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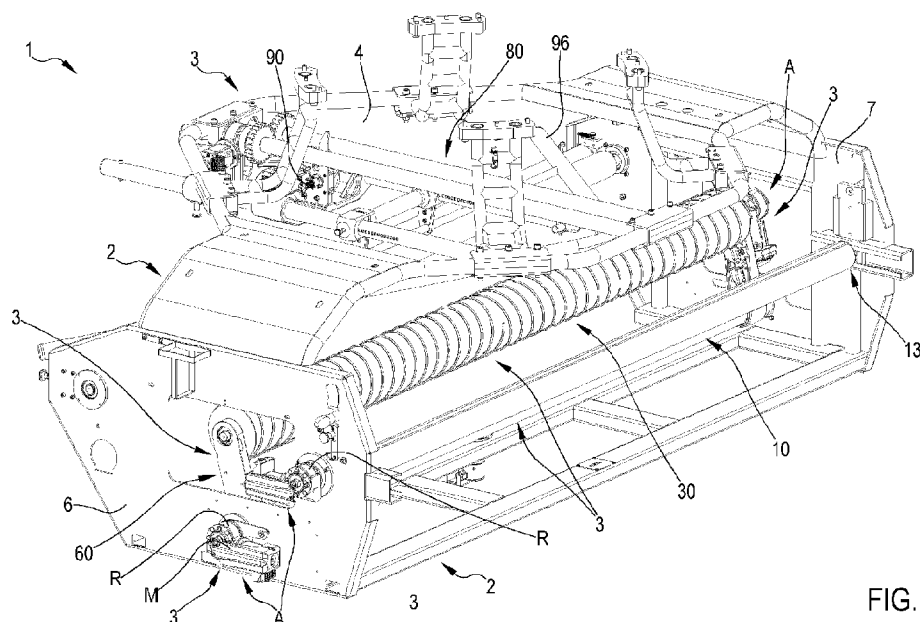


FIG.1

(57) Abstract: A take-down and/or collection group (1) of a fabric (F), manufactured by a circular weft knitting machine (100) comprising a textile head (T) and a base (B); the take-down and/or collection group comprises a frame (2), mounted in a rotating manner to the circular knitting machine, and operating organs (3) supported by the frame, comprising a collection roller (10) and configured to open and spread the fabric (F) manufactured by the circular knitting machine, wrapping it continuously on the collection roller (10); the operating organs comprise: a plurality of motorized axes (10; 30; 60; 70; 80) each configured to selectively rotate around a respective rotation axis; a plurality of motor groups (20; 40; 50; 75; 85); each motorized axis is individually associated to a respective motor group and independently activated by the respective motor group.

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DESCRIPTION

“Take-down and/or collection group of a fabric manufactured by a circular weft knitting machine”

Field of the invention

5 The present invention has as its object a take-down and/or collection group of the fabric manufactured by a circular weft knitting machine.

In greater detail, the present invention refers to a take-down and/or collection group, for a circular knitting machine, provided with operating organs able to manage in a controlled manner the collection of the fabric on a collection roller.

10 The present invention has as its object also a circular weft knitting machine comprising said take-down and/or collection group.

In addition, the present invention concerns a collection method of the fabric manufactured by a circular weft knitting machine by means of a take-down and/or collection group.

15 Background of the invention

The present invention is placed first of all in the technical field of circular weft knitting machines.

In the present text with the term “knitting machine” it is generally intended a circular knitting machine adapted to the manufacturing of textile items and provided with at least one needle-bearing organ or needle-bearing cylinder in a rotating manner mounted in a bearing structure of the machine and supporting a plurality of needles
20 movable parallel to a rotation axis of the needle-bearing cylinder to manufacture a weft knitted fabric. Furthermore, the knitting machine is provided with a plurality of yarn feed points, or knitting “falls”, where the yarn is supplied to the machine needles. This knitting machine can, for example, be of the single-needle bed or double-needle bed type. Circular knitting machines can comprise a variable number of falls, e.g. 1, 2, 4, 6, 8 or more knitting falls.

25 The present invention is preferably, but not exclusively, in the technical field of circular weft knitting machines belonging to a typology referred to in the industry with the term “OPEN”. Such a typology comprises circular knitting machines provided with at least one needle-bearing organ, one cam device, to control the movement of the needles, and especially one take-down and collection group able to collect the fabric manufactured by the machine in a single layer, typically by wrapping it on a roller. The single layer fabric, deriving from the needle-
30 bearing organ and collected by the take-down and collection group, can be obtained by means of cutting and stretching (or “opening”) of a tubular fabric (if - as in most cases - the circular machine continuously manufactures a tubular fabric) or, alternatively, it can be manufactured directly “in the open”, i.e. as a single continuous layer of fabric (having a determined width). In other words, the take-down and collection group collects (by wrapping it on a roller) a single layer fabric and not a cylindrically developed tubular: the single layer

fabric has a continuous "stripe" conformation (or cloth or patch) of particular width and can be obtained by "opening" a tubular, by means of a continuous cut carried out parallel to the direction of longitudinal development of the manufactured tubular fabric, or derive from the machine already as "open" fabric, in a single layer: hence the term "open" used to identify this typology of machine. "Open" type knitting machines can sometimes
5 comprise an only collection unit, i.e. without a taking-down function: it occurs, for example, in machines where the taking-down is carried out directly at the needle bed; in this case, the fabric manufactured by the needle-bearing organ descends into the collection unit, which takes care of wrapping it on a roller, typically by means of a winder. In any case, an "open" type machine is definable as a circular weft knitting machine in which the manufactured fabric is collected "in the open", i.e. as a single layer, by wrapping it on a collection roller.

10 The circular weft knitting machines of the technical field of the present invention can be of single needle bed (with single needle-bearing cylinder) or double needle bed (with needle-bearing cylinder and needle-bearing plate) type.

The description and claims of the present patent application, where they indicate an "open type" knitting machine, therefore identify - specifically - a knitting machine having the characteristics above described for
15 "open" machines, characteristics which clearly and unambiguously identify and define such a typology in the reference field, and are clearly understandable to a person skilled in the art. The nomenclature used in the claims must therefore be correctly interpreted in light of this information about the technical reference field. In particular, the characteristic according to which the machine object of the present invention is of the "open" type is to be understood as a precise technical characteristic, which constitutes a limitation and is not to be
20 interpreted as a mere example of a knitting machine, among the many existing typologies, on which the further technical characteristics described in the claims are to be incorporated.

The present invention can also be placed in the technical field of traditional circular knitting machines, i.e. knitting machines in which the needle-bearing organ manufactures a tubular fabric which is collected by the take-down and collection group still in tubular form (i.e. not open). In this case, the take-down and collection group collects
25 the fabric "in a double layer", i.e. as a "flattened" tubular (but not open in a single layer); the tubular fabric manufactured by the machine is typically collected by wrapping it on a collection roller.

The circular knitting machines, both traditional and of "open" type, are provided with a base which constitutes the bearing structure thereof and which supports and houses all the machine components, in particular the textile head (comprising the needle-bearing organ, a plurality of needles and command means of these needles)
30 and the take-down and collection group. The base allows furthermore to firmly lean the machine in the place where it operates.

The open type machines typically have a needle-bearing organ, i.e. a needle-bearing cylinder or a needle-bearing plate, having a diameter in the order of 30 to 40 inches, but there are also exemplars having a smaller diameter, e.g. 24 inches, or greater than 40 inches.

In the "open" type machines that manufacture a tubular fabric (i.e. do not manufacture a directly "in the open" fabric), the take-down and/or collection group comprises cutting organs adapted to longitudinally cut the tubular fabric deriving from the needle-bearing organ so as to make it "open" and therefore wrappable in a single layer on the collection roller.

5 The traditional knitting machines, not of open type, are provided with a needle-bearing organ, i.e. a needle-bearing cylinder or a needle-bearing plate, that can have various diameter measures; the so-called "big diameter" machines can have a needle-bearing organ having a diameter in the order of 30 to 40 inches, but also lower, for example 24 inches, or higher than 40 inches.

10 The take-down and collection group comprises typically further organs, such as flattening means of the tubular fabric, spreading means to open the fabric after cutting, tensioning rollers for the controlled advancement of the fabric on its path towards the collection roller, as well as actuators and mechanical synchronizing means of the movements of the various organs.

15 Among the means determining the advancement of the fabric towards the collection roller, of particular importance is a roller called spreading roller, also called a spiral roller or tensioning roller, which intercepts the fabric upstream of the collection roller and is configured to progressively open it, in the sense of its width, and eliminate wrinkles and folds in such a way that the fabric reaches the collection roller on which it is wrapped as open and spread as possible, in all its width. An example of a spreading roller having such a purpose is shown in patent document WO0050678: such a roller has two helical embossed elements which develop in the opposite direction from the center towards the two ends of the roller.

20 The take-down and collection group is typically mounted to the machine underneath the needle-bearing organ (in a collection space specifically designed for such a group) and is able to rotate integrally with the needle-bearing organ to follow its fabric manufacturing and collect the fabric on a roll.

25 The take-down and collection groups of known type are typically connected, directly or indirectly, to the needle-bearing organ of the textile head through connection means configured to transmit the motion of the needle-bearing organ to the take-down and collection group so that it can move, i.e. rotate, synchronously with the needle-bearing organ. By way of example, said connection means comprise one or more brackets connected to the textile head by means of fastening means such as screws or bolts.

30 Examples of take-down and collection groups for open type knitting machines are shown in patent documents EP0456576, EP0696658 and WO0050678. More in detail, these take-down and collection groups have a frame supporting all the organs of the group and arranged in the machine below the textile head. The entire frame rotates integrally with the needle-bearing organ, and is furthermore laid at the lower base of the machine by means of supporting means (comprising e.g. a bearing) which support its weight and at the same time allow it to rotate; the supporting means in the lower part can be driven (e.g. by a motor) to determine the rotation of the entire frame.

The document WO2014191868A1 in the name of the Applicant describes a take-down and collection group for an "open" type circular knitting machine.

In known type solutions, the take-down and collection group typically comprises motion generation and transmission means, which have the function to drive the various organs in charge of fabric treatment for controlling its advancement on its path from the needle-bearing cylinder to the collection roller.

The known take-down and collection groups typically comprise electric motors positioned in determined positions and a series of mechanical transmissions for putting in rotation the various fabric treatment rollers (collection roller, spreading roller, tensioning roller, etc.).

These mechanical transmissions typically comprise belts, chains, pulleys, epicycloidal gearbox.

Summary

In the collection of the fabric manufactured by the circular weft knitting machines, in particular (but not exclusively) of the "open" type i.e. with collection of the fabric in a single layer, the Applicant has noted the presence of certain limitations and drawbacks, and believes that the known solutions can be improved in several aspects.

First of all, in the known take-down and collection groups the motion generation and transmission means do not allow an effective control of the various fabric treatment rollers. In particular, the control of the various rollers is typically imprecise and poorly performing, and this does not allow to precisely regulate the fabric collection.

