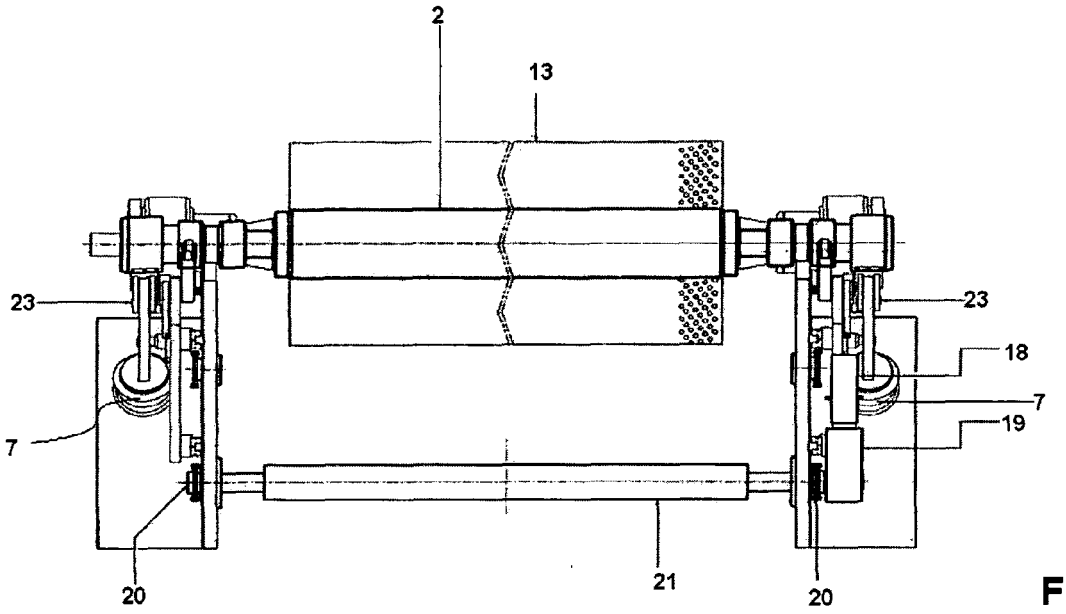

Fig.3

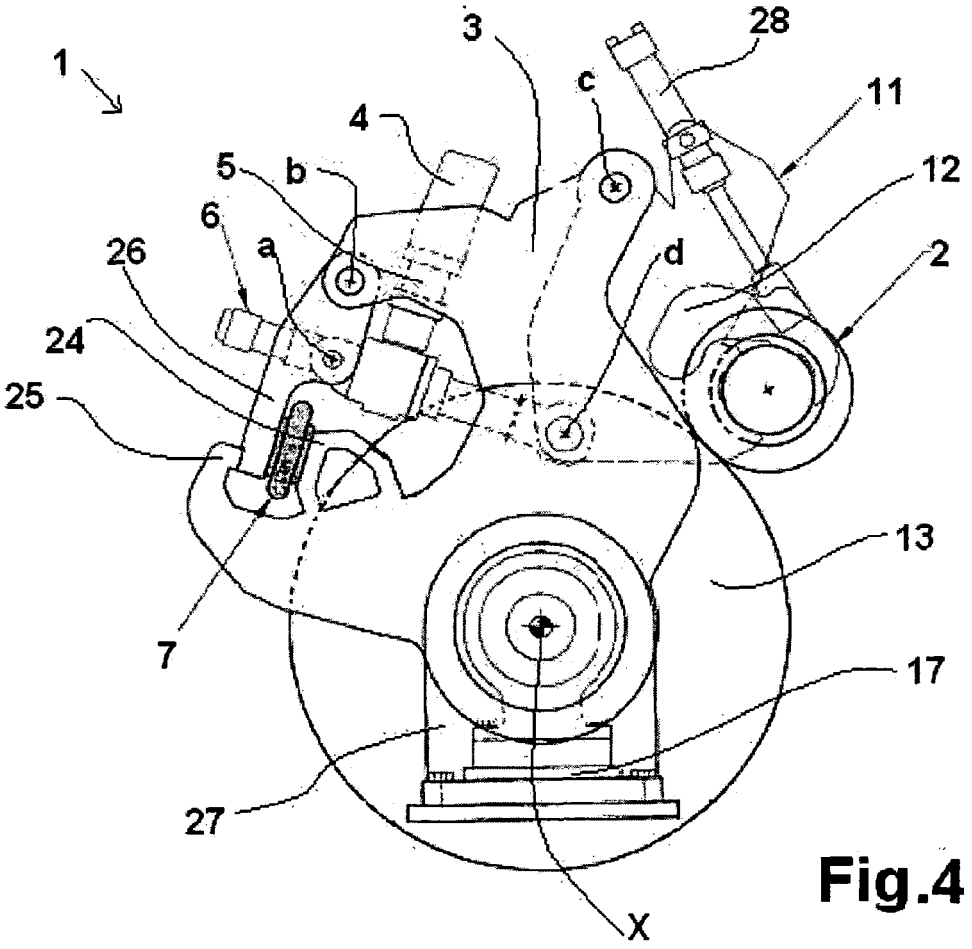

Fig.4

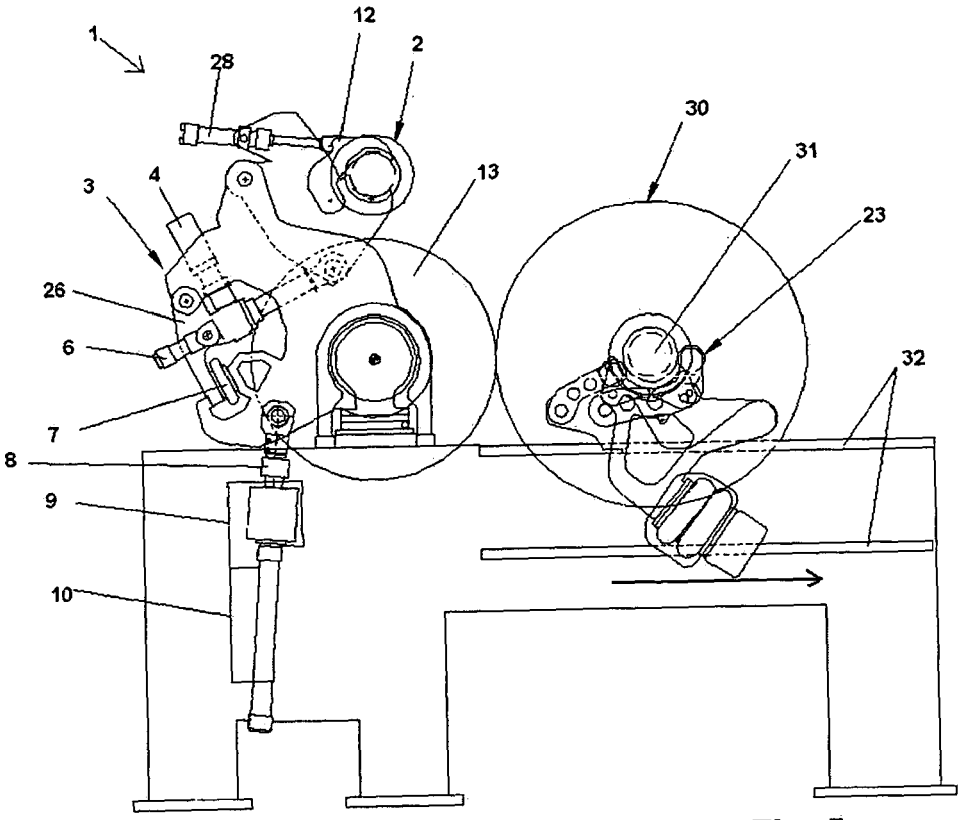
