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(71) Applicant: **International Tobacco Machinery Poland Sp. z o.o.**
26-600 Radom (PL)

(72) Inventors:
- **BILSKI, Pawel**
  26-600 Radom (PL)
- **GIELNIEWSKI, Adam**
  26-600 Radom (PL)

(74) Representative: **Markieta, Jaroslaw Franciszek**
Kancelaria Rzeczników Patentowych
J. Markieta, M. Zielinska-Lazarowicz Sp. p.
Bukowinska 2 lok 160
02-703 Warszawa (PL)

(54) SYSTEM FOR FEEDING WEB MATERIAL, MANIPULATOR HEAD FOR SYSTEM FOR FEEDING WEB MATERIAL AND METHOD FOR FEEDING WEB MATERIAL

(57) The object of the application is a system (1) for feeding web material (9, 29) to at least one production apparatus (P1, P2, P3, ... Pn), comprising a storage (3) of bobbins (2), a manipulator (5) provided with a head (30) for gripping and carrying the bobbin (2), unwinding apparatuses (100) for unwinding the web material (9, 29) from the successive bobbins (2, 2') and feeding the web material (9, 29) to the production apparatuses (P1, P2, P3, ... Pn). The head (30) is provided with an three finger gripper (31) for gripping the carrier roll (8) of the bobbin (2) and a jaw gripper (33) for gripping the end (9B) of the new web material (9) of the bobbin (2), the manipulator (5) being slidably mounted along the path (T) at the unwinding apparatuses (100), while the unwinding apparatus (100) comprises a splicing unit (101) for splicing the new web material (9) of the new bobbin (2) and the old web material (29) of the used bobbin (2'), and the manipulator (5) is adapted to wind through the new web material (9) of the bobbin (2) placed on the unwinding apparatus (100) to the splicing unit (101). The object of the application is also a manipulator head and a method for feeding at least one production apparatus.

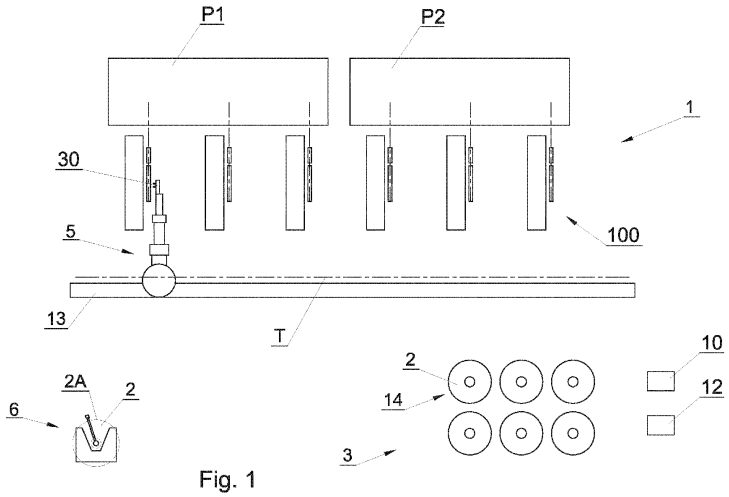


Fig. 1

EP 4 549 351 A1

Description

[0001] The object of the invention is a system for feeding web material, a manipulator head for a system for feeding web material and a method for feeding web material.

[0002] The feeding of web material is currently widely used. There is a demand for paper tubes used in packaging production. In the food industry, for example, multilayer tubes of diversified diameters are used in the hygiene products industry. Apparatuses manufacturing drinking straws as well as cylindrical packaging form continuous multilayer tubes from several web materials and require feeding from several unwinding apparatuses, such tubes are cut into individual straws or tubes. Web materials unwound from bobbins are also used in the tobacco industry for the manufacture of rod-like articles, in the tobacco industry, the production processes are carried out at high capacities and require frequent changes of semi-finished products in the form of webs of wrapping material. A web of wrapping material can be fed for an entire product or semi-finished product, for example to wrap a filler material, to wrap the mouthpiece of a finished product or to partially wrap a semi-finished product. Unwinding apparatuses adapted to splice successive web materials in order to maintain uninterrupted production are known.

[0003] The document EP1256538 A2 discloses a system and method of feeding a tobacco industry material to an operating unit. The system comprises a feeding unit for feeding the material (for example in the form of a bobbin) laid flat on a support to a corresponding unwinding pin of the feeding unit. According to the disclosure of the document EP1256538 A2, the bobbin is unwound on an unwinding mandrel mounted on the circumference of a rotatable platform rotating around a horizontal axis. The system allows the position of the unwinding mandrel to be changed to a vertical receiving position by changing the position of the rotating platform.

[0004] The publication WO02092483 A1 discloses a method of feeding a bobbin from a bobbin storage and an apparatus for feeding the bobbin. According to the disclosure of WO02092483 A1, the apparatus comprises a manipulator with a gripping element for carrying the bobbin from the bobbin storage and for manipulating the bobbins. The manipulator has an articulated arm attached to the frame for rotating the bobbin around a vertical axis. The gripping element is provided with a distance sensor which allows the gripping element to be correctly positioned in a hole in the bobbin so that the bobbin can be correctly carried onto an unwinding unit.

[0005] The application US9670021 B2 discloses an unwinding station for unwinding a web material rolled into a roll for the manufacture of nappies. According to the disclosure of patent US9670021 B2, the unwinding station can be provided with an apparatus for gripping the roll of rolled web material in the form of a robotic arm capable of automatically determining the characteristics of the roll, e.g. the diameter of the roll, the diameter of the roll core, the type of material rolled into the roll. In addition, the robotic arm allows the roll of material to be moved to any position or location.

[0006] The document WO2016033399 A1 describes an apparatus for feeding, loading, splicing and unwinding wound web materials used for manufacturing disposable materials such as nappies. The apparatus described in the publication WO2016033399 A1 is in the form of a multi-axis robot having an arm, a wrist subassembly, an end effector, a holder, a rocker arm and an extension arm. The multi-axis robot can determine the characteristics of a roll of rolled material, e.g. roll diameter, core diameter, type of material rolled into the roll, as well as its physical properties. According to the disclosure of the document WO2016033399 A1, the robot may have at least six independent axes of rotation.

[0007] There is a demand for an apparatus that feeds the bobbins of material efficiently and without the risk of feeding a wrong material and without the risk of feeding the bobbin in the opposite direction to the required unwinding direction. Today's production processes require feeding web materials at increasingly higher speeds. As the processes are run continuously, it is common to use apparatuses for changing the bobbins, which entails waste in the form of web material fragments at the beginning and at the end of the web. There is a demand to optimise the amount of waste in the form of unused web material. The process of feeding new bobbins can be automated, there is a demand on the part of the manufacturers that the supplied feeding systems have the capacity to handle multiple production apparatuses, including sorting of waste into paper and plastic waste. In the light of the presented state of the art, there is a need to provide a comprehensive solution allowing to automate the bobbin loading process and to maintain uninterrupted production, while checking the correctness of the fed bobbins and optimising the amount of waste.

[0008] The object of the invention is a system for feeding web material to at least one production apparatus, comprising a storage of bobbins, a manipulator provided with a head for gripping and carrying the bobbin, an unwinding apparatus for unwinding the web material from successive bobbins and feeding the web material to the production apparatuses. The manipulator head is provided with a three finger gripper for gripping the carrier roll of the bobbin and a jaw gripper for gripping the end of a new web material of the bobbin. The manipulator is slidably mounted along a path at the unwinding apparatuses. Furthermore, the unwinding apparatus comprises a splicing unit for splicing the new web material of the new bobbin and the old web material of the used bobbin, and the manipulator is adapted to wind through the new web material of the bobbin placed on the unwinding apparatus to the splicing unit.

[0009] Preferably, the system according to the invention is characterised in that the jaw gripper is provided with a sensor for checking the presence of the end of the new web material of the bobbin between the jaws of the jaw gripper and closing the jaw gripper when the end of the web material of the bobbin is detected.

[0010] Preferably, the system according to the invention is characterised in that the splicing unit is provided with a first winding roll for accelerating the new web material and for winding a waste section of the new web material, and a second winding roll for winding a waste section of the old web material, such waste sections remaining after splicing the new web material with the old web material.

[0011] Preferably, the system according to the invention is characterised in that the manipulator is adapted to remove the waste section of the new web material and the waste section of the old web material remaining after the web material splicing operation, and the system is further provided with a first container for discarding the waste sections of the web materials.

[0012] Preferably, the system according to the invention is characterised in that the manipulator is adapted for discarding empty carrier rolls, and the system is further provided with a second container for discarding empty carrier rolls.

[0013] Preferably, the system according to the invention is characterised in that the head is provided with a distance meter.

[0014] Preferably, the system according to the invention is characterised in that the head is provided with a head camera and the controller is adapted to control the manipulator so that the first axis of the head is in the axis of the bobbin before the bobbin is gripped.

[0015] Preferably, the system according to the invention is characterised in that the controller is adapted to determine the height at which the top of the bobbin stack is situated, based on the image from the head camera and the information of the distance meter.

[0016] Furthermore, the object of the invention is the manipulator head for the system for feeding the web material to at least one production apparatus for gripping and carrying the bobbin, provided with a three finger gripper adapted to grip the carrier roll of the bobbin, the three finger gripper being provided with two stationary pins and one movable pin driven by an actuator, and a jaw gripper adapted to grip the end of the new web material of the bobbin.

[0017] Preferably, the head according to the invention is characterised by being provided with the distance meter.