Still, in the known take-down and collection groups the various rollers are hardly synchronisable due to the structure of the motion generation and transmission means, i.e. the motors and mechanical transmissions.

For this reason the known take-down and collection groups are not always able to operate an effective and uniform wrapping of the fabric on the collection roller: in particular, the known elements of the take-down and collection groups can introduce, in the fabric wrapped on the collection roller, unwanted creases, wrinkles and/or overlaps, which can damage the fabric, compromise its quality, complicate the subsequent finishing or packaging processes carried out on the fabric, or can even require further operations of regulation of the fabric on the collection roller. For example, the performance limitations of the known take-down and collection groups can determine a reduced effectiveness in spreading the outer edges of the fabric, which tend to "curl" or wrap on themselves, in a longitudinal direction, forming on each side what is called a "cigarette" in technical jargon.

Another drawback of the known take-down and collection groups is represented by the fact that they usually require to insert a freewheel or brake at the end of the chain transmitting motion to the various rollers to prevent the rollers from rotating backwards in an undesirable manner. This is because, e.g. in the event of an absence of power supply, the rollers could determine a torque opposite to the normal direction of rotation (e.g. due to inertia or tensions in the fabric) and this could cause a mismatch between the various rollers and/or errors in fabric collection.

Another drawback of the known take-down and collection groups is represented by the difficulty in the control of the collection of the fabric; it is in fact difficult to know precisely the state of the different organs that cooperate to the collection of the fabric deriving from the textile head (e.g. position, angular speed, reciprocal positioning of the various rollers), and typically it is not possible to have precise parameters that are representative of the operational state in which the take-down and collection group is in. This can lead to errors in the collection of the fabric, can introduce defects into the collected fabric, and generally makes it difficult to co-ordinate the operations performed by the take-down and collection group with the operations performed by the other parts of the knitting machine, in particular by the textile head where the fabric is manufactured.

Furthermore, in the known take-down and collection groups the motion generation and transmission means typically have high electricity consumption, high wear and difficulty in maintenance operations.

Again, the known take-down and collection groups are characterized by a complex structure and a high cost of implementation and maintenance.

In this situation, a purpose at the basis of the present invention, in its various aspects and/or embodiments, is to provide a take-down and/or collection group for circular knitting machines (in particular, but not exclusively, of the "open" type), a circular weft knitting machine, and a collection method of the fabric manufactured by a circular weft knitting machine that can be able to solve one or more of the above-mentioned drawbacks.

Another purpose of the present invention is to provide a take-down and/or collection group and a circular weft knitting machine which allow to implement an improved control and an evolved management of the collection of the manufactured fabric.

Another purpose of the present invention is to provide a take-down and/or collection group and a circular weft knitting machine able to operate in an innovative manner with respect to the known solutions.

Another purpose of the present invention is to provide a take-down and/or collection group for a circular weft knitting machine having high technological characteristics.

Another purpose of the present invention is to provide a take-down and/or collection group for a circular weft knitting machine able to be calibrated and controlled with high precision.

Another purpose of the present invention is to provide a take-down and/or collection group and a circular weft knitting machine characterized by reduced power consumption compared to known solutions.

It is furthermore purpose of the present invention to propose a solution to realize a take-down and/or collection group, for a circular weft knitting machine, able to be easily subjected to operations of maintenance and replacement of its parts.

Another purpose of the present invention is to provide a take-down and/or collection group characterized by a high operational reliability and/or a lower susceptibility to failures and malfunctions. Another purpose of the present invention is to provide a take-down and/or collection group and a circular weft knitting machine able to

prevent the formation of misalignments and/or wrinkles in the collected fabric, and/or prevent the wrapping of lateral edges of the fabric.

Another purpose of the present invention is to provide a take-down and/or collection group and a circular weft knitting machine able to realize a uniform and flat wrapping of the fabric on the collection roller.

5 Another purpose of the present invention is to provide a take-down and/or collection group and a circular weft knitting machine able to effectively open and spread the fabric.

Another purpose of the present invention is to provide a take-down and/or collection group and a circular weft knitting machine with improved performance, for example in terms of productivity and/or quality and uniformity of the manufactured knitwear, with respect to known solutions.

10 Another purpose of the present invention is to provide a take-down and/or collection group that is versatile and adaptable to different textile needs and different fabric typologies and dimensions.

Another purpose of the present invention is to provide a take-down and/or collection group and a circular weft knitting machine characterized by a simple and rational structure.

15 Another purpose of the present invention is to create alternative solutions, with respect to the known art, in the realization of take-down and/or collection groups, in particular (but not exclusively) for "open" type circular weft knitting machines, and/or to open up new design fields.

These purposes and any others, which will become clearer in the following description, are substantially reached by a take-down and/or collection group for circular knitting machines (in particular, but not exclusively, of the "open" type), a circular weft knitting machine, and a collection method of the fabric manufactured by a circular weft knitting machine, according to one or more of the attached claims, as well as according to the following aspects and/or embodiments, variously combined, possibly also with the above-mentioned claims.

20 In the present description and in the attached claims the terms "upper", "lower", "on", "below", "horizontal", "vertical", are relative to the positioning of the take-down and/or collection group and the knitting machine in normal functioning, for example with the central axis of rotation of the needle-bearing organ vertically placed.

25 In the present description and in the attached claims the terms "axial", "longitudinal", "circumferential", "radial" are referred from time to time to a determined axis defined for a determined element or component.

Aspects of the invention are listed below.

In a first aspect thereof, the present invention refers to a take-down and/or collection group of a fabric manufactured by a circular weft knitting machine.

30 In an aspect the take-down and/or collection group comprises:

- a textile head provided with at least one needle-bearing organ rotating around a central axis, having shape of needle-bearing cylinder or needle-bearing plate, with a plurality of needles movably mounted to said at least one needle-bearing organ, and with command organs adapted to selectively actuate said plurality of needles and to allow the manufacturing of a fabric;

- a base constituting the bearing structure of the knitting machine and configured to support said textile head, said base defining, below said textile head, a housing volume.

In an aspect the take-down and/or collection group comprises:

- a frame configured to be mounted in a rotating manner to said circular knitting machine in said housing volume;
5 - operating organs operatively associated to, and supported by, said frame and comprising at least one collection roller developing along a rotation axis and longitudinally extending between two ends, the operating organs being configured at least to open and spread, or also eventually to draw it from said needle-bearing organ, the fabric manufactured by the circular knitting machine, wrapping it continuously on said collection roller.

In an aspect said operating organs comprise:

10 - a plurality of motorized axes, each of them being configured to selectively rotate around a respective rotation axis;
- a plurality of motor groups.

In an aspect each motorized axis is individually associated to a respective motor group and independently actuated by the respective motor group.

15 In an aspect the motorized axes represent the elements, being part of the operating organs, configured to treat the fabric from the needle-holder organ to the collection roller, i.e. to contact, manipulate and move it.

In an aspect, with the expression "plurality of motorized axes" it is intended at least two (or more) motorized axes.

In an aspect, with the expression "plurality of motor groups" it is intended at least two (or more) motor groups.

20 In an aspect each motor group of said plurality of motor groups comprises a modular type gearmotor, i.e. a gearmotor that is repeated in each of the motor groups.

In an aspect said gearmotor comprises:

- an electric motor, preferably a stepper motor;
- an endless screw / helicoidal toothed wheel mechanical transmission (worm drive), placed downstream of,
25 and actuated by, said electric motor.

In an aspect the electric motors of gearmotors of all the motor groups of said plurality of motor groups are identical or equivalent to each other in terms of size and/or power (e.g. driving torque).

In an aspect the mechanical transmissions of gearmotors of all of the motor groups of said plurality of motor groups are identical or equivalent to each other in terms of size and/or gear ratio and/or component
30 dimensioning.

In an aspect said plurality of motorized axes comprises:

- said collection roller, configured to collect, by continuously wrapping it, the fabric manufactured by the circular knitting machine and transiting in the take-down and/or collection group;

- at least one transfer roller (or taking-down roller) rotatably mounted to the frame in position upstream with respect to said collection roller and configured to draw and/or tension the fabric (so as to allow an optimal wrapping, i.e. without creases) and address it along an articulated path towards the collection roller.

In an aspect the collection roller is configured to collect, by continuously wrapping it around it:

5 - a single-layer fabric, in case wherein the knitting machine is of the "open" type, said single-layer fabric having a continuous strip conformation of particular width and being obtained:

- by opening a tubular, by means of a continuous cut carried out parallel to the direction of longitudinal development of the tubular fabric manufactured; or

10 - directly from the textile head, which already manufactures it as an "open" fabric, in a single and continuous layer;

or

- a double-layer fabric, i.e. as a flattened tubular fabric (having two facing fabric flaps) and wrapped on the collection roller in case wherein the knitting machine is not of "open" type and the fabric is kept in tubular shape also when wrapped on the collection roller.

15 In an aspect said plurality of motor groups comprises:

- a first motor group, directly active on said collection roller in such a way that the collection roller results axially motorized, i.e. it is put in rotation around its own rotation axis by said first motor group;

- a second motor group, directly active on said transfer roller in such a way that the transfer roller results axially motorized, i.e. it is put in rotation around its own rotation axis by said second motor group.

20 In an aspect:

- each motor group is directly active on the respective motorized axis;

- each motor group comprises its own modular gearmotor.

In an aspect the driving torque necessary for the rotation of each motorized axis is generated by the respective motor group directly at the motorized axis.

25 In an aspect, in said gearmotor:

- the electric motor is of stepper type and comprises a drive shaft integrally connected to the endless screw of the mechanical transmission to put it into rotation;

- the helicoidal toothed wheel of the mechanical transmission is geared to the endless screw and mounted (for example coupled) on an output shaft of the mechanical transmission.

30 In an aspect the output shaft of the mechanical transmission is connected, eventually by means of the interposition of further mechanical organs (for example gears) to the respective motorized axis in order to put it in rotation.

In an aspect said electric motor, comprised in said motor group, has:

- a body of the electric motor;

- rotation generating means, housed in said body.

In an aspect said drive shaft, put in rotation by said generating means, is provided with:

- a front portion, emerging from a front side of the body, where it is connected to the mechanical transmission placed downstream;

5 - a rear portion, emerging from a rear side of the body, opposed to said front side.

In an aspect said front portion and said rear portion of the drive shaft are integral with each other (i.e. rotate in unison), and preferably are in one piece (i.e. the drive shaft is a one-piece component).

In an aspect said rear portion of the drive shaft, emerging rearward from the body of the electric motor, is configured to be manually actuated - selectively - for manually controlling the rotation of the drive shaft, and thus - in cascade - of the endless screw, of the toothed wheel and of the motorized axis placed downstream of the mechanical transmission.

In an aspect the actuation of the rear portion of the drive shaft occurs through the use of a special tool.