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Fig. 5

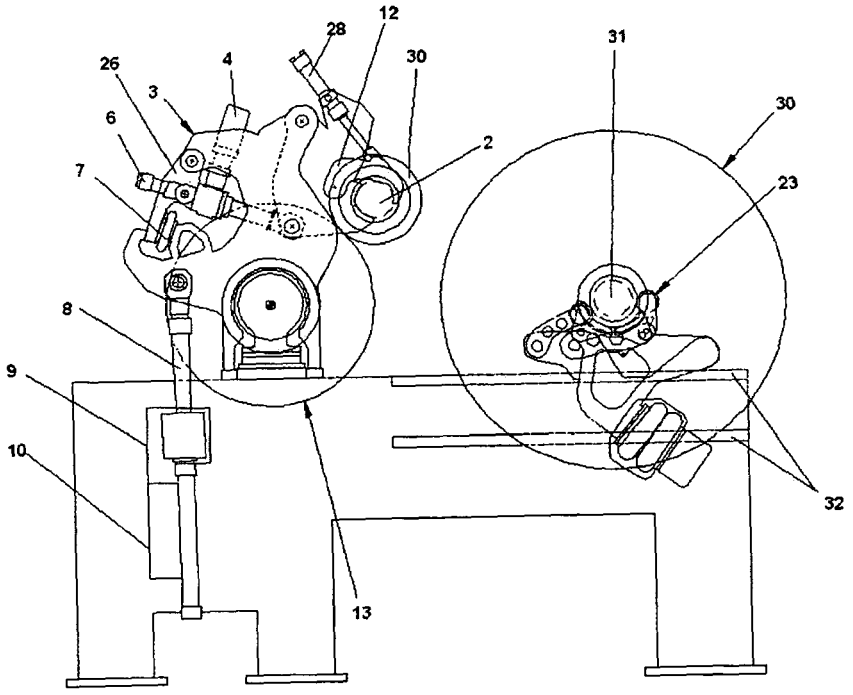
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Fig. 6