[0018] Preferably, the head according to the invention is characterised by being provided with the head camera.

[0019] Preferably, the head according to the invention is characterised in that the jaw gripper is provided with the sensor for checking the presence of the end of a new web material of the bobbin between the jaws of the jaw gripper.

[0020] The object of the invention is also a method for feeding web material to at least one production apparatus, comprising steps of: moving a manipulator along the path at the unwinding apparatuses and positioning the manipulator head above the stack of the bobbins. Then checking the position of the uppermost bobbin on the basis of the image from the head camera and the signal from the distance meter on the head, after that gripping the bobbin from the stack of the bobbins by means of the manipulator provided with the three finger gripper, taking into account the position of the uppermost bobbin. In the next step, carrying the bobbin by means of the head to the unwinding apparatus of the selected production apparatus directly opposite a fixing mandrel and checking the position of the three finger gripper relative to the fixing mandrel. Then placing the bobbin on the fixing mandrel, taking into account the position of the fixing mandrel, pushing the jaw gripper of the manipulator against the circumferential surface of the placed bobbin, rotating the placed bobbin until the end of the web material is detected by the sensor on the jaw gripper. Gripping the end of the web material by means of the jaw gripper, detaching the end of the web material and winding the new web material by means of the jaw gripper between the rolls of the unwinding apparatus to the splicing unit for splicing the new web material and the old web material, then rotating the first winding roll and accelerating the new web material to a speed equal to the speed of the old web material, after that placing a splicing insert between the old web material and the new web material. Then pressing the old web material against the new web material and splicing the old web material with the new web material by means of the splicing insert, cutting off the unused waste section of the new web material with a first knife, winding up the unused waste section of the new web material by means of a first winding roll, cutting off the unused waste section of the old web material by means of a second knife, winding up the unused waste section of the old web material by means of a second winding roll. In the next step, gripping the unused waste section of the old web material with the jaw gripper and discarding it into a first container, gripping the unused waste section of the new web material with the jaw gripper and discarding it into the first container, and then gripping the empty carrier roll of the used bobbin with the three finger gripper and discarding it into a second container.

[0021] The system according to the invention provides a universal feeding system for use in production lines in many industrial branches. The manipulator head used in the system is a multifunctional head so as to handle the process of placing a new bobbin, unwinding the beginning of the web as well as receiving waste materials. The central location of the head camera makes it possible to verify the position of the three finger gripper relative to the carrier roll of the bobbin both before and during the head movement towards the new bobbin or both before and during the head movement towards the mandrel on the unwinding unit, as the camera remains positioned centrally relative to the carrier roll or the mandrel during the three finger gripper's approach movement. The three finger gripper can both pick up a new bobbin and take away an empty carrier roll after a web material has been used. The jaw gripper makes it possible both to start unwinding the web material and to pick up unused waste sections of the web material. The system and method according to the invention allow automating the process of loading the bobbin by eliminating operator errors associated with feeding a wrong material or

bobbin in a way opposite to the required unwinding direction of the web material on the unwinding apparatus. The elimination of human errors, on the other hand, carries a further beneficial technical effect related to the reduction of the labour intensity of the process. The system and method according to the invention allow optimising the use of materials as well as proper segregating of waste, which results from the multifunctionality of the head capable not only of placing a new bobbin, but also of receiving waste materials.

[0022] The object of the invention is shown in more detail in a preferred embodiment in a drawing in which:

Fig. 1 shows a system for feeding web material in a top view;

Fig. 2 shows the system for feeding web material in a perspective view;

Fig. 3 shows a feeding apparatus;

Fig. 4 shows a manipulator head in a view towards the axis of a three finger gripper in a position when the three finger gripper is not holding a bobbin;

Fig. 5 shows the manipulator head in a view perpendicular to the axis of a three finger gripper, the pins are positioned as in Fig. 4 and a jaw gripper is open;

Fig. 6 shows a cross-section A-A through the jaw gripper of Fig. 4,

Fig. 7 shows placing a new web material on an unwinding apparatus,

Fig. 8 shows the unwinding apparatus after placing a new web material,

Fig. 9 shows the equalisation of speed of the new web material and the old web material,

Fig. 10 shows the splicing of the new web material and the old web material, and the cutting off of unused parts of such web materials, and

Fig. 11 shows the unwinding apparatus after winding the waste sections of the old and new web materials.

[0023] **Fig. 1** shows a system for feeding **1** of production apparatuses, in the embodiment shown the system feeds two production apparatuses **P1, P2.** The feeding system **1** comprises a plurality of unwinding apparatuses **100** for unwinding a web material from a bobbin **2.** The system **1** may comprise a plurality of production apparatuses **P1, P2,** ... **Pn.** The feeding system **1** may comprise one production apparatus **P1** and a plurality of unwinding apparatuses 100. Each of the production apparatuses **P1, P2,** ... **Pn** may be fed with a different type of material, each of the production apparatuses **P1, P2,** ... **Pn** may be fed with several different types of material. The system for feeding **1** of production apparatuses comprises a storage **3** of the bobbins **2,** a manipulator **5,** the manipulator **5** moving along a beam **13,** i.e. along the path of movement **T,** a toothed bar or a guide screw may be used to move the manipulator along the beam **13** (a drive is not shown in the figure). The feeding system **1** may be provided with an inspection station **6** and a reversing table **7.** The bobbin **2** comprises a carrier roll **8** (**Fig. 5**) and a web material **9** wound onto such roll. Furthermore, the system **1** comprises a first container **10** for receiving waste sections of the web material of the bobbin **2** and a second container **12** for receiving empty carrier rolls **8.**

[0024] In the embodiment in **Fig. 1,** the storage of **3** the bobbins **2** contains multiple stacks of **14** the bobbins **2.** The stacks **14** of the bobbins **2** may contain new bobbins, but also partially unwound bobbins recovered in other production stages or in other apparatuses where the production process required a change of a bobbin before the web material of the bobbin was fully used. For the sake of simplicity, both types of bobbins brought into the system are referred to as new bobbins. The system **1** may be provided with a monitoring camera **15** adapted to monitor the storage **3** of the new bobbins **2,** and a system controller **16** adapted to preselect the new bobbin **2** from any of the stacks **14** of the new bobbins 2 in the storage **3** of the new bobbins **2,** based on the image from the monitoring camera **15.** The system **1** may be provided with a system controller **16** adapted to preselect the new bobbin **2** first from the stack **14** higher of any of the stacks **14** of the bobbins in the storage **3.**

[0025] The inspection station **6** (**Fig. 2**) is provided with an inspection camera **17** which is mounted on a rotating arm **18.** The arm **18** moves the inspection camera **17** along a circular path of movement **19,** whereas the head **30** of the manipulator **5** moves the new bobbin **2** to the inspection station **6** and holds it horizontally so that the axis **m** of the new bobbin **2** substantially coincides with the centre of the circular path of movement **19** along which the inspection camera **17** moves. In **Fig. 1** and **Fig. 2,** the new bobbin **2** to be inspected is indicated by a dashed line, whereas the head **30** that holds the new bobbin **2** is not shown. The inspection camera **17** is adapted to observe the circumferential surface **2A** of the new bobbin **2**

held by the manipulator **5,** while the controller **16** is adapted to identify the new bobbin **2** by reading the bar code **20** (**Fig. 5**) and/or determining the unwinding direction of the new web material **9** from the new bobbin **2** based on the image from the inspection camera **17,** the unwinding direction being defined by an arrow **21** placed on the circumferential surface **2A** of the bobbin **2.**

[0026] The system shown in **Fig. 1** and **Fig. 2** is provided with containers **10, 12** for waste materials. The manipulator **5** is adapted to put waste sections of the web material into the first container **10,** furthermore, the manipulator **5** is adapted to put empty carrier rolls **8** into the second container **12.** The waste sections of the web material are understood to be the waste section **9A** of the new web material **9** and the waste section **29A** of the old web material **29** remaining after the operation of splicing the new web material **9** with the old web material **29.** The new web material **9** is understood to be the web that will be unwound after the change of the bobbins, the old web material **29** is understood to be the web that is unwound before the change of the bobbins. As **101** is denoted the splicing unit in which the splicing of the new web material **9** with the old web material **29** takes place. The waste section **9A** of the new web material is wound so that it can be received from the unwinding apparatus **100** by the jaw gripper **33** (as discussed below) situated on the head **30** of the manipulator **5.** Similarly, the section **29A** of the old web material **29** is wound so that it can be received from the unwinding apparatus **100** by the jaw gripper **33.** The system **1** is further provided with a second container **12** for the carrier rolls **8** of the used bobbins **2.** The empty carrier roll **8** is gripped by the three finger gripper **31.**

[0027] Fig. 3 shows a feeding apparatus **100** from which a web of used bobbin **2'** is being unwound and on which a web of new bobbin **2** has been placed. The web of the new bobbin **2** is fixed on a fixing mandrel **102,** and the web material unwinding direction is indicated by an arrow **U.** The new web material **9** passes through the splicing unit **101** and is wound onto the receiving mandrel. The section of the new web **9** wound onto the receiving mandrel after passing through the splicing unit **101** is the waste section **9A** of the new web material. The section of the used web material unwound from the bobbin **2'** and remaining before the splicing unit **101** forms the waste section **29A** of the old web material.