In an aspect the electric motor comprises a transducer configured to measure the position and the angular speed of the drive shaft.

15 In an aspect said transducer is a hollow encoder, placed around said drive shaft and provided with a central hole for allowing the passage of the rear portion of the drive shaft and its exit from the rear side of the body of the electric motor. The hollow encoder allows, then, to dispose of the rear portion of the drive shaft, manually actuatable when necessary for manually moving the motorized axis. On the other hand, in known type electric motors, the traditional type encoder occupies the rear side of the motor and does not allow access to the drive shaft, nor therefore its actuation.

20 In an aspect said encoder comprises one or more Hall effect sensors (e.g. three sensors) for the measurement of angular position and angular speed of the drive shaft.

In an aspect, said at least one transfer roller longitudinally extends in a direction substantially parallel to said rotation axis of the collection roller and is configured to rotate around a longitudinal rotation axis thereof.

25 In an aspect, said motorized axes comprise at least one pair of transfer rollers (or taking-down rollers).

In an aspect said plurality of motorized axes comprises at least one spreading roller, or tensioning roller, mounted rotatably to the frame in upstream position (preferably immediately upstream) with respect to said collection roller and configured to interact with the fabric advancing towards the collection roller in such a way to spread it and enlarge it before the wrapping on the collection roller.

30 In an aspect said plurality of motor groups comprises a third motor group, directly active on said spreading roller in such a way that the spreading roller is axially motorized, i.e. put in rotation around its rotation axis by said third motor group.

In an aspect said plurality of motorized axes comprises a positioning mechanism of the spreading roller, movably mounted to the frame and active on the spreading roller for moving it selectively in such a way to increase or

decrease an operating distance that separates it from said collection roller, preferably keeping the spreading roller parallel to the collection roller.

In an aspect said plurality of motor groups comprises a fourth motor group, directly active on said positioning mechanism in such a way that the positioning mechanism results axially motorized, i.e. is put in rotation around its rotation axis by said fourth motor group.

In an aspect the positioning movement of the spreading roller by effect of the fourth motor group is a rotation or a translation or a rototranslation.

In an aspect said plurality of motorized axes comprises:

- a pair of flattening rollers, rotatably mounted to the frame preferably substantially at an upper opening of the frame of the take-down and/or collection group and configured to flatten or approach the fabric deriving from the textile head as closed tubular fabric.

In an aspect said plurality of motor groups comprises:

- a fifth motor group, directly active on at least one roller of said pair of flattening rollers in such a way that the roller results axially motorized, i.e. is put in rotation around its rotation axis by said fifth motor group.

In an embodiment, the rollers of said pair of flattening rollers are arranged parallel to each other. In another embodiment, said flattening rollers can comprise a pair of bars arranged parallel to each other. Said rollers/bars are arranged side-by-side between them in such a way as to define a substantially rectilinear passage for the fabric, such as to determine a substantial flattening of the tubular shape of the fabric along a diameter thereof, which has two layers approaching or substantially in contact with each other.

In an aspect each motorized axis comprises:

- a respective rod longitudinally extending between two ends and configured to determine a specific action on the fabric in transit in the take-down and/or collection group;
- at least one support configured to support in rotation said rod, preferably two supports placed at the two ends of the rod.

In an aspect, in each motorized axis the respective rod has its rotation axis coinciding with its longitudinal development.

In an aspect each motor group can comprise, downwards of the respective (modular) gearmotor, one or more additional mechanical organs interposed between the mechanical transmission and the respective motorized axis. Said additional mechanical organs are configured to opportunely connect the mechanical transmission to the motorized axis and can comprise, for example:

- toothed wheels;
- gears;
- angular drives.

In an aspect the collection roller:

- has an outer collection surface, corresponding to the outermost layer of the fabric wrapped to the collection roller;

- has, instant by instant during the collection of the fabric, a radius of the collection roller, corresponding to the radial distance between the outer collection surface and the rotation axis;

5 - has, instant by instant during the collection of the fabric, an angular speed of rotation around the rotation axis;

- has, instant by instant during the collection of the fabric, a tangential speed, i.e. the linear speed at said outer collection surface.

In an aspect said first motor group is configured to vary said angular speed of the collection roller in such a way to always keep opportunely adjusted, i.e. under control during the collection of the fabric, said tangential speed
10 of the collection roller.

In an aspect, the take-down and/or collection group defines an articulated path of the textile fabric exiting from said textile head that ends on said collection roller.

In an aspect, said spreading roller:

15 - has an outer operating surface, that contacts the fabric in its transit toward the collection roller and acts on the fabric itself for enlarging and spreading it;

- has a radius of the spreading roller having a constant value and corresponding to the radial distance between the outer operating surface and the rotation axis of the spreading roller.

In an aspect the spreading roller is configured to be moved, during the collection, by varying said operating distance that separates it from said collection roller, in such a way to keep constant, instant by instant, an
20 optimal separation value equal to a distance between the outer operating surface of the spreading roller and the outer collection surface of the collection roller.

In an aspect the take-down and/or collection group comprises at least one control unit configured to command the functioning of said operating organs.

In an aspect said control unit is configured to:

25 - command the electric motors of said motor groups for controlling the functioning of each motorized axis;

- eventually make the different motor groups communicate among them, in such a way to coordinate the functioning of the motorized axes.

In an aspect said control unit is connected to said operating organs for sending them command signals capable of modifying and controlling the operating configuration thereof.

30 In an aspect said control unit is configured to:

- send to said first motor group a command signal for progressively reducing said angular speed of the collection roller as said radius of the collection roller increases, in such a way to keep said tangential speed of the collection roller constant;

- send to said second motor group a command signal for putting in rotation the transfer roller at a determined speed for taking-down and/or tensioning the fabric and for addressing it towards the collection roller;
- send to said third motor group a command signal for putting in rotation the spreading roller at a determined speed for generating a correct action of spreading and enlarging of the fabric in transit on the spreading roller;
- 5 - send to said fourth motor group a command signal for moving the spreading roller on the basis of the value of the radius of the collection roller, by varying said operating distance in such a way to keep, during the collection of the fabric, said optimal separation value constant;
- send to said fourth motor group a command signal for progressively increasing said operating distance as said radius of the collection roller, by keeping, during the collection of the fabric, said optimal separation value
- 10 constant.

In an independent aspect thereof, the invention refers to a circular weft knitting machine comprising:

- a textile head provided with at least one needle-bearing organ rotating around a central axis, having shape of needle-bearing cylinder or needle-bearing plate, with a plurality of needles movably mounted to said at least one needle-bearing organ, and with command organs adapted to selectively actuate said plurality of needles
- 15 and for allowing the manufacturing of a fabric;
- a base constituting the bearing structure of the knitting machine and configured to support said textile head, said base defining, below said textile head, a housing volume;
- a take-down and/or collection group according to one or more of the preceding aspects.

In an aspect the knitting machine comprises supplying organs configured to electrically supply said motor

20 groups.

In an aspect said supplying organs comprise a plurality of electric drives configured to supply the electric motors of the modular gearmotors of the motor groups of the take-down and/or collection group.

In an aspect all the electric motors of the gearmotors are supplied, by said electric drives, at low voltage, preferably at 48V.

25 In an aspect said electric drives are switched-mode power suppliers (switching).

In an aspect the circular weft knitting machine is of "open" type, i.e. it is configured to manufacture fabric and collect it in the open, i.e. as single layer and continuously, by wrapping it on the collection roller of the take-down and/or collection group.

In an aspect the single layer fabric, deriving from the needle-bearing organ and collected by the take-down and

30 collection group, is obtained:

- by means of cutting and stretching, or "opening", of a tubular fabric, if the textile head continuously manufactures a tubular fabric; or
- directly "in the open", i.e. as continuous single layer of fabric having a determined width;

in both cases the take-down and/or collection group by collecting, by wrapping it on the collection roller, a single layer fabric and not a cylindrical development tubular.

In an aspect the single layer fabric has a continuous stripe conformation of particular width and is obtained:

- by opening a tubular, by means of a continuous cut carried out parallel to the direction of longitudinal development of the manufactured tubular fabric; or
- directly from the textile head, which already manufactures it as an "open", single layer and continuous fabric.

In an independent aspect thereof, the invention refers to a collection method of the fabric manufactured by a circular weft knitting machine, the method comprising the steps of:

- arranging and operating said circular weft knitting machine;
- arranging and operating said take-down and/or collection group;
- independently actuating each motor group.

In an aspect said step of independently actuating each motor group comprises a step of synchronizing the operating organs on determined working parameters necessary to obtain:

- the correct tensioning and the correct spreading of the fabric;
- the correct collection of the fabric.

Further features and advantages will result better from the detailed description of a preferred embodiment of a take-down and/or collection group for circular knitting machines, a circular weft knitting machine, and a collection method of the fabric, according to the present invention.

Description of figures

This description will be expressed herein with reference to the attached figures, provided for illustrative purposes only and therefore not limitative, in which:

- figure 1 shows a perspective view of a possible embodiment of a take-down and/or collection group for circular knitting machines according to the present invention;
- figure 2 shows a plant view from above, of the take-down and/or collection group of figure 1;
- figure 3 shows a front view of the take-down and/or collection group of figure 1;
- figure 4 shows a left lateral view of the take-down and/or collection group of figure 1;
- figure 5 shows a right lateral view of the take-down and/or collection group of figure 1;
- figure 6 shows a further perspective view of the take-down and/or collection group of figure 1, with some parts removed;
- figure 7 shows an enlargement of a portion of the take-down and/or collection group of figure 6, seen from the outside;
- figure 8 shows an enlargement of the portion of the take-down and/or collection group of figure 6, seen from the inside;

- figure 9 shows a rear perspective view of the take-down and/or collection group of figure 1;
- figure 10 shows an enlargement of a portion of the take-down and/or collection group of figure 9, in this case an upper and rear portion;
- figure 11 shows a cross-sectional view of the take-down and/or collection group of figure 1; the section is carried out on a vertical plane, orthogonal to the longitudinal axis of the frame and, with take-down group mounted, parallel to the central axis of the knitting machine;
- figure 12 shows a perspective view of the take-down and/or collection group of figure 1, sectioned along the above-mentioned plan according to figure 11;
- figure 13 shows a perspective view of an exemplary embodiment of a motor group according to the present invention;
- figure 14 shows a further perspective view of the motor group of figure 13;
- figure 15 shows the motor group of figure 13, associated to a motorized axis (exemplary type) according to the present invention;
- figure 16 shows a further perspective view of the take-down and/or collection group of figure 1, with some parts removed; figure 16 furthermore shows - by way of example - a fabric manufactured by a circular knitting machine and sent to the take-down and/or collection group; a certain length of such fabric is advancing within the take-down and/or collection group, while a determined quantity is already wrapped, in a single layer, to the collection roller;
- figure 17 is a lateral view of the take-down and/or collection group of figure 16 (comprising the fabric within it);
- figure 18 shows a perspective view from above of a possible exemplary embodiment of a circular weft knitting machine according to the present invention, to which it is in a rotating manner mounted the take-down and/or collection group of figure 1; from the knitting machine of figure 18 were removed some parts; the figure shows, in particular, the base and the textile head of the circular knitting machine, further than the take-down and/or collection group;
- figure 19 shows a further perspective view (from below) of the circular weft knitting machine of figure 18;
- figure 20 shows a perspective view of a possible exemplary embodiment of a circular weft knitting machine according to the present invention; in this figure the knitting machine is shown with the textile head complete with every part, with the cone-holder structure placed above the textile head and with the closing cages that close the operating space occupied by the take-down and/or collection group (which is then closed inside these cages).