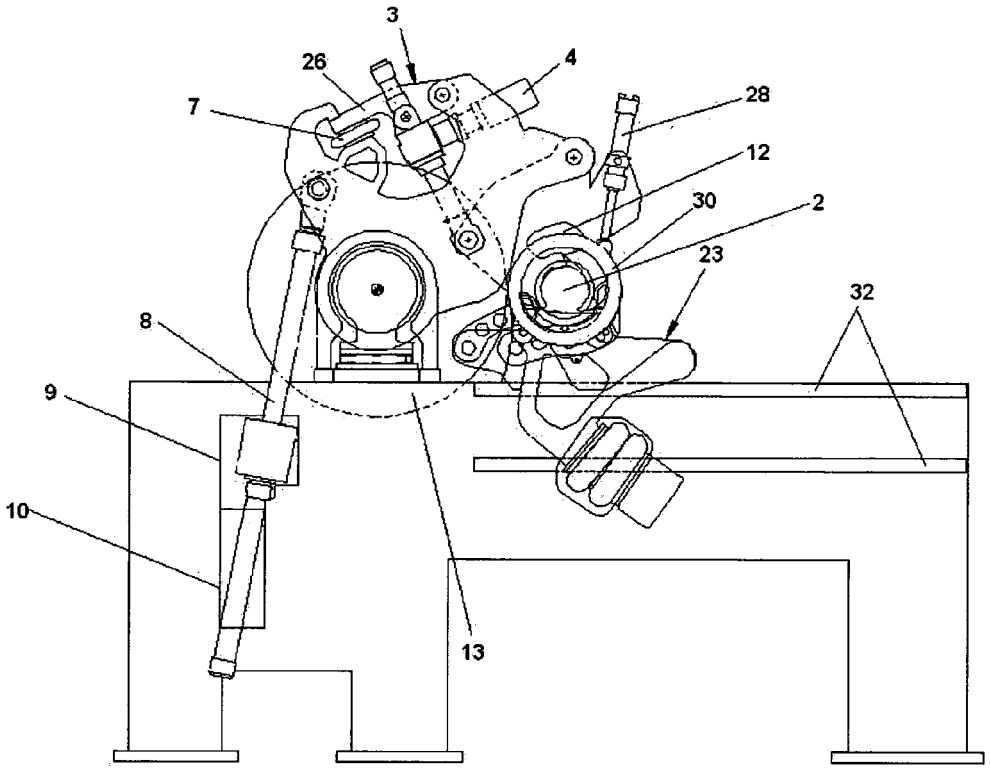

Fig.7

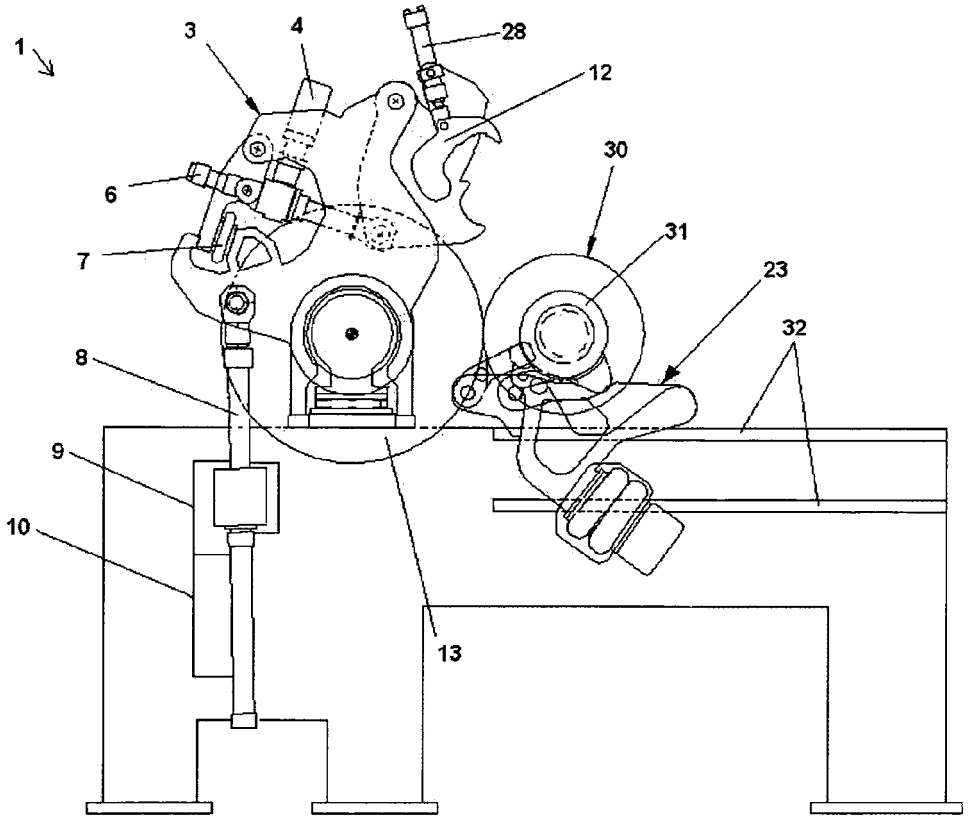

Fig.8

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Application Number
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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
Munich	14 November 2007	Fachin, Fabiano

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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