[0028] The head **30** of the manipulator **5** shown in **Fig. 4** and **Fig. 5** in the feeding system **1** comprises the three finger gripper **31** for gripping the carrier roll **8** of the new bobbin **2** and the empty carrier roll **8,** the jaw gripper **33** for gripping the end **9B** of the new web material **9** of the new bobbin **2,** for gripping the waste sections **9A, 29A** of the web materials **9, 29,** the sensor **34** for detecting the end **9B** of the new web material **9** of the new bobbin **2,** a distance meter **35** for measuring the distance of the head **30** of the manipulator **5** to the picked new bobbin **2** or to the fixing mandrel **102** on the unwinding apparatus **100,** a head camera **36** for determining the position of the picked new bobbin **2.**

[0029] in **Fig. 5,** the first axis of the head **30** is indicated as **k.** The three finger gripper **31** comprises three grooved pins, including two immovable pins **37** (immovable relative to the body **40**) and one movable pin **38** arranged around the first axis **k.** The pins **37, 38** have circumferential grooves that allow the carrier roll **8** and thus the entire bobbin 2 to be kept stable, whereas the pins **37, 38** may have any elements, for example having sharp edges which facilitate fixing the carrier roll **8** on the mandrels **37, 38.** The pins **37** are immovable mounted on the body **40** of the head **30,** while the pin **38** is fixed on a slider **39** linearly slidably mounted on the body **40.** The slider **39** is moved by means of an actuator **44.** The pins **37** and **38** are arranged radially relative to the first axis **k** of the head **30.** The pins **37** and **38** are shown in **Fig. 4** and **Fig. 5** in the holding position, i.e. they press on the carrier roll **8** of the bobbin **2** from the inside. The pin **38** moves in a direction perpendicular to the first axis **k** of the head **30.** Substantially centrally within the three finger gripper **31,** there is situated a head camera **36** for observing the space in front of the three finger gripper **31.** The optical axis of the head camera **36** may coincide with the first axis **k** of the head **30.** Next to the head camera **36,** there is situated an optical distance meter **35** for measuring the distance to objects situated in front of the three finger gripper **31** along the direction of the first axis **k** (in **Fig. 5** from the gripper **31** down the figure).

[0030] The controller **16** is adapted so that on the basis of the image from the head camera **36** and the distance meter **35** it determines the height at which the top of the stack of new bobbins **2** is situated and the position of the three finger gripper **31** relative to the new bobbin **2.** The image from the head camera **36** allows the movement of the manipulator **5** to be controlled so that it is possible to centrally position the three finger gripper **31** relative to the new bobbin **2** to be picked from the stack **14.**

[0031] The head **30** is provided with the jaw gripper **33** arranged along the second axis **n** of the head **30** which is arranged substantially perpendicular to the first axis **k.** The jaw gripper **33** comprises a first jaw **45** which is arranged along the second axis **n,** and a second jaw **46,** which is rotatably mounted on the axis **t.** The second jaw **46** can be moved by an actuator (not shown) or any other drive. The head **30** can be provided with a vacuum gripper for gripping the end of the web material.

[0032] In order to load a new bobbin, the new bobbin **2** is picked up from the stack **14** of bobbins by means of the gripper **31** arranged on the head **30** of the manipulator **5,** the manipulator moving along the path **T** to reach the correct stack **14.** During the gripping, the distance meter **35** together with the head camera **36** check the position of the new bobbin **2** which is first on the stack **14.** The head **30** is positioned above the stack **14** of the new bobbin **2,** the head camera **36** captures an image including at least the carrier roll **8,** the head camera **36** may capture an image of the entire new bobbin **2,** while the distance meter **35** measures the distance of the lateral surface **2B** of the new bobbin **2** from the head **30.** The controller **16** determines the centre of the carrier roll **8.** The head **30** together with the bobbin **2** is then moved so that the first axis **k** of the

head **30** is positioned substantially coaxial with the axis **m** of the carrier roll **8.** The manipulator **5** moves the head **30** so that the pins **37, 38** of the three finger gripper **31** are positioned inside the carrier roll **8,** whereas the movement of the head **30** can be verified by means of the head camera **36** during the movement to pick up the new bobbin **2.** The three finger gripper **31** grips the new bobbin **2** and then the manipulator **5** carries the picked new bobbin **2** to the inspection station **6** and keeps it there in a horizontal position. At the inspection station **6,** the bobbin **2** is identified and the direction of winding of the web material **9** on the bobbin **2** is verified. The bobbin **2** has, on its circumferential surface, a barcode **20** which contains data such as, inter alia, the type of the web material, the width of the web material, the diameter of the carrier roll, etc. Furthermore, the bobbin **2** has, on its circumferential surface **2A,** an arrow **21** which indicates the winding direction of the web material **9** so that the controller **16,** upon receiving the image from the inspection camera **17,** has the information whether the bobbin **2** is gripped correctly, i.e. so that when the bobbin **2** is placed on the fixing mandrel **102** of the unwinding apparatus **100,** the web material **9** will be unwound according to the unwinding direction **U** defined on the unwinding apparatus **100.** The circumferential surface **2A** is scanned, the inspection camera **17** moves along the motion path **19** which is a circle and captures an image of the circumferential surface **2A** of the bobbin **2,** and the controller **16** reads the barcode **20** applied on this surface and finds the arrow **21** which indicates the unwinding direction of the web material **9.** The camera **17** transmits the image to the controller **16** where the new bobbin **2** is identified. If an incorrect unwinding direction of the web material **9** is identified, the head **30** of the manipulator **5,** after gripping the new bobbin **2,** does not have the possibility to grip the new bobbin **2** from the side opposite to the gripping side, while the unwinding apparatus **100** has a determined unwinding direction **U.** In the event of incorrect gripping, it is necessary to change the gripping side of the new bobbin **2.** The manipulator **30** carries the bobbin **2** to the reversing table **7** situated below the inspection station **6.** The head **30** places the new bobbin **2** on the reversing table **7** during the downward movement and then grips the new bobbin **2** from the other side, i.e. from above. After gripping the new bobbin **2** again, the manipulator **5** places the new bobbin **2** onto the fixing mandrel **102** of the unwinding apparatus **100.** If the verification of correct positioning of the bobbins **2** on the stack **14** has been carried out previously, the step of verifying the position of the bobbin **2** and changing the gripping side as described above is omitted. When placing the bobbin **2,** the head camera **36** together with the distance meter **35** verify the position of the head **30** relative to the fixing mandrel **102,** the first axis **k** of the head **30** being positioned substantially parallel to the axis of the fixing mandrel **102.** The recorded image of the front surface of the mandrel **102** on the unwinding apparatus **100** allows the head **30** to be controlled so that the first axis **k** of the head **30** is aligned coaxially with the axis of the fixing mandrel **102,** furthermore, the position of the pins **37, 38** is verified with respect to the notches in the mandrel **102** into which the pins **37, 38** are inserted when placing the new bobbin **2.** The distance meter **35** checks the distance of the head **30** from the front surface of the fixing mandrel **102** so that the position of the head **30** relative to the fixing mandrel **102** can be verified before and during the movement of the head **30.** After placing the bobbin **2** onto the fixing mandrel **102,** the head **30** is withdrawn and then the jaw gripper **33** is pushed against the circumferential surface **2A** of the new bobbin **2,** then the bobbin **2** is rotated until the end **9B** of the web material **9** is detected by the sensor **34** on the lower, first jaw **45** of the jaw gripper **33.** After detecting the end **9B** and stopping the rotational movement of the bobbin **2,** the end **9B** is gripped by clamping the upper, second jaw **46** of the jaw gripper **33** (**Fig. 6**). The manipulator **5** moves the head **30** so that the end **9B** is detached from the bobbin **2** and winds the new web material **9** between the rollers **51, 52, 55, 56** (**Fig. 7**) of the unwinding apparatus **100** to and through the splicing unit **101** for splicing the unwound old web material **29** from the currently unwound used bobbin **2'** with the new web material **9** of the new bobbin **2.**

[0033] As shown in **Fig. 8,** the new strip of material **9** to be unwound from the new bobbin **2** is guided at the rolls **51, 52** and further to the first winding roller **53,** whereas the first winding roller **53** having a slot **54** is axially displaced (perpendicular to the plane of the drawing) so that the new web material **9** is placed in the slot **54.** The old web material **29** unwound from the old bobbin **2'** is guided at the rolls **55, 56,** further at the second winding roll **57,** whereas the second winding roll **57** having a slot **58** is axially displaced (perpendicular to the plane of the drawing) so that the old web material **29** is placed in the slot **58.** The amount of web material on the old bobbin **2'** is checked, when the amount of web material decreases to a certain predetermined minimum, the first winding roller **53** starts to rotate at such a speed as to ensure that the speed **v9** of the new web material **9** is equal to the speed **v29** of the old web material **29** (**Fig. 9**). Once the speeds **v9** and **v29** are equal, a section of double-sided adhesive tape so-called "splicing insert" is fed between the new web material **9** and the old web material **29,** and then the two web materials **9, 29** are pressed together by means of pressure rollers **61, 62** (not shown in **Fig. 7, 8, 9**), at least one of these rollers is adjustable and after pressing against the other roller and pressing the webs **9** and **29** against each other, it moves away from the new web material **9,** the web materials **9** and **29** remaining in motion during the splicing. A portion of the new web material **9** that cannot be used is cut off by means of the first knife **63,** thus a waste section **9A** of the new web material **9** is formed (**Fig. 10**). A portion of the old web material 29 that cannot be used is cut off by the second knife **64,** thus a waste section **29A** of the old web material **29** is formed. After splicing the new web material **9** with the old web material **29** in the splicing unit **101,** the unwinding apparatus **100** winds up the unused waste section **29A** of the old web material **29** by rotating the second winding roll **57** (**Fig. 11**), whereas the portion of the old web material remaining on the carrier roll **8** is also wound up, and the head **30** moves so that the jaw gripper **33** grips the unused waste section **29A** of the old web material **29** and discards it into the first container **10,** further, the unwinding apparatus **100** winds up the unused waste section **9A** of the new web material **9** by rotating the first winding roller **53,** and the head **30** moves so

that the jaw gripper **33** grips the unused waste section **9A** of the new web material **9** and discards it into the first container **10.** The head **30** moves so that the three finger gripper **31** grips the empty carrier roll **8** of the used bobbin **2',** carries the empty carrier roll **8** and discards it into the second container **12.**