Detailed description

With reference to the above-mentioned figures, a take-down and/or collection group according to the present invention, intended to be mounted in a circular weft knitting machine (indicated by the reference 100), has been overall indicated with reference number 1.

5 The circular weft knitting machine 100 comprises:

- a textile head T provided with at least one needle-bearing organ C rotating around a central axis X, having shape of needle-bearing cylinder or needle-bearing plate, with a plurality of needles movably mounted to the needle-bearing organ, and with command organs adapted to selectively actuate the plurality of needles and for allowing the manufacturing of a fabric F;

10 - a base B constituting the bearing structure of the knitting machine and configured to support the textile head T; the base B defines, below the textile head T, a housing volume.

The needle-bearing cylinder C is usually vertically mounted, as in figures 18-20, on the base B with needles vertically arranged which protrude further than an upper edge of the needle-bearing cylinder.

15 From a textile technology point of view, the structure of the entire circular knitting machine 100 and the functioning of the needle-bearing organ C (for example the cooperation between needles and threads, etc.) are not described in detail, as they are known in the technical field of the present invention.

The take-down and/or collection group 1 comprises:

- a frame 2 configured to be mounted in a rotating manner to the circular knitting machine 100 in said housing volume;

20 - operating organs 3, operatively associated to the frame 2 and supported thereby, and comprising at least one collection roller 10, rotatably mounted to the frame 2, developing along a rotation axis 11 and longitudinally extending between the two ends 12 and 13.

The operating organs 3 are configured at least to open and spread, or also eventually to draw it from the needle-bearing organ C, the fabric F manufactured by the circular knitting machine, wrapping it continuously on the collection roller 10.

25 The operating organs 3 comprise:

- a plurality of motorized axes (detailed below and indicated with references 10, 70, 30, 60, 80), each configured to rotate selectively around a respective rotation axis;

- a plurality of motor groups (detailed below too and indicated with references 20, 75, 50, 40, 85).

30 Preferably each motorized axis is individually associated to a respective motor group and independently activated by the respective motor group.

Preferably the motorized axes represent the elements, being part of the operating organs 3, configured to treat the fabric F from the needle-holder organ C to the collection roller 10, i.e. to contact, manipulate and move it.

With the expression "plurality of motorized axes" it is intended at least two (or more) motorized axes, and with the expression "plurality of motor groups" it is intended at least two (or more) motor groups.

Preferably each motor group comprises a modular type gearmotor M, i.e. a gearmotor M that is repeated in each of the motor groups.

5 Preferably the gearmotor A comprises:

- an electric motor M, preferably a stepper motor;
- an endless screw / helicoidal toothed wheel mechanical transmission R (worm drive), placed downstream of, and activated by it.

10 Preferably the electric motors M of gearmotors A of all the motor groups of said plurality of motor groups are identical or equivalent to each other in terms of size and/or power (e.g. driving torque).

Preferably the mechanical transmissions R of gearmotors A of all of the motor groups of said plurality of motor groups are identical or equivalent to each other in terms of size and/or gear ratio and/or component dimensioning.

Preferably said plurality of motorized axes comprises:

- 15
- the collection roller 10, configured to collect, by continuously wrapping it, the fabric F manufactured by the circular knitting machine 100 and transiting in the take-down and/or collection group 1;
 - at least one transfer roller 70 (or taking-down roller) rotatably mounted to the frame 2 in position upstream with respect to the collection roller 10 and configured to draw and/or tension the fabric F (so as to allow an optimal wrapping, i.e. without creases) and address it along the articulated path towards the collection roller.

20 Preferably the transfer roller 70 longitudinally extends in a direction substantially parallel to the rotation axis 11 of the collection roller 10 and is configured to rotate around a longitudinal rotation axis 71 thereof.

Preferably the motorized axes comprise at least one pair of transfer rollers (or taking-down rollers) 72 and 73. In a possible embodiment, the motorized axes can also comprise a plurality of transfer rollers arranged in series along the articulated path of the fabric.

25 It should be noted that, within the scope of the present invention, the collection roller 10 is configured to collect, by continuously wrapping it around itself:

- a single-layer fabric F in case wherein the knitting machine is of the "open" type, having a continuous strip conformation of particular width and obtained:

- 30
- by opening a tubular, by means of a continuous cut carried out parallel to the direction of longitudinal development of the tubular fabric manufactured; or
 - directly from the textile head T, which already manufactures it as an "open" fabric, in a single and continuous layer;

or

- a double-layer fabric F, i.e. as a flattened tubular fabric (with two facing fabric flaps) and wrapped on the collection roller 10 in case wherein the knitting machine is not of "open" type and the fabric is kept in tubular shape also when wrapped on the collection roller 10.

Preferably said plurality of motor groups comprises:

- 5 - a first motor group 20, directly active on the collection roller 10 in such a way that the collection roller 10 results axially motorized, i.e. it is put in rotation around its own rotation axis 11 by the first motor group 20;
- a second motor group 75, directly active on the transfer roller 70 in such a way that the transfer roller 70 results axially motorized, i.e. it is put in rotation around its own rotation axis 71 by said second motor group 75.

Preferably each motor group is directly active on the respective motorized axis.

- 10 Preferably each motor group comprises its own modular gearmotor A.

Preferably each motor group is configured to put in rotation the respective motorized axis with a variable and selectable angular speed.

Preferably each motor group is configured to put in rotation the respective motorized axis with a variable and selectable angular speed regardless of the rotation speed of the needle-holder organ C.

- 15 Preferably, for example in determined operating conditions, each motor group is configured to put in rotation the respective motorized axis with a variable and selectable angular speed in a manner coordinated to the rotation of the needle-bearing organ C, preferably in a manner coordinated - for example, proportional - to the rotation speed of the needle-bearing organ C.

Preferably each motor group is configured to put the respective motorized axis in rotation with a variable and selectable angular speed also in condition of constant rotation speed of the needle-bearing organ C.

- 20 Preferably the driving torque necessary for the rotation of each motorized axis is generated by the respective motor group directly at the motorized axis.

Preferably, in said gearmotor A:

- 25 - the electric motor M is of stepper type and comprises a drive shaft integrally connected to the endless screw of the mechanical transmission R to put it into rotation;
- the helicoidal toothed wheel of the mechanical transmission R is geared to the endless screw and mounted (for example coupled) on an output shaft of the mechanical transmission.

The output shaft of the mechanical transmission R is connected, eventually by means of the interposition of further mechanical organs, for example gears, to the respective motorized axis in order to put it in rotation.

- 30 The rotation axis of the endless screw and the rotation axis of the helicoidal toothed wheel are axes to each other skewed and orthogonal; consequently, also the rotation axis of the output shaft of the electric motor M and the rotation axis of the output shaft are axes skewed and orthogonal to each other.

The endless screw is always driving, while the helicoidal toothed wheel is always guided.

It should be noted that the output shaft of the electric motor M and the endless screw and the helicoidal toothed wheel of the mechanical transmission R are not visible in figures 13-15 since they are inner components; however, the electric motor and the mechanical transmission can be advantageously commercial products from catalog, and their inner components are known in the art.

5 It should be noted that the transmission ratio is a function of the number of start threads of the endless screw. For example if the endless screw has a one start thread, with each revolution of the endless screw the helicoidal wheel shifts by one tooth (advancing or receding depending on the direction of rotation of the screw).

The endless screw / helicoidal toothed wheel transmission (garmotor) has the advantage of having a compact shape, and therefore a smaller footprint than other typologies of gearmotors, and can be connected directly to
10 the axis to be moved. In addition, this transmission has a low manufacturing cost and high reliability.

In addition, it allows to obtain high reduction ratios and thus very high motion reductions. With a high rotation speed of the drive shaft of the electric motor, a low rotation speed of the output shaft of the mechanical transmission is obtained (gearing down).

An important advantage of using an endless screw/helical toothed wheel transmission (garmotor) is
15 represented by the fact that such a transmission is (tendentially) kinematically non-reversible, i.e. the helical toothed wheel can hardly actuate the endless screw.

Technically, the irreversibility of such a mechanical transmission is only achievable with high reduction ratios (e.g. from 70-80 upwards); in any case, the torque required at the output (the toothed wheel) to rotate the input (the endless screw) increases as the reduction ratio increases and becomes high enough to ensure that the
20 element downstream of the transmission can actuate the transmission in the opposite direction.

In the context of the present invention, the mechanical transmission R drives the motorized axis downstream of it (and connected to the helical toothed wheel). The control of the rotation of the motorized axis occurs by means of the control of the direction of rotation, and relative speed, of the electric motor M which drives the endless screw. Hence, even if an opposing torque were to occur on the motorized axis, e.g. due to weight, inertia, or
25 taking-down forces on the fabric, this would not cause an undesired rotation in the opposite direction of the motorized axis, since - for this to occur - a counter-rotation of the endless screw / helicoidal toothed wheel mechanical transmission should occur, which we have seen to be inherently irreversible (at certain reduction ratios).

Therefore, the endless screw/ helical toothed wheel transmission in the above-mentioned modular garmotor
30 A, which is used in the various motor groups, guarantees a high degree of safety in the actuation of the motorized axes.

For example, in the event of a shutdown of the knitting machine or absence of power supply, the garmotors A prevent the motorized axes from undesirably "coming back".

Preferably the electric motor M, comprised in a motor group, has:

- a body 55 of the electric motor M;
- rotation generating means, housed in the body (not visible in the figures, e.g. of a known type).

Preferably the drive shaft, put in rotation by the generating means, is provided with:

- a front portion, emerging from a front side of the body 55, where it is connected to the mechanical transmission R placed downstream (for this reason the front portion of the drive shaft is not visible in the figures);
- a rear portion 56, emerging from a rear side of the body 55, opposed to the front side.

Preferably the front portion and the rear portion of the drive shaft are integral with each other (i.e. rotate in unison), and preferably are in one piece (i.e. the drive shaft is a one-piece component).

Preferably the rear portion 56 of the drive shaft, emerging rearward from the body 55 of the electric motor, is configured to be manually actuated - selectively - for manually controlling the rotation of the drive shaft, and thus - in cascade - of the endless screw, of the toothed wheel and of the motorized axis placed downstream of the mechanical transmission R.