List of reference designations:

[0034]

1	feeding system	35	distance meter
2	bobbin / new bobbin	36	head camera
2'	used bobbin	37	pins
2A	circumferential surface of the bobbin	38	movable pin
2B	lateral surface of the bobbin	39	slider
3	storage	40	body
5	manipulator	44	actuator
6	inspection station	45	first jaw
7	reversing table	46	second jaw
8	carrier roller	51, 52, 55, 56	rolls of unwinding apparatus
9	web material / new web material	53	first winding roll
9A	waste section of new web material	54	slot of first winding roll
9B	end of web material	57	second winding roll
10	first container	58	slot of second winding roll
12	second container	60	splicing insert
13	beam	61, 62	pressure rollers
14	bobbin stack	63	first knife
15	monitoring camera	64	second knife
16	controller	100	unwinding apparatus
17	inspection camera	101	splicing unit
18	arm	102	fixing mandrel
19	path of movement	m	axis of new bobbin
20	barcode	k	first axis of the head
21	arrow (indication of unwinding direction)	n	axis of the jaw gripper
29	old web material	P1	first production apparatus
29A	waste section of old web material	P2	second production apparatus
30	head	T	path of movement
31	three finger gripper	U	unwinding direction of web material
33	jaw gripper	v9	speed of new web material
34	sensor	v29	speed of old web material

Claims

1. A system (**1**) for feeding web material (**9, 29**) to at least one production apparatus (**P1, P2, P3,** ... **Pn**) comprising

- a storage (**3**) of bobbins **(2),**
- a manipulator (**5**) provided with a head (**30**) for gripping and carrying the bobbin (**2**),
- an unwinding apparatus (**100**) for unwinding the web material (**9, 29**) from successive bobbins (**2**, **2'**) and feeding the web material (**9, 29)** to the production apparatuses (**P1, P2, P3, ... Pn**),

whereas the head (**30**) is provided with a three finger gripper (**31)** for gripping the carrier roll (**8)** of the bobbin (**2**) and a jaw gripper (**33)** for gripping the end (**9B**) of the new web material (**9)** of the bobbin (**2**),
the manipulator (**5**) is slidably mounted along the path (**T**) at the unwinding apparatuses (**100)**,
while the unwinding apparatus (**100**) comprises a splicing unit (**101**) for splicing the new web material (**9**) of the new bobbin (**2)** and the old web material (**29**) of the used bobbin (2'),

and the manipulator (**5**) is adapted to wind through the new web material (**9**) of the bobbin (**2)** placed on the unwinding apparatus (**100)** to the splicing unit (**101**).

2. The system as in claim 1, **characterised in that** the jaw gripper (**33**) is provided with a sensor (**34)** for checking the presence of the end (**9B**) of the new web material (**9)** of the bobbin (**2)** between the jaws of the jaw gripper (**33)** and closing the jaw gripper (**33)** when the end (**9B)** of the web material (**9)** of the bobbin (**2**) is detected.

3. The system as in claim 1 or 2, **characterized in that** the splicing unit (**101**) is provided with a first winding roll (**53)** for accelerating the new web material (**9**) and for winding a waste section (**9A)** of the new web material (**9)** and a second winding roll (**57)** for winding a waste section (**29A)** of the old web material (**29)**, such waste sections (**9A, 29A**) remaining after splicing the new web material (**9)** with the old web material (**29**).

4. The system as in any of the claims 1 to 3, **characterised in that** the manipulator (**5**) is adapted to remove the waste section (**9A**) of the new web material (**9)** and the waste section (**29A**) of the old web material (**29**) remaining after the web material (**9, 29)** splicing operation, and the system (**1**) is further provided with a first container (**10)** for discarding the waste sections (**9A, 29A**) of the web materials (**9, 29)**.

5. The system as in any of the claims 1 to 4, **characterised in that** the manipulator (**5**) is adapted for discarding empty carrier rolls (**8)** and the system (**1**) is further provided with a second container (**12)** for discarding empty carrier rolls (**8)**.

6. The system as in any of the preceding claims 1 to 5, **characterised in that** the head (**30**) is provided with a distance meter (**35**).

7. The system as in any of the claims 1 to 6, **characterised in that** the head (**30**) is provided with a head camera (**36)** and the controller (**16**) is adapted to control the manipulator (**5)** so that the first axis (**k**) of the head (**30)** is in the axis (**m**) of the bobbin (**2)** before the bobbin (**2**) is gripped.

8. The system as in any of the claims 1 to 7, **characterised in that** the controller (**16**) is adapted to determine the height at which the top of the bobbin (**2**) stack (**14**) is situated, based on the image from the head camera (**36)** and the information of the distance meter (**35)**.

9. A manipulator head **(5**) for the system (**1**) for feeding the web material (**9, 29**) to at least one production apparatus (**P1**, **P2, P3,** ... **Pn**) for gripping and carrying the bobbin (**2**), is provided with

a three finger gripper (**31**) adapted to grip the carrier roller (**8)** of the bobbin (**2**), the three finger gripper being provided with two stationary pins (**37)** and one movable pin (**38)** driven by an actuator (**44)**, and
a jaw gripper (**33**) adapted to grip the end (**9B)** of the new web material (**9**) of the bobbin (**2)**.

10. The head as in claim 9, **characterised by** being provided with a distance meter (**35**).

11. The head according to claims 9 or 10, **characterised by** being provided with a head camera (**36**).

12. The head as in any of the claims 9 to 11, **characterised in that** the jaw gripper is provided with a sensor (**34)** for checking the presence of the end (**9B**) of a new web material (**9**) of the bobbin (**2)** between the jaws of the jaw gripper (**33**).

13. A method for feeding web material (**9, 29**) to at least one production apparatus (**P1, P2, P3, ... Pn**) comprising steps of:

moving a manipulator (**5)** along the path of movement (**T**) at the unwinding apparatuses (**100**), and positioning the head (**30)** of the manipulator (**5**) above the stack (**14)** of the bobbins (**2)**,
checking the position of the uppermost bobbin (**2**) on the basis of the image from the head camera (**36**) and the signal from the distance meter (**35)** on the head (**30**),
gripping the bobbin (**2**) from the stack (**14**) of the bobbins (**2**) by means of the manipulator (**5)** provided with the three finger gripper (**31**), taking into account the position of the uppermost bobbin (**2**),
carrying the bobbin (**2**) by means of the head (**30**) to the unwinding apparatus (**100**) of the selected production apparatus (**P1**, **P2, P3,** ... **Pn**) directly opposite the fixing mandrel **(102**) and checking the position of the three finger gripper (**31)** relative to the fixing mandrel (**102)**, then placing the bobbin (**2**) on the fixing mandrel (**102**), taking into account the position of the mandrel (**102**),

pushing the jaw gripper (**33**) of the manipulator (**5**) against the circumferential surface (**2A**) of the placed bobbin (**2**),
rotating the placed bobbin (**2**) until the end (**9B**) of the web material (**9**) is detected by the sensor (**34)** on the jaw gripper (**33**),
gripping the end (**9B**) of the web material (**9**) by means of the jaw gripper (**33**),
detaching the end (**9B**) of the web material (**9)** and winding the new web material (**9**) by the jaw gripper (**33**) between the rolls (**51, 52, 55, 56**) of the unwinding apparatus (**100)** to the splicing unit (**101**) for splicing the new web material (**9)** and the old web material (**29**),
rotating the first winding roll (**53**) and accelerating the new web material (**9)** to a speed (**v9**) equal to the speed (**v29**) of the old web material (**29**),
placing a splicing insert (**60**) between the old web material (**9)** and the new web material (**29**),
pressing the old web material (**9)** against the new web material (**29)**, splicing the old web material (**9)** with the new web material (**29**) by means of the splicing insert (**60**),
cutting off the unused waste section (**9A**) of the new web material (**9**) by means of a first knife (**63**),
winding up the unused waste section (**9A**) of the new web material (**9**) by means of a first winding roll (**53**),
cutting off the unused waste section (**29A**) of the old web material (**29**) by means of a second knife (**64**),
winding up the unused waste section (**29A**) of the old web material (**29**) by means of a second winding roll (**57**),
gripping the unused waste section (**29A**) of the old web material (**29**) with the jaw gripper (**33**) and discarding it into a first container (**10**),
gripping the unused waste section (**9A**) of the new web material (**9**) with the jaw gripper (**33**) and discarding it into the first container (**10**),
gripping the empty carrier roll (**8**) of the used bobbin (**2'**) by means of the three finger gripper (**31**) and discarding it into a second container (**12**).