Preferably the manual actuation of the rear portion of the drive shaft occurs for determining a counter-rotation, with respect to the direction of rotation of the drive shaft during the normal functioning of the take-down and/or collection group 1, in order to make the motorized axis "move backwards". This may occur, for example, for purposes of manual regulation/calibration of the motorized axis (e.g. following a stop), or to recover an undesired rotation that has occurred during the normal functioning of the take-down and/or collection group 1, or also to relieve an excessive pulling condition of the fabric F during the collection.

Preferably the actuation of the rear portion 56 of the drive shaft occurs through the use of a special tool.

Preferably the electric motor M comprises a transducer 57 configured to measure the position and the angular speed of the drive shaft.

Preferably the transducer 57 is a hollow encoder, placed around the drive shaft and provided with a central hole for allowing the passage of the rear portion 56 of the drive shaft and its exit from the rear side of the body 55 of the electric motor M. The hollow encoder allows, then, to dispose of the rear portion 56 of the drive shaft, manually actuatable when necessary for manually moving the motorized axis. On the other hand, in known type electric motors, the conventional type encoder occupies the rear side of the motor and does not allow access to the drive shaft, nor therefore its actuation.

Preferably the encoder comprises one or more Hall effect sensors (e.g. three sensors) for the measurement of angular position and angular speed of the drive shaft.

Preferably each motor group comprises a respective flange 58 mounted on the frame 2 and bearing the respective gearmotor A.

Preferably the flange 58 is crossed by, and supports in rotation, the respective drive shaft.

Preferably the electric motor M of the modular gearmotor A is directly mounted on, and supported by, the respective mechanical transmission.

Preferably the electric motor M of the modular gearmotor A is directly mounted on the respective mechanical transmission R and is supported by it. In this configuration the flange 58 supports the entire modular gearmotor A by mounting it to the frame 2.

In a possible embodiment, said plurality of motorized axes comprises at least one spreading roller 30 (also referred to as tensioning roller), mounted to the frame 2 in upstream position (preferably immediately upstream along the path of the fabric F) with respect to the collection roller 10. The spreading roller 30 is configured to interact with the fabric F advancing toward the collection roller 10 in such a way as to spread it before the wrapping on the collection roller.

Preferably the spreading roller 30 longitudinally extends, between two lateral ends 32 and 33, in a direction substantially parallel to the rotation axis 11 of the collection roller 10 and is configured to rotate around a rotation axis 31 thereof. In other words, the spreading roller 30 is arranged parallel to the collection roller 10 and is configured to enlarge and spread the fabric toward its ends 32 and 33.

Preferably said plurality of motor groups comprises a third motor group 50, directly active on the spreading roller 30 in such a way that the spreading roller is axially motorized, i.e. put in rotation around its rotation axis 31 by the third motor group 50. The third motor group 50 puts in rotation the spreading roller 30 for generating the action of spreading and enlarging of the fabric in transit on it.

It should be noted that the take-down and/or collection group 1:

- comprises the spreading roller 30 in case the knitting machine is of "open" type, and the fabric F is collected in a single layer;

- does not comprise the spreading roller 30 in case the knitting machine is not of "open" type, and the fabric F is collected in tubular, i.e. in double layer.

Preferably the plurality of motorized axes comprises a positioning mechanism 60 of the spreading roller 30, movably mounted to the frame 2 and active on the spreading roller 30 for moving it selectively in such a way to increase or decrease an operating distance that separates it from the collection roller 10, preferably keeping the spreading roller 30 parallel to the collection roller 10.

Preferably the plurality of motor groups comprises a fourth motor group 40, directly active on the positioning mechanism 60 in such a way that the positioning mechanism 60 results axially motorized, i.e. is put in rotation around the rotation axis 63 by the fourth motor group 40.

Preferably the positioning movement of spreading roller 30 by effect of the fourth motor group 40 is a rotation or a translation or a rototranslation.

Further details regarding the positioning mechanism 60 and an exemplary embodiment will be described below. Preferably the plurality of motorized axes comprises a pair of flattening rollers 80, rotatably mounted to the frame 2 preferably substantially at an upper opening 4 of the frame 2 of the take-down and/or collection group 1 and configured to flatten or approach the fabric F deriving from the textile head T as closed tubular fabric.

Preferably the plurality of motor groups comprises a fifth motor group 85, directly active on at least one roller of said pair of flattening rollers 80 in such a way that the roller results axially motorized, i.e. is put in rotation around its rotation axis 81 by the fifth motor group 85.

Preferably the rollers of said pair of flattening rollers 80 are arranged parallel to each other. In a possible embodiment, the flattening rollers can comprise a pair of bars arranged parallel to each other. These rollers/bars are arranged side-by-side between them in such a way as to define a substantially rectilinear passage for the fabric, such as to determine a substantial flattening of the tubular shape of the fabric along a diameter thereof, which has two layers (or flaps) approaching or substantially in contact with each other.

Preferably the flattening rollers 80:

- are orthogonally (or transversely) oriented to the longitudinal axis 5 of the frame 2 in case wherein the knitting machine is of the "open" type, and the fabric F is destined to be subsequently cut, opened and collected in a single layer (this condition is shown in the figures);
- are oriented parallel to the longitudinal axis 5 of the frame 2 in the case wherein the knitting machine is not of the "open" type, and the fabric F is collected in tubular, i.e. in double layer (in this case the flattening rollers are rotated by 90° with respect to the condition shown in the figures).

Preferably, the operating organs 3 comprise cutting organs 90 arranged downwards of the flattening rollers 80 and adapted to longitudinally cut, along a preferably vertical generatrix line, the textile fabric of tubular shape manufactured by the textile head T so as to subsequently open and wrap it in a single layer on the collection roller 10, as it occurs in circular knitting machines of the "open" type.

Preferably the operating organs 3 comprise a motor group 91 of the cutting organs configured to actuate the cutting organs and determine the longitudinal opening of the tubular fabric exiting from the textile head T.

It should be noted that the take-down and/or collection group 1 comprises the cutting organs 90 only in the event that the knitting machine 100 is of "open" type, and the fabric F is collected open and in a single layer.

Preferably each motorized axis comprises:

- a respective rod longitudinally extending between two ends and configured to determine a specific action on the fabric F in transit in the take-down and/or collection group 1;
- at least one support configured to support in rotation said rod, preferably two supports placed at the two ends of the rod.

Preferably, in each motorized axis the respective rod has its own rotation axis coinciding with its longitudinal development.

It should be noted, preferably, each motor group (of the various motor groups above described) can comprise, downwards of the respective (modular) gearmotor M, one or more additional mechanical organs interposed between the mechanical transmission R and the respective motorized axis. These additional mechanical organs

are configured to opportunely connect the mechanical transmission to the motorized axis and can comprise, for example:

- toothed wheels;
- gears;
- 5 - angular drives.

Here is a description, in more detail, of the collection roller 10.

Preferably the mechanical transmission R of the first motor group 20 ends with a shaft bearing a motor organ 23 configured to directly transfer a controlled rotating motion to the rod 16 of the collection roller 10.

Preferably the motor organ 23 is a gear, for example a first toothed wheel 23.

- 10 Preferably the rod 16 of the collection roller comprises a guided organ 19 directly gearable to the motor organ 23 for receiving from it the controlled rotating motion and putting the rod 16 of the collection roller 10 in rotation. Preferably the guided organ 19 is integral to the rod 16 of the collection roller 10, preferably at an end thereof. Preferably the guided organ 19 is coaxial to the rod 16 of the collection roller 10.

Preferably the guided organ is a gear 19, for example a second toothed wheel 19.

- 15 It should be noted that since the guided organ 19 is integral with the rod 16 of the collection roller 10 (and coaxial to it), and since the motor organ 23 is directly gearable to the guided organ 19 for transmitting a rotary motion, the action of the first motor group 20 occurs directly on the rotation axis 11 of the collection roller 10, which is thus directly put in rotation.

- 20 Preferably the engagement of the guided organ 19 with the motor organ 23 occurs by means of meshing of the first toothed wheel with the second toothed wheel.

Preferably the motor organ 23 and the guided organ 19 have respective rotation axes parallel to each other.

Preferably the guided organ 19:

- engages on the motor organ 23 when the collection roller 10 is mounted on the frame 2;
- disengages from the motor organ 23 when the collection roller 10 is demounted from the frame 2.

- 25 In particular, the mounting of the collection roller 10 to the frame 2 determines the meshing of the second toothed wheel with the first toothed wheel, and vice versa the demounting of the collection roller 10 from the frame 2 determines the detachment and the distancing of the second toothed wheel from the first toothed wheel. Preferably the rotation axis of the first toothed wheel 23 and the respective rotation axis of the second toothed wheel 19 are parallel to each other and parallel to the rotation axis of the collection roller.

- 30 Preferably the collection roller 10, actuated by the first motor group 20, is mounted hanging in the frame 2, in such a way to result hanging in the take-down and/or collection group 1, and in such a way that the entire surface of the fabric F wrapped on the collection roller 10 does not result in contact with the operating organs 3 or other elements of the take-down and/or collection group.

Preferably the collection roller 10 is mounted to the frame 2 in such a way that the entire surface of the fabric F wrapped on collection roller 10 results free and not leaning against any element.

Preferably the collection roller 10 is in a rotating manner mounted to the frame 2 at the two ends thereof, in such a way to result exclusively supported by the two ends.

5 Preferably the collection roller 10 remains, in use, with its rotation axis 11 in a fixed position with respect to the frame 2, during all the steps of collection of the fabric and regardless of the amount of fabric wrapped on collection roller 10.

Preferably the first motor group 20 is fixed at one of the two ends of the collection roller 10, and from this position it puts in rotation the collection roller directly on the rotation axis 11.

10 Preferably the collection roller 10:

- has an outer collection surface 15, corresponding to the outermost layer of the fabric F wrapped on the collection roller 10;

- has, instant by instant during the collection of the fabric, a radius Y of the collection roller, corresponding to the radial distance between the outer collection surface 15 and the rotation axis 11;

15 - has, instant by instant during the collection of the fabric, an angular speed of rotation around the rotation axis 11;

- has, instant by instant during the collection of the fabric, a tangential speed, i.e. the linear speed at the outer collection surface 15.

Preferably the first motor group 20 is configured to vary the angular speed of the collection roller 10 in such a way to always keep opportunely regulated, i.e. under control during the collection of the fabric F, the tangential speed of the collection roller 10.

20

Preferably the tangential speed is, instant by instant, equal to the product of the angular speed by the radius Y of the collection roller 10.

Said tangential speed:

25 - has a preferably constant value during the entire collection of the fabric F;

- has a preferably constant value at tracts during discrete steps of the collection of the fabric F;

- is function of rotation speed of the needle-bearing organ C that manufactures the fabric F;

- corresponds substantially to the advancement linear speed of the fabric F in the take-down and/or collection group 1, and to the linear amount of fabric F that is wrapped on the collection roller 10 per time unit.