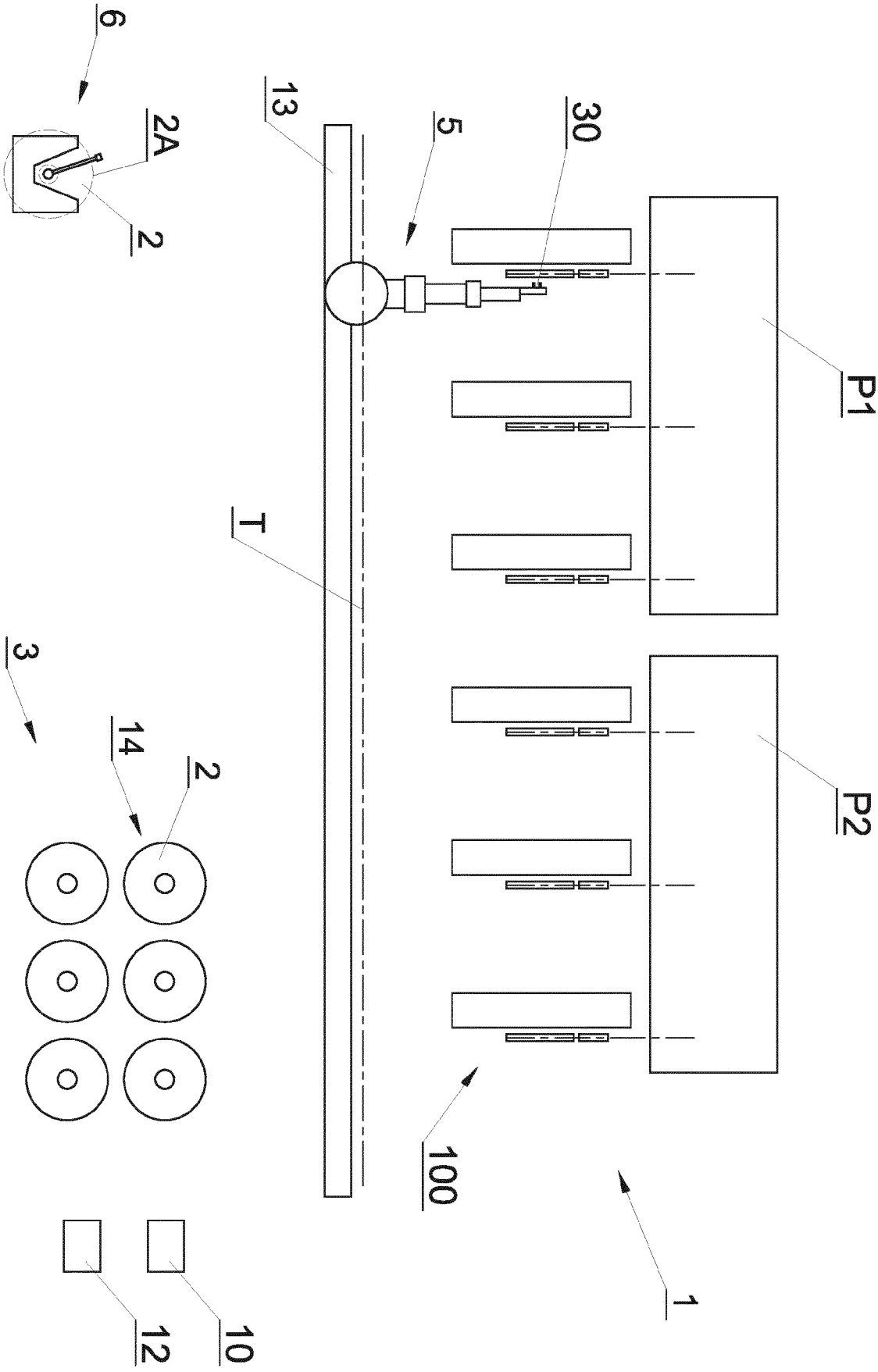


Fig. 1

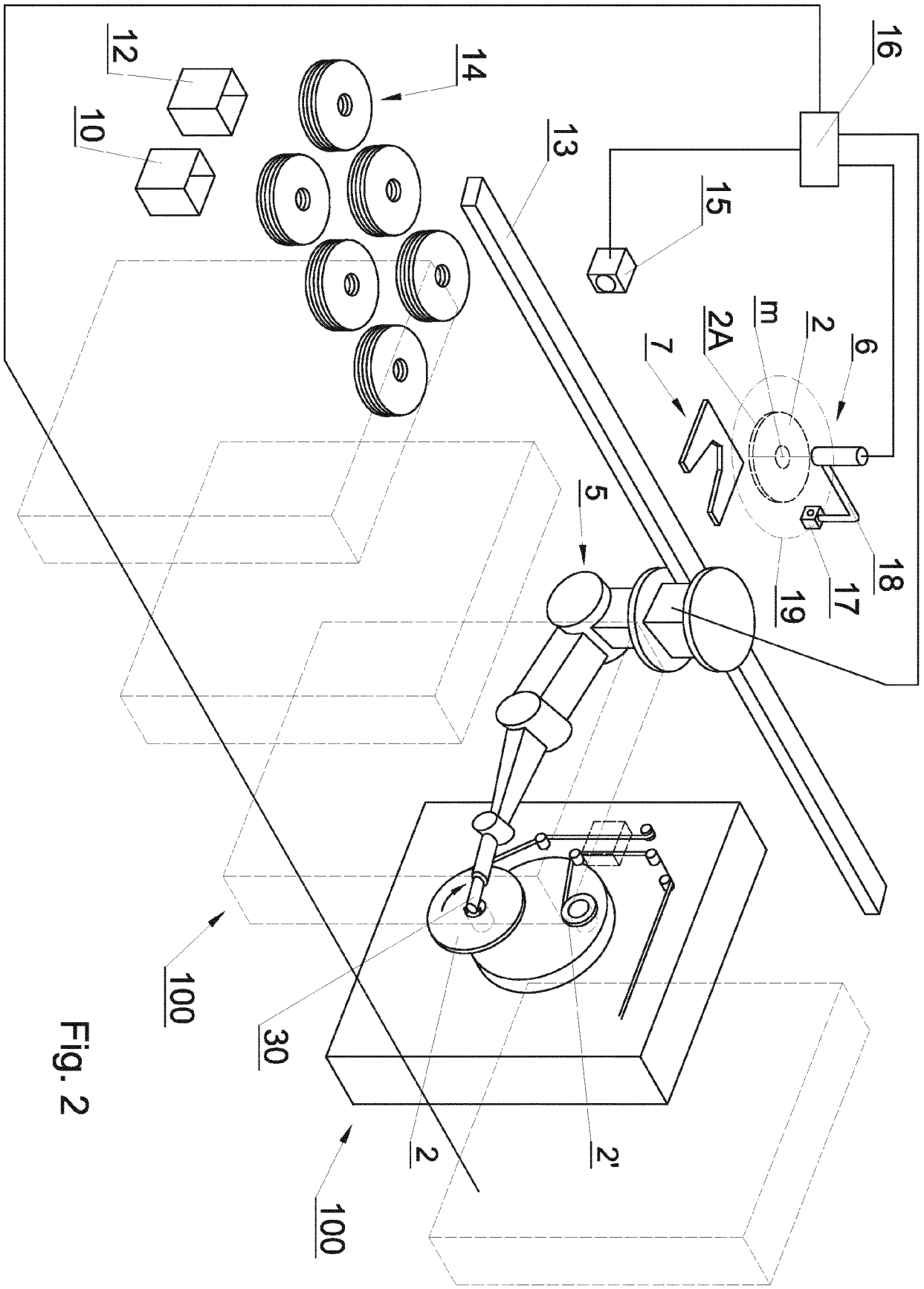
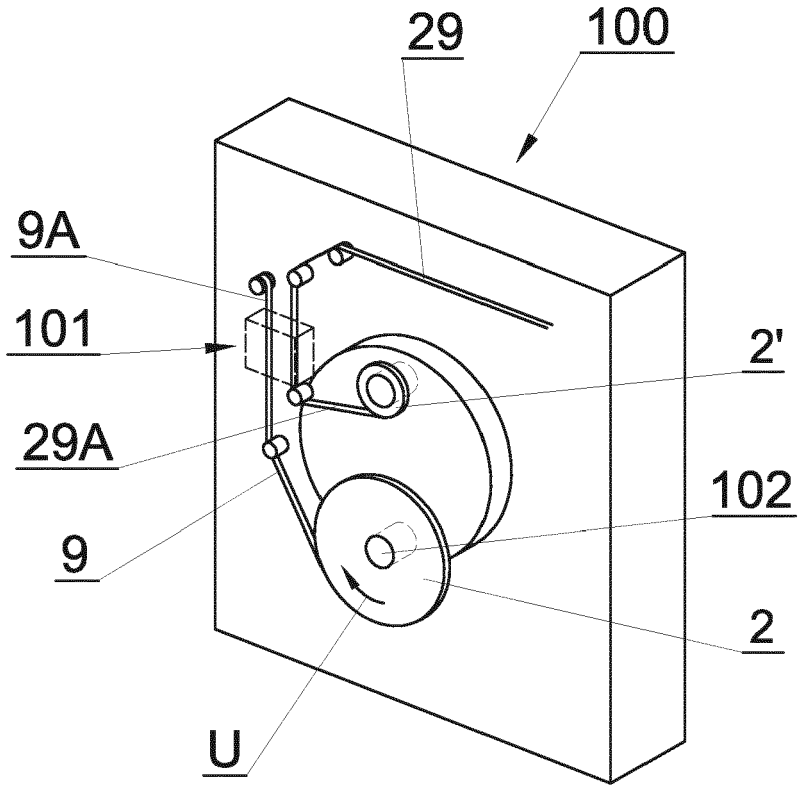