30

Preferably the first motor group 20 is configured to progressively reduce the angular speed of the collection roller 10 as the radius Y of the collection roller increases, in such a way to keep the tangential speed of the collection roller 10 constant. In fact, since the tangential speed is equal to the product of the angular speed by the radius Y of the collection roller 10, as the radius Y of the collection roller increases, the angular speed must decrease in order to keep the tangential speed constant.

Preferably the take-down and/or collection group 1 is configured to process the value of the radius Y of the collection roller 10 in real time, i.e. instant by instant, thus continuously monitoring the value of the radius Y of the collection roller.

Preferably, the take-down and/or collection group 1 defines an articulated path of the fabric F exiting from the textile head T which ends on the collection roller 10. In particular, the take-down and/or collection group 1 defines an articulated path that begins from an upper opening 4 of the frame 2 and ends in the collection roller 10.

Preferably, the frame 2 is mounted in the knitting machine in such a way as to rotate around a vertical axis preferably coinciding with the central axis X of the textile head T. Preferably the vertical axis coincides, in use, with a direction orthogonal to a bearing plane of the knitting machine, in particular to a bearing plane of the base B. Preferably the development of the frame 2 along its vertical axis coincides with the height of the frame.

Preferably the frame 2 develops along a longitudinal axis 5 between a first lateral portion 6 and a second lateral portion 7. Preferably, the longitudinal axis 5 is orthogonal to the vertical axis. Preferably, the development of the frame 2 along the longitudinal axis coincides with the width of the frame. Preferably, the development of the frame 2 along the longitudinal axis 5, i.e. the width of the frame, coincides with the dimension of greater development of the frame 2.

Preferably the collection roller 10 is mounted, with its two ends, to the first lateral portion 6 and to the second lateral portion 7 of the frame 2, in such a way that the rotation axis 11 of the collection roller 10 is substantially parallel to the longitudinal axis 5 of the frame 2.

Here is a description, in more detail, of said spreading roller 30.

Preferably the spreading roller 30 is mounted in a movable manner, for example translatable or rototranslatable, to the frame 2 and is configured to be able to vary an operating distance that separates it from the collection roller 10.

Preferably this operating distance corresponds to the linear distance between the rotation axis 31 of the spreading roller 30 and the respective rotation axis 11 of the collection roller 10.

Preferably the spreading roller 30:

- has an outer operating surface 35, that contacts the fabric F in its transit toward the collection roller 10 and acts on the fabric itself for enlarging and spreading it;

- has a radius of the spreading roller 30 having a constant value and corresponding to the radial distance between the outer operating surface 35 and the rotation axis 31 of the spreading roller.

In an aspect the spreading roller 30 is configured to be moved, during the collection, by varying the operating distance that separates it from the collection roller, in such a way to keep constant, instant by instant, an optimal separation value equal to a distance between the outer operating surface 35 of the spreading roller 30 and the outer collection surface 15 of the collection roller 10.

Preferably this optimal separation value is an operating value (for example set when setting up the knitting machine) corresponding to the ideal distance at which to keep the spreading roller 30 with respect to the collection roller 10 for carrying out an optimal spreading of the fabric F which passes from the spreading roller to the collection roller.

5 Preferably the fourth motor group 40 is configured to move the spreading roller 30 on the basis of the measure of the radius Y of the collection roller 10, by varying the operating distance that separates the spreading roller 30 from the collection roller 10 in such a way to keep constant, instant by instant, the optimal separation value. Preferably the fourth motor group 40 is configured to progressively increase the operating distance as the radius Y of the collection roller 10 increases, keeping said optimal separation value during the collection of the fabric F constant.

10 In fact, as the radius Y of the collection roller 10 increases its outer collection surface 15 approaches the spreading roller 30, so the latter must be progressively distanced. In other words, as the radius Y of the collection roller 10 increases, the operating distance (if calculated as the distance between the rotation axes 11 and 31) necessary to keep constant the optimal separation value increases.

15 Alternatively, the operating distance can correspond directly to a linear distance between the outer collection surface 15 of the collection roller 10 and the outer operating surface 35 of the spreading roller 30. In this case the operating distance is the linear interval between the surfaces of the two rollers 10 and 30 and therefore is variable, during the collection of the fabric F, depending on the radius Y of the collection roller; in fact the radius of the collection roller 10 increases as the fabric F is collected.

20 In this case the fourth motor group 40 is configured to selectively move the spreading roller 30 so as to keep the operating distance that separates it from the collection roller 10 constant.

Preferably the spreading roller 30 comprises two embossed elements 36 and 37 in helical or spiral shape (or double helical or double spiral) developing in the opposite direction from the center of the spreading roller 30 toward its two lateral ends 32 and 33; the embossed elements 36 and 37 operate, thanks to the rotation of the spreading roller 30, a progressive spreading and enlarging action of the fabric F in contact with the spreading roller.

It is now described in more detail the embodiment of the spreading roller 30 by way of example shown in figures. Preferably the spreading roller 30 is mounted to the frame 2 by means of said positioning mechanism 60. Preferably the positioning mechanism comprises a pair of movable arms 61 and 62. Preferably each of the two movable arms 61 and 62 extends between a lower end, at which it is hinged to the frame 2, and an upper end, at which it is connected at a lateral end (32 or 33) of the spreading roller 30; the distance between the lower end and the upper end defines a length of the movable arm. Preferably the two movable arms 61 and 62 are identical to each other. The two movable arms 61 and 62 are configured to oscillate, i.e. tilt, in unison by rotating

around said rotation axis 63, which passes through the lower ends of both arms, where they are hinged to the frame 2.

The oscillation of the two arms 61 and 62 determines a movement of the spreading roller 30 along a circumference arc trajectory having a center on the rotation axis 63 and radius equal to the length of the movable arms; in the movement along that trajectory, the spreading roller 30 keeps its own rotation axis 31 parallel to the respective rotation axis 11 of the collection roller 10.

Preferably the two movable arms 61 and 62 can selectively oscillate clockwise and counterclockwise to decrease and increase the operating distance that separates the spreading roller 30 from the collection roller 10.

Preferably the electric motor M of the fourth motor group 40 is active on at least one of the two movable arms, for determining the selective oscillation of the two arms clockwise and counterclockwise and moving the spreading roller 30 along said circumference arc trajectory.

Preferably one of the two movable arms (the arm 61 in figures) is actuated by the fourth motor group 40 and the other movable arm (the arm 62 in figures) is hinged in idle mode (i.e. free to rotate) to the frame 2, such that a rotation (i.e. an oscillatory motion) of one of the two movable arms corresponds to an equal and corresponding rotation of the other movable arm.

Substantially, the positioning mechanism 60 comprises the two movable arms 61 and 62 (which represent levers) which are rotated to move the spreading roller; the rotation occurs around the rotation axis 63.

It should be noted that in the motorized axis constituted by the positioning mechanism 60 of the spreading roller 30, said "respective rod" of the motorized axis is constituted by at least one of the two movable arms 61 and/or 62, in particular by the first movable arm 61 in the exemplary embodiment shown in figures. This rod of the positioning mechanism 60 determines the specific action on the fabric F consisting in the correctly positioning the spreading roller 30 (supported and moved precisely by the positioning mechanism 60).

In the motorized axis constituted by the positioning mechanism 60, said "at least one support" (configured to support in rotation the respective rod) is constituted by the support (for example a bearing) which movably connects the lower end of the movable arm (61 and/or 62) to the frame 2.

In a possible alternative and functionally equivalent embodiment, not shown, the fourth motor group can comprise a linear guide to which the spreading roller is mounted and configured to move the spreading roller in order to selectively vary the operating distance. In this case, the variation of the distance between the two rollers occurs by means of a translatory movement (of approaching or distancing of the spreading roller with respect to the collection roller) instead of by means of said rotary or rototranslatory movement obtained through the oscillation of the two movable arms.

Preferably the operating organs comprise spreading organs 95 of the fabric F in the open, deriving directly as single layer from the needle-bearing organ or obtained from the action of the cutting organs 90. These spreading

organs 95 are arranged downstream of the cutting organs 90 and upstream of the transfer roller 70 (or of the transfer rollers 72 and 73 if more than one), of the spreading roller 30 and of the collection roller 10 along the articulated path of the fabric F. The spreading organs 95 are configured to open the fabric F exiting from the flattening rollers 80 and longitudinally cut by means of the cutting organs 90.

5 The take-down and/or collection group 1 comprises the spreading organs 95 only in the event that the knitting machine is of "open" type, and the fabric F is collected open and in a single layer.

Preferably the spreading organs 95 comprise at least one spreading bar 96 mounted, preferably in a fixed manner to the take-down and/or collection group in use, to the frame 2 and structured to determine an opening, by means of progressive distancing, of two lateral edges of the fabric F; the fabric F passes on the spreading
10 bar 96 along its articulated path and spreads on the spreading bar as single layer of fabric F.

The spreading bar 96 can be registered in its position (for example before the take-down and/or collection group starts to operate); preferably such registration occurs by means of a translation along a direction parallel to the longitudinal development (or the rotation axes) of the flattening rollers 80.

Preferably, the spreading bar 96 is longitudinally positioned between the first lateral portion 6 and the second
15 lateral portion 7 of the frame 2.

Eventually the spreading bar 96 can also not be connected to the lateral portions 6 and 7 of the frame; for example, the spreading bar 96 can be mounted to a suitable supporting structure integral with the frame 2.

Preferably the spreading bar 96 has an overall rounded "V" conformation, i.e., it has the curvilinear central, or arc of a circumference, portion and two straight portions protruding, in opposite directions, from two sides of the
20 central portion and ending at, respectively, the first lateral portion 6 and the second lateral portion 7. Preferably the spreading bar 96 has a substantially symmetrical conformation with respect to a symmetry plane.

Preferably the axis 11 of the collection roller 10 is orthogonal to the symmetry plane of the spreading bar 96.

Preferably the operating organs 3 comprise a coupling structure 97 configured to mount the cutting organs 90 and/or the spreading organs 95 on the frame 2.

25 It should be noted that, with particular reference to figures 16 and 17, the articulated path of the fabric F:

- the fabric is manufactured (in the embodiment of figures, in tubular shape) by the needle-bearing organ C of the textile head T and drops inside the needle-bearing organ itself and then passes into the upper opening 4 of the frame 2;

- the fabric, still in tubular shape, passes through the two flattening rollers 80;

30 - the fabric is subjected progressively to longitudinal cutting by the cutting organs 90 (especially by a cutter), and in this way the tubular fabric is opened;

- by means of the spreading bar 96 the fabric (just opened by the cutter) is stretched, so that its two left and right flaps are opened;

- the fabric F, single-layered (i.e., flapped) and stretched, passes to the two transfer rollers 72 and 73, where it undergoes taking-down; in particular, the fabric passes behind the back roller 72, then from underneath enters the space between the back roller 72 and the front roller 73, passes over the front roller 73 and continues to the spreading roller;

- 5 - the fabric F reaches the spreading roller 30 and passes over it, contacting the embossed elements 36 and 37;
- from the spreading roller 30 the fabric F passes to the collection roller, where it is wrapped; wrapping can occur with a clockwise rotation of the collection roller (in which case the fabric F passes under the collection roller) or with a counterclockwise rotation of the collection roller (in which case the fabric F passes over the collection roller).