Fig. 2



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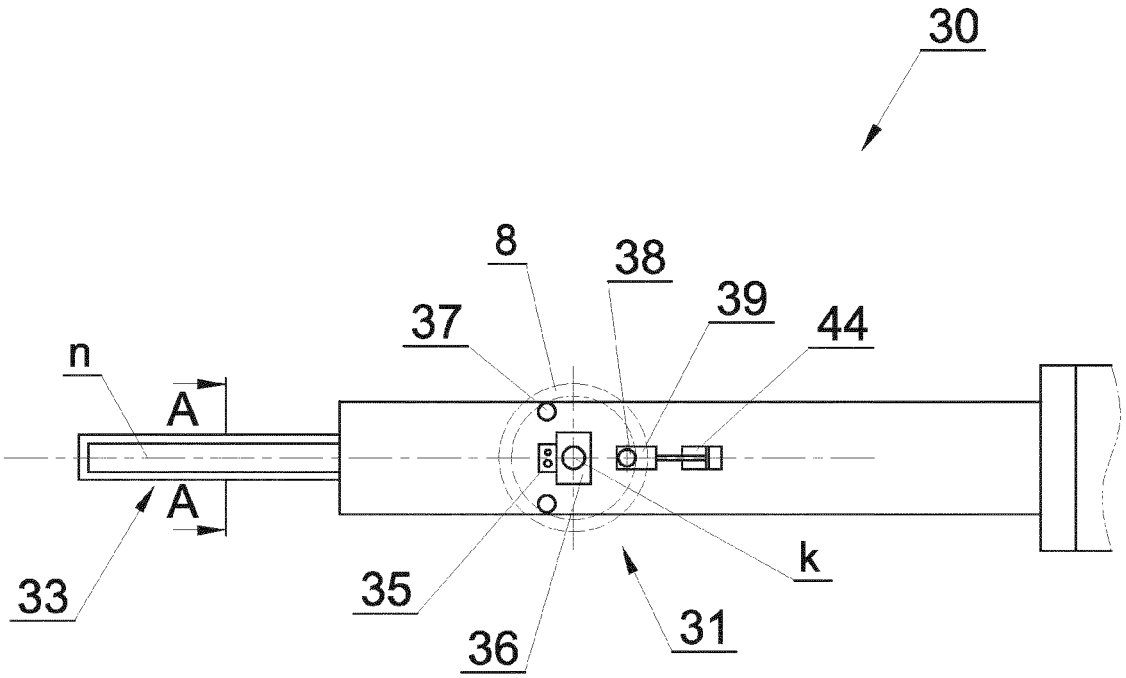
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38
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37
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A
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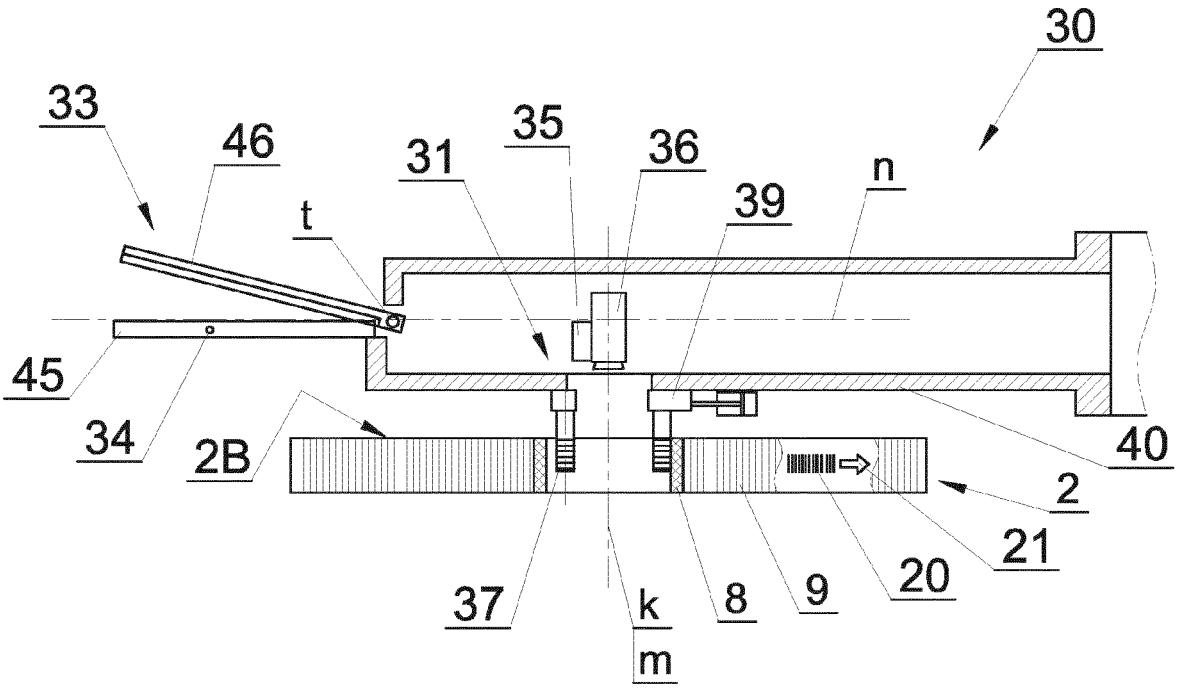
33
35
36
31
k

Fig. 4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33
46
31
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2B
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m

Fig. 5

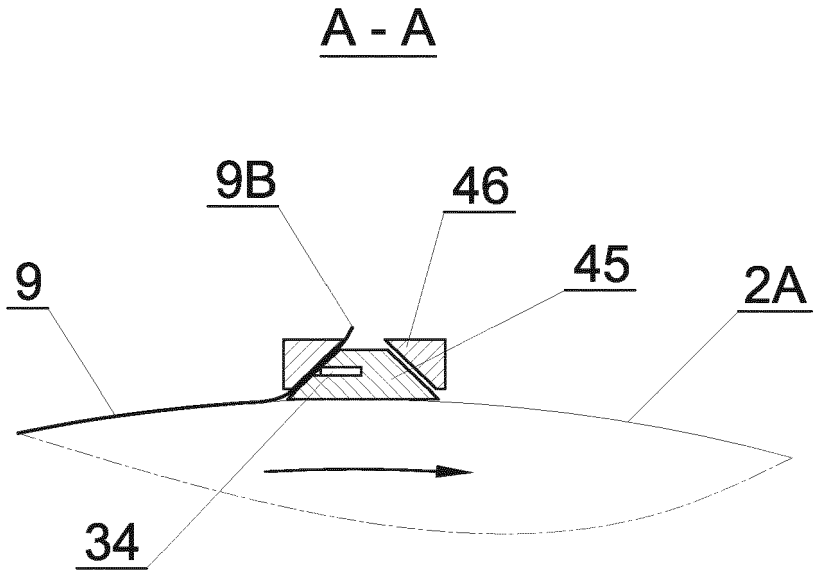

Fig. 6

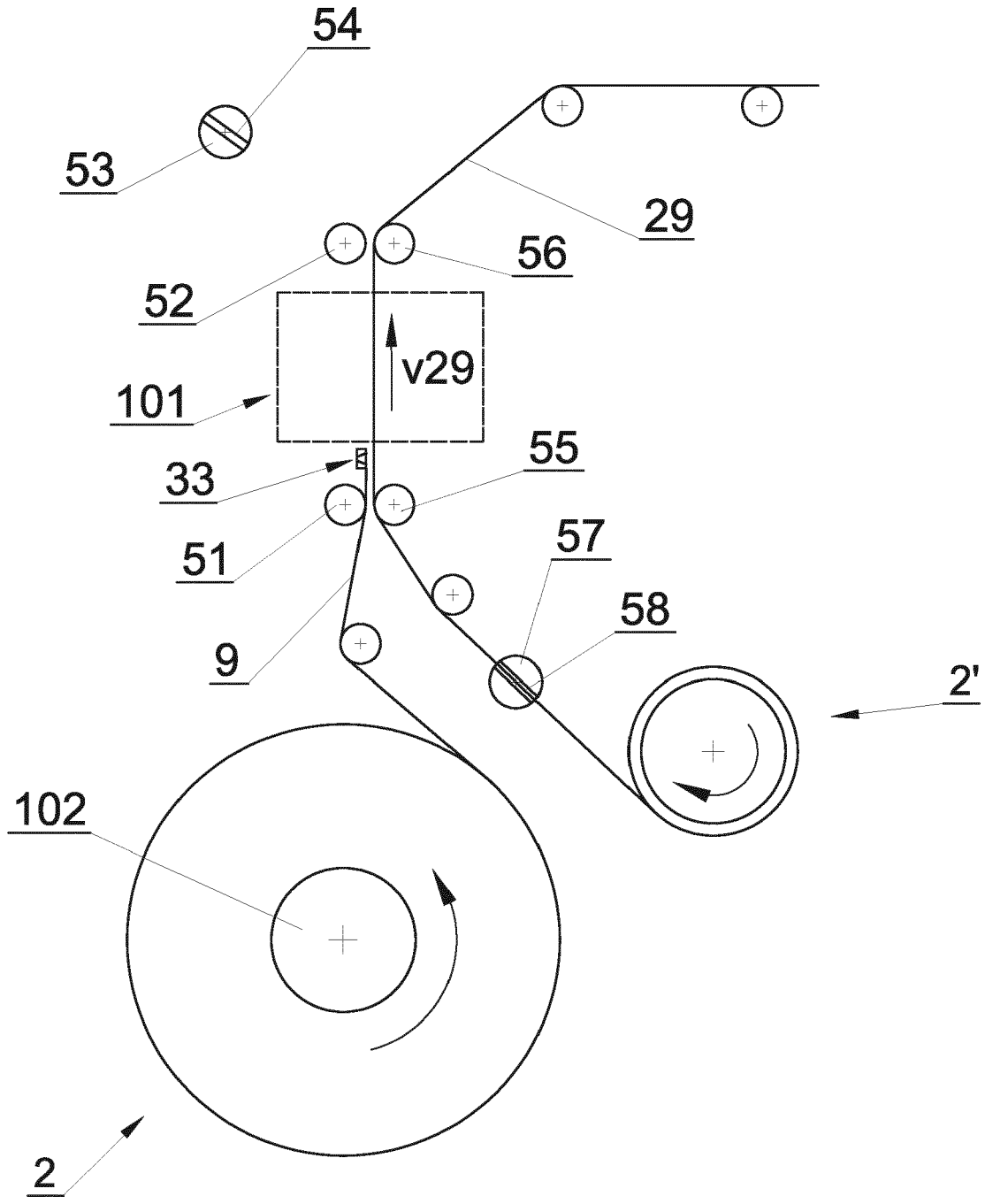

Fig. 7

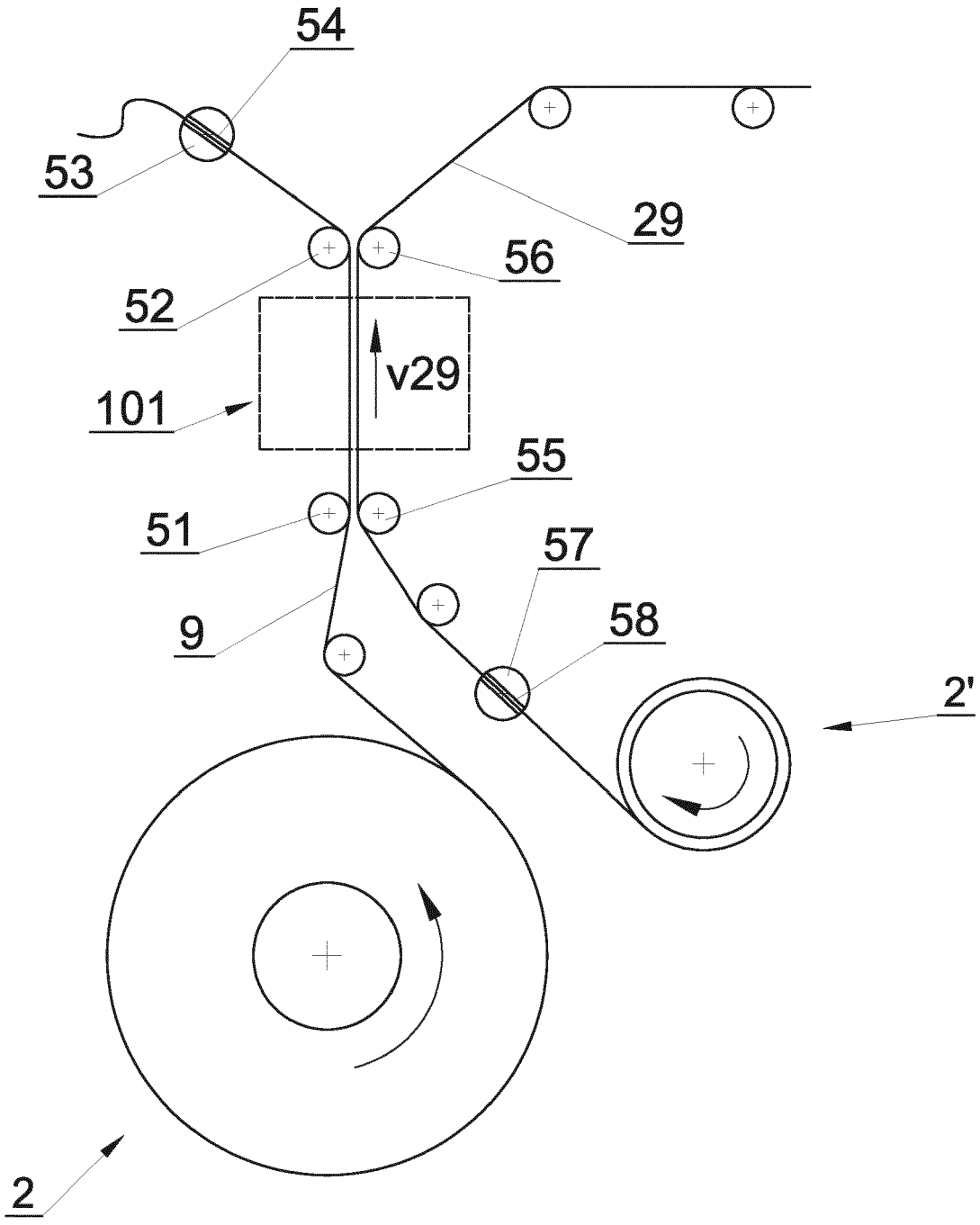

Fig. 8

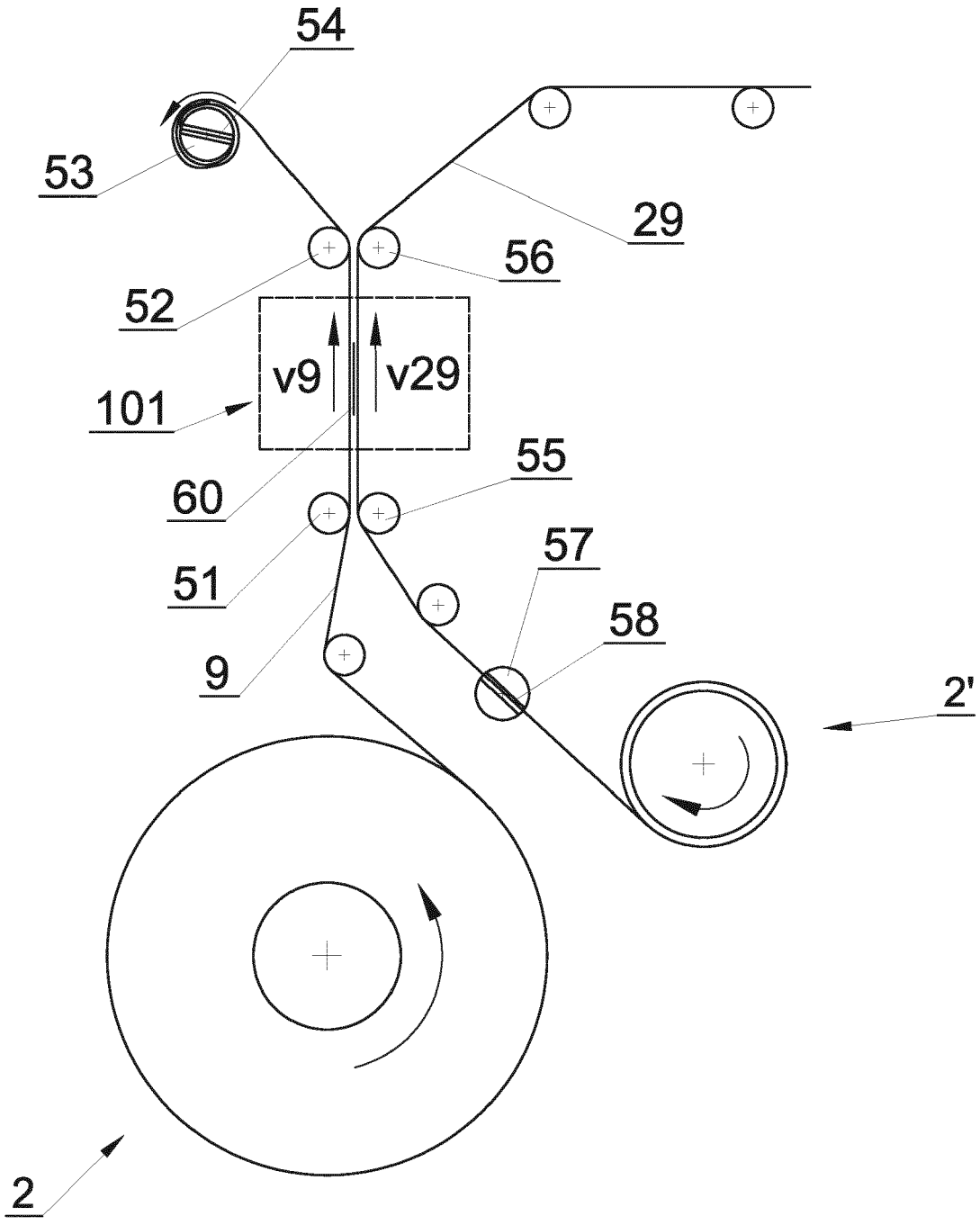

Fig. 9

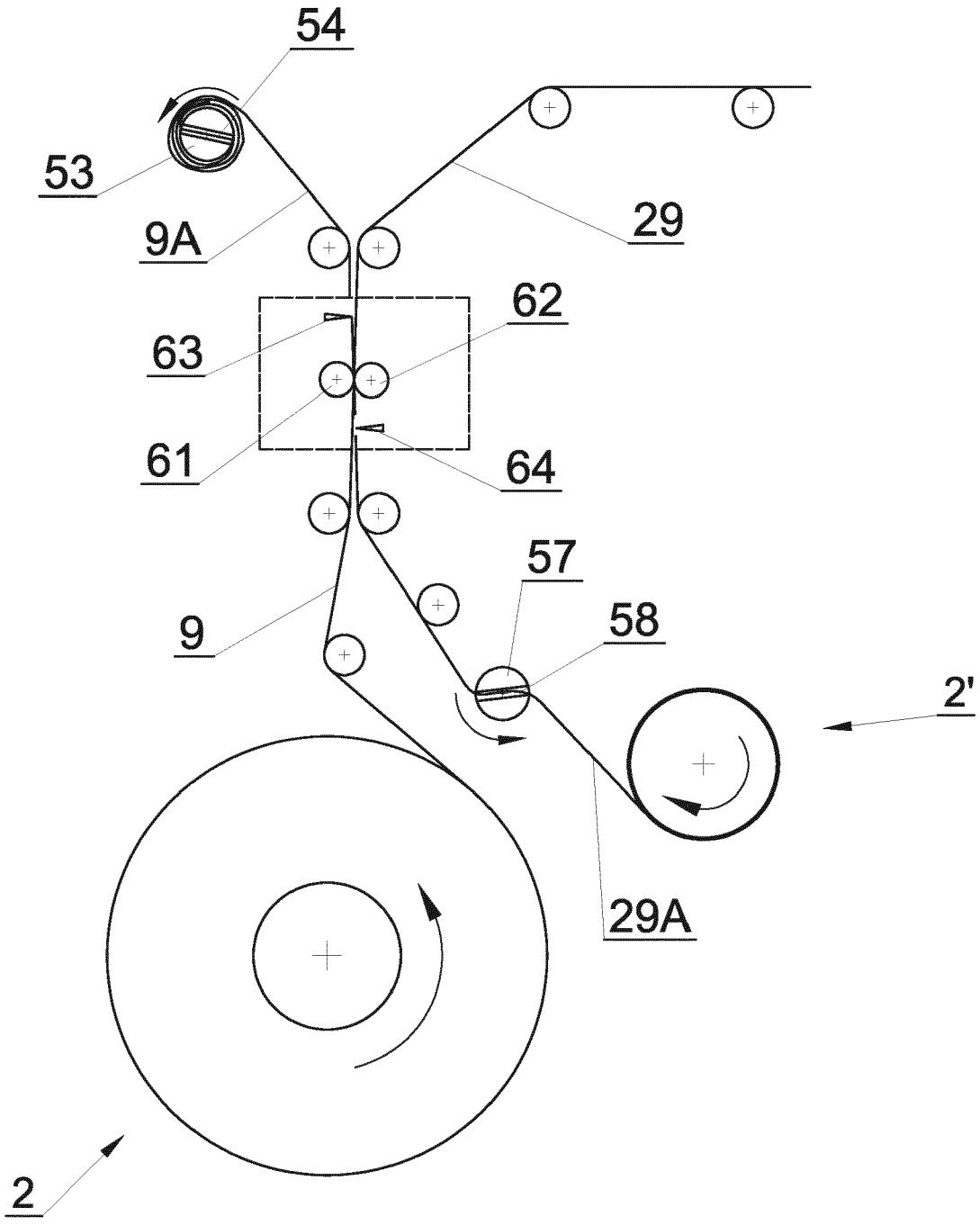

Fig. 10

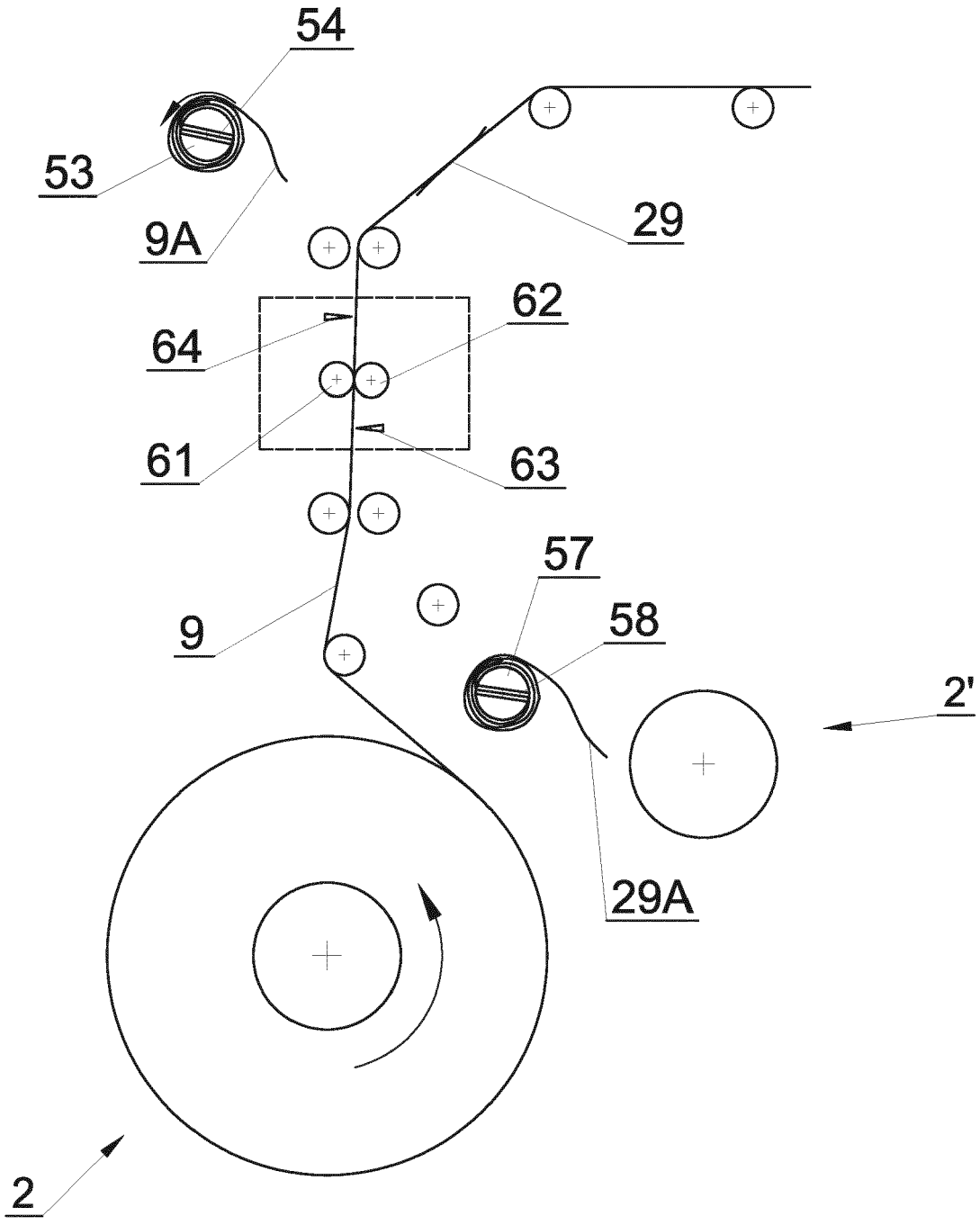

Fig. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 23 20 6752

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y A	US 2023/183037 A1 (PASSARELLA FABIO [IT]) 15 June 2023 (2023-06-15) * the whole document *	1,6-12 3,5 2,4,13	INV. B65H19/12
X Y A	JP 2022 148432 A (FUJI MACHINERY CO) 6 October 2022 (2022-10-06) * abstract; figures *	1,6-12 3,5 2,4,13	
Y	GB 2 135 283 A (GD SPA) 30 August 1984 (1984-08-30) * the whole document *	3	
Y	US 5 935 361 A (TAKAHASHI HISASHI [JP] ET AL) 10 August 1999 (1999-08-10) * column 5, line 34 - line 44 *	5	
A	US 2006/051185 A1 (SPATAFORA MARIO [IT]) 9 March 2006 (2006-03-09) * the whole document *	1,13	

TECHNICAL FIELDS SEARCHED (IPC)

B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 March 2024	Haaken, Willy

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 20 6752