- 10 The fabric F, before reaching the spreading roller 30, can optionally pass under a fixed bar 64 which connects the two movable arms 61 and 62 and is preferably coaxial to said common oscillation axis 63. In this case the fabric F, deriving from transfer rollers 70, passes under the fixed bar 64, goes back, rises above the spreading roller 30, goes around it and continues toward the collection roller 10. The deviation of the trajectory of the fabric by passing it underneath the fixed bar 64 can serve if one wishes to wrap around more, i.e. at a greater angle,
15 the spreading roller.

The fixed bar 64, placed below of the spreading roller, is configured to mechanically reinforce the structure that supports the spreading roller; this structure also comprises the two movable arms 61 and 62.

Preferably the rotation axis 63 of the positioning mechanism 60 corresponds to the longitudinal axis of the fixed bar 64.

- 20 Preferably the position of the cutter can be set (for example by sliding on special guides) typically during the setting of the take-down and/or collection group, for example according to the dimensions of the tubular fabric manufactured by the knitting machine.

- The passage of the fabric F on the spreading roller necessarily occurs above the latter (and not below) as the embossed (spiral) elements then act correctly on the fabric to enlarge and spread it. If the fabric were to pass
25 under the spreading roller, the embossed elements would act in the opposite way, closing the fabric instead of opening it. Obviously, the spreading roller and its reliefs can be suitably modified to operate with rotations in the opposite direction or with different paths of the fabric.

- The take-down and/or collection group can comprise/use at least one control unit configured to control the operating conditions put in place by the group itself and/or to control the steps of the collection method of the fabric. The control unit can be a single unit or be formed by a plurality of different control units according to the
30 designing choices and the operating needs.

As control unit it is intended an electronic-type component, which can comprise at least one of: a digital processor (CPU), an analogue type circuit, or a combination of one or more digital processors with one or more analogue type circuits. The control unit can be "configured" or "programmed" to carry out certain steps: this can

be realized in practice with any means that allows to configure or program the control unit. For example, in case of a control unit comprising one or more CPU and one or more memories, one or more programs can be stored in appropriate memory banks attached to the CPU or CPUs; the program or programs contain instructions which, when carried out by the CPU or CPUs, program or configure the control unit to carry out the operations described in relation to the control unit. Alternatively, if the control unit is or comprises analogue type circuitry, then the circuit of the control unit can be designed to include circuitry configured, in use, to process electrical signals in such a way as to carry out the steps relative to the control unit.

Preferably the take-down and/or collection group 1 comprises at least one control unit configured to command the functioning of operating organs 3.

Preferably the control unit is configured to:

- command the electric motors M of motor groups 20, 40, 50, 75, 85 for controlling the functioning of each motorized axis 10, 30, 60, 70, 80;
- eventually make the different motor groups communicate among them, in such a way to coordinate the functioning of the motorized axes.

Preferably the control unit is connected to the operating organs 3 for sending command signals to them able to modify and control the operating configuration thereof.

Preferably the control unit is configured to:

- send to the first motor group 20 a command signal for progressively reducing the angular speed of the collection roller 10 as the radius Y of the collection roller 10 increases, in such a way to keep the tangential speed of the collection roller 10 constant;
- send to the second motor group 75 a command signal for putting in rotation the transfer roller 70 at a determined speed for taking-down and/or tensioning the fabric F and for addressing it toward the collection roller 10;
- send to the third motor group 50 a command signal for putting in rotation the spreading roller 30 at a determined speed for generating a correct spreading and enlargement action of the fabric F in transit on the spreading roller 30;
- send to the fourth motor group 40 a command signal for moving the spreading roller 30 on the basis of the value of the radius Y of the collection roller 10, by varying the operating distance in such a way to keep constant, during the collection of the fabric F, said optimal separation value;
- send to the fourth motor group 40 a command signal for progressively increasing the operating distance as the radius Y of the collection roller 10 increases, keeping constant, during the collection of the fabric F, said optimal separation value. Preferably the control unit of the take-down and/or collection group 1 can be shared with the knitting machine 100, for example can be positioned in the base B or in the textile head T and operate the control of the entire knitting machine.

The circular knitting machine 100 according to the present invention can comprise supplying organs configured to electrically supply said motor groups 20, 40, 50, 75, 85.

Preferably the supplying organs comprise a plurality of electric drives configured to supply the electric motors M of the modular gearmotors A of the motor groups of the take-down and/or collection group 1.

5 Preferably all the electric motors M of the gearmotors A are supplied, by said electric drives, at low voltage, preferably at 48V.

Preferably the electric drives are switched-mode power suppliers (switching).

Preferably the electric drives are connected to, and controlled by, said control unit.

10 Preferably the take-down and/or collection group 1 of the fabric F in manufacturing is arranged downstream of the textile head T with respect to a supply direction of the fabric in manufacturing.

Preferably the take-down and/or collection group 1 is configured to rotate integrally with, or in a coordinated manner with respect to, said needle-bearing organ during the manufacturing of the fabric F.

Preferably the circular knitting machine 100 can be of single needle bed (only with a needle-bearing cylinder) or a double needle bed (with needle-bearing cylinder and needle-bearing plate) type.

15 Preferably the circular knitting machine 100 can be of the type with rotating needle-bearing organ (with non-rotating needle control organs and take-down and/or collection group rotating together with the needle-bearing organ during the manufacturing of the fabric) or fixed needle-bearing organ (with rotating needle control organs and take-down and/or collection group fixed during the manufacturing of the fabric). The embodiment shown in figures is a circular knitting machine with rotating needle-bearing organ and take-down and/or collection group
20 rotating together with it.

Preferably the take-down and/or collection group 1 is hanging below the textile head T. Preferably the take-down and/or collection group 1 is hanging to and supported by the needle-bearing organ C. In this situation, preferably, the regulation is carried out by rotating by a predefined angle the take-down and/or collection group with respect to the textile head while, preferably, this group remains hanging.

25 In a different embodiment, not shown, the take-down and/or collection group can be laid on the ground or on the base and be constrained to the needle-bearing organ.

Preferably, if the needle-bearing organ C is of the rotating type, the take-down and collection group 1 is dragged in rotation during the manufacturing of the fabric F by the rotation of the needle-bearing organ C and rotates integrally with the needle-bearing organ, i.e. without any relative rotational motion with respect to the needle-bearing organ. The motor that moves (i.e. put in rotation) the needle-bearing organ C and the take-down and/or
30 collection group 1 can therefore be one, with consequent space, cost and energy savings.

In a possible embodiment (not shown), if the needle-bearing organ is of the fixed type, the take-down and collection group is fixed, i.e. without any relative rotational motion with respect to the needle-bearing organ.

In an exemplary embodiment, shown in figures, the circular knitting machine 100 is of the "open" type, i.e. is configured to manufacture fabric F and collect it in the open, i.e. as single layer and continuously, by wrapping it on the collection roller 10 of the take-down and/or collection group 1.

The single layer fabric F, deriving from the needle-bearing organ and collected by the take-down and collection group 1, is obtainable:

- by means of cutting and stretching, or "opening", of a tubular fabric, if the textile head T continuously manufactures a tubular fabric; or

- directly "in the open", i.e. as continuous single layer of fabric F having a determined width;

in both cases the take-down and collection group 1 collects, by wrapping it on the collection roller 10, a single layer fabric F and not a cylindrical development tubular.

The single layer fabric F has a continuous stripe conformation of particular width and is obtained:

- by opening a tubular, by means of a continuous cut carried out parallel to the direction of longitudinal development of the manufactured tubular fabric; or

- directly by the textile head, which already manufactures it as an "open", single layer and continuous fabric.

The circular knitting machine, as shown by way of example in figure 20, can comprise other components, such as:

- components of the textile head, such as coverings, cams, wire guides, etc.;

- a P cone-holder structure placed above the textile head T;

- a plurality of closing cages G that close the operating space occupied by the take-down and/or collection group 1 (that results then closed inside such cages).

The closing cages G are movably mounted (e.g. hinged) to the base B at least between a closing configuration, in which they prevent the access to the operating space, and an opening configuration, in which they allow the access to the operating space.

The cages G are adapted to allow the safe functioning of the knitting machine 100: actually, the take-down and/or collection group 1 operates by rotating in the operating space, and it is therefore necessary to make this volume inaccessible during the functioning of the machine, to avoid accidental contacts with moving organs. On the contrary, the cages must also allow the access to the inside of the operating space for configuration and maintenance operations of the machine and for the loading/unloading of the collection roller of the fabric, reason for which the cages can be opened individually and selectively, manually or automatically.

The collection method of the fabric manufactured by a circular weft knitting machine, according to the present invention, comprises the steps of:

- arranging and operating the circular knitting machine 100;

- arranging and operating the take-down and/or collection group 1;

- independently actuating each motor group 20, 40, 50, 75, 85.

Preferably the step of independently actuating each motor group comprises a step of synchronizing the operating organs 3 on determined working parameters necessary to obtain:

- the correct tensioning and the correct spreading of the fabric F;
- the correct collection of the fabric F.

5 It should be noted that the collection method of the fabric substantially corresponds to a procedure for controlling the functioning of the take-down and/or collection group 1.

The present invention reaches important advantages.

First of all, the Applicant has verified that the invention allows to solve the problems and overcome the above-mentioned limits typical of the known solutions, and then to obtain the predetermined purposes.

10 In particular, the take-down and/or collection group 1 is characterized by an innovative structure and functioning, which provide the modularity of gearmotors inside each group motor that actuate the motorized axes.

Substantially, the solution at the basis of the present invention provides for:

- defining a series of motorized axes that have the purpose of appropriately treating the fabric F from the needle-holder organ C to the collection roller 10;
- 15 - combining each motorized axis with its own individually dedicated motor group;
- realizing each motorized axis by means of a modular type gearmotor A, i.e. that is repeated in substantially analogous manner in all the motor groups.

This advantageously allows to:

- implement a better control and an evolved management of the collection of the manufactured fabric;
- 20 - dynamically control, even in real time, all the organs involved in the treatment of the fabric up to its collection;
- achieve improved performance, for example in terms of productivity and/or quality and uniformity of the collected knit, with respect to known solutions;
- prevent the formation of misalignments and/or wrinkles in the collected fabric, and prevent the rolling up of lateral edges of the fabric;
- 25 - open and spread the fabric effectively at all times, realizing a uniform and flat wrapping of the fabric on the collection roller;
- adapt the take-down and/or collection group to different textile needs and to different typologies and dimensions of fabric;
- easily subject the operating organs to maintenance and replacement operations of their own parts;
- 30 - provide a system having a high reliability of functioning and a lower susceptibility to failures and malfunctions.