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28-03-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2023183037 A1	15-06-2023	EP 4194384 A1	14-06-2023
		US 2023183037 A1	15-06-2023
JP 2022148432 A	06-10-2022	JP 7367998 B2	24-10-2023
		JP 2022148432 A	06-10-2022
GB 2135283 A	30-08-1984	BR 8307263 A	13-11-1984
		DE 3346592 A1	16-08-1984
		FR 2540846 A1	17-08-1984
		GB 2135283 A	30-08-1984
		IT 1169165 B	27-05-1987
		JP S59149258 A	27-08-1984
US 5935361 A	10-08-1999	DE 69729693 T2	21-10-2004
		EP 0819639 A2	21-01-1998
		US 5935361 A	10-08-1999
US 2006051185 A1	09-03-2006	AT E289971 T1	15-03-2005
		BR 0209591 A	30-03-2004
		CN 1507408 A	23-06-2004
		DE 60203107 T2	13-04-2006
		EP 1385766 A1	04-02-2004
		ES 2236521 T3	16-07-2005
		JP 2004521845 A	22-07-2004
		RU 2296096 C2	27-03-2007
		US 2006051185 A1	09-03-2006
		WO 02092483 A1	21-11-2002

EPO FORM P0459

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Patent documents cited in the description

- EP 1256538 A2 **[0003]**
- WO 02092483 A1 **[0004]**
- US 9670021 B2 **[0005]**
- WO 2016033399 A1 **[0006]**