The modularity represented by the use of a same gearmotor in all the group motors (composed by an electric motor, preferably stepper, and by a preferably endless screw / helicoidal wheel mechanical transmission) represents a major step forward in the design and realization of take-down and collection groups. In fact, the modularity allows to:

- reduce the cost for the realization of movable parts (motorized axes) present in the take-down and/or collection group;
- possibility of using components (in particular the motor and the mechanical transmission) from catalog;
- make the various gearmotors effectively "interchangeable", as they are suitable for the various motorized axes;
- 5 - reduce the storage necessary for the production and maintenance of take-down and collection groups, since the gearmotors are repeated modularly in the various motor groups (avoiding that each motorized axis/roller and each roller needs a different actuator applicable only to that axis/roller);
- make maintenance of the motor groups simple, easy and quick.

In addition, the solution of the present invention, with modular gearmotors and motor groups individually coupled

10 to the motorized axes, allows to greatly improve the control possibilities of the take-down and/or collection group, and thus the control of the fabric collection. The control achievable with the present invention is:

- advanced and precise, as it allows to know and regulate the status of each motorized axis individually and at any time;
- freely programmable and parameterizable;
- 15 - integrable into the knitting machine.

It should be noted that the take-down and/or collection group of the present invention also allows to obtain a further very important advantage, which is represented by the absence of chains and transmission belts, typical instead of the known solutions. In the present invention, each motorized axis/roller is directly driven, i.e. directly rotated around its own axis, by its own motor group; each motor group is individually coupled to a single

20 motorized axis and is dedicated exclusively to it.

A further advantage of the present invention is represented by the presence of a hollow encoder that allows the exit, from the body of the motor, of the rear portion of the drive shaft, which is then manually actuatable when necessary, for example for regulating and calibrating the motorized axis.

Further advantages of the present invention derive from the use, in the gearmotor, of a stepper motor combined

25 with an endless screw / helicoidal toothed wheel transmission. These advantages, as above shown, consist of:

- compact shape and smaller encumbrance;
- irreversibility of the mechanical transmission;
- possibility of being directly connected to the axis to be moved;
- high reduction ratios;
- 30 - high safety and reliability.

The solution at the basis of the present invention allows overall to obtain a take-down and/or collection group characterized by a simple and rational structure.

CLAIMS

1. Take-down and/or collection group (1) of a fabric (F) manufactured by a circular weft knitting machine (100), said circular knitting machine comprising:

- a textile head (200) provided with at least a needle-bearing organ (C) rotating around a central axis, having shape of needle-bearing cylinder or needle-bearing plate, with a plurality of needles movably mounted to said at least one needle-bearing organ (C), and with command organs adapted to selectively actuate said plurality of needles and for allowing the manufacturing of a fabric (F);

- a base (B) constituting the bearing structure of the knitting machine and configured to support said textile head (T), said base (B) defining, below said textile head (T), a housing volume;

the take-down and/or collection group (1) comprising:

- a frame (2) configured to be mounted in a rotating manner to said circular knitting machine (100) in said housing volume;

- operating organs (3) operatively associated to, and supported by, said frame (2) and comprising at least one collection roller (10), rotatably mounted to the frame (2), developing along a rotation axis (11) and longitudinally extending between two ends (12, 13), the operating organs (3) being configured at least to open and spread, or also eventually to draw it from said needle-bearing organ (C), the fabric (F) manufactured by the circular knitting machine (100), wrapping it continuously on said collection roller (10);

wherein said operating organs (3) comprise:

- a plurality of motorized axes, each of them being configured to selectively rotate around a respective rotation axis;

- a plurality of motor groups;

wherein each motorized axis is individually associated to a respective motor group and independently activated by the respective motor group.

2. Take-down and/or collection group (1) according to claim 1, wherein each motor group of said plurality of motor groups comprises a gearmotor (A) of modular type, i.e. a gearmotor (A) which is repeated in each of the motor groups, and/or wherein said gearmotor (A) comprises:

- an electric motor (M), preferably a stepper motor;

- an endless screw / helicoidal toothed wheel mechanical transmission (R) (worm drive), placed downstream of, and activated by, said electric motor (M),

and/or wherein the electric motors (M) of gearmotors (A) of all the motor groups of said plurality of motor groups are identical or equivalent to each other in terms of size and/or power, and/or wherein the mechanical transmissions (R) of the gearmotors (A) of all the motor groups of said plurality of motor groups are identical or equivalent to each other in terms of size and/or gear ratio and/or component dimensioning.

3. Take-down and/or collection group (1) according to claim 1 or 2, wherein said plurality of motorized axes comprises:

- said collection roller (10), configured to collect, by continuously wrapping it, the fabric (F) manufactured by the circular knitting machine (100) and transiting in the take-down and/or collection group;

5 - at least a transfer roller (70) rotatably mounted to the frame (2) in position upstream with respect to said collection roller (10) and configured to draw and/or tension the fabric (F) and address it along an articulated path towards the collection roller (10);

and wherein the collection roller (10) is configured to collect, by wrapping it continuously around it:

10 - a single-layer fabric (F), in case wherein the knitting machine is of the "open" type, said single-layer fabric having a continuous strip conformation of particular width and being obtained:

- by opening a tubular, by means of a continuous cut carried out parallel to the direction of longitudinal development of the tubular fabric manufactured; or

- directly from the textile head (T), which already manufactures it as an "open" fabric, in a single and continuous layer;

15 or

- a double-layer fabric (F), i.e. as a flattened tubular fabric and wrapped on the collection roller (10) in case wherein the knitting machine is not of "open" type and the fabric is kept in tubular shape also when wrapped on the collection roller.

20 4. Take-down and/or collection group (1) according to any one of the preceding claims, wherein said plurality of motor groups comprises:

- a first motor group (20), directly active on said collection roller (10) in such a way that the collection roller results axially motorized, i.e. it is put in rotation around its own rotation axis (11) by said first motor group;

- a second motor group (75), directly active on said transfer roller (70) in such a way that the transfer roller results axially motorized, i.e. it is put in rotation around its own rotation axis (71) by said second motor group,

25 and/or wherein:

- each motor group is directly active on the respective motorized axis;

- each motor group comprises its own modular gearmotor (A),

and/or wherein said first motor group (20) is configured to vary an angular speed of the collection roller (10) in such a way to keep always opportunely adjusted, i.e. under control during the collection of the fabric, a tangential speed of the collection roller (10), and/or wherein said first motor group (20) is configured to progressively reduce said angular speed of the collection roller (10) as a radius (Y) of the collection roller (10) increases, in such a way to keep a tangential speed of the collection roller (10) constant.

30

5. Take-down and/or collection group (1) according to any one of the preceding claims, wherein:

- the electric motor (M) is of stepper type and comprises a drive shaft integrally connected to the endless screw of the mechanical transmission (R) to put it into rotation;

- the helicoidal toothed wheel of the mechanical transmission (R) is geared to said endless screw and mounted on an output shaft of the mechanical transmission (R);

5 - the output shaft of the mechanical transmission (R) is connected, eventually by means of the interposition of further mechanical organs, for example gears, to the respective motorized axis in order to put it in rotation; and/or wherein each motor group is configured to put in rotation the respective motorized axis with a variable and selectable angular speed, and/or wherein each motor group is configured to put the respective motorized axis in rotation with a variable and selectable angular speed in a manner coordinated to the rotation of the
10 needle-bearing organ (C), preferably in a manner coordinated - for example, proportional - to the rotation speed of the needle-bearing organ (C), and/or wherein each motor group is configured to put the respective motorized axis in rotation with a variable and selectable angular speed also in condition of constant rotation speed of the needle-bearing organ (C), and/or wherein the driving torque necessary for the rotation of each motorized axis is generated by the respective motor group directly at the motorized axis.

15 6. Take-down and/or collection group (1) according to any one of the preceding claims, wherein said electric motor (M), comprised in said motor group, has:

- a body (55) of the electric motor (M);

- rotation generating means, housed in said body (55),

and/or wherein said drive shaft, put in rotation by said generating means, is provided with:

20 - a front portion, emerging from a front side of the body, where it is connected to the mechanical transmission (R) placed downstream;

- a rear portion (56), emerging from a rear side of the body (55), opposed to said front side,

and/or wherein said rear portion (56) of the drive shaft, emerging rearward from the body (55) of the electric motor (M), is configured to be manually actuated - selectively - for manually controlling the rotation of the drive
25 shaft, and thus - in cascade - of the endless screw, of the toothed wheel and of the motorized axis placed downstream of the mechanical transmission (R).

7. Take-down and/or collection group (1) according to any one of the preceding claims, wherein the electric motor (M) comprises a transducer (57) configured to measure the position and the angular speed of the drive shaft, and/or wherein said transducer (57) is a hollow encoder, placed around said drive shaft and provided with
30 a central hole for allowing the passage of the rear portion (56) of the drive shaft and its exit from the rear side of the body (55) of the electric motor (M), the hollow encoder allowing to dispose of the rear portion (56) of the drive shaft, manually actuatable when necessary for manually moving the motorized axis, and/or wherein each motor group comprises a respective flange (58) mounted to said frame (2) and supporting the respective gearmotor (A).

8. Take-down and/or collection group (1) according to any one of the preceding claims, wherein said plurality of motorized axes comprises:

- at least a spreading roller (30), or tensioning roller, rotatably mounted to the frame (2) in position upstream with respect to said collection roller (10) and configured to interact with the fabric (F) advancing towards the collection roller (10) in such a way to spread it and enlarge it before the wrapping on the collection roller (10), and said plurality of motor groups comprises:

- a third motor group (50), directly active on said spreading roller (30) in such a way that the spreading roller (30) results axially motorized, i.e. it is put in rotation around its own rotation axis (31) by said third motor group (50),

and/or wherein the take-down and/or collection group (1):

- comprises the spreading roller (30) in case wherein the knitting machine is of "open" type, and the fabric (F) is collected in a single layer;

- does not comprise the spreading roller (30) in case wherein the knitting machine is not of "open" type, and the fabric (F) is collected in tubular, i.e. in double layer.

9. Take-down and/or collection group (1) according to any one of the preceding claims, wherein said plurality of motorized axes comprises:

- a positioning mechanism (60) of the spreading roller (30), movably mounted to the frame (2) and active on the spreading roller (30) for selectively moving it so as to increase or decrease an operating distance that separates it from said collection roller (10), preferably by keeping the spreading roller (30) parallel to the collection roller (10),

and said plurality of motor groups comprises:

- a fourth motor group (40), directly active on said positioning mechanism (60) in such a way that the positioning mechanism results axially motorized, i.e. it is put in rotation around its own rotation axis (63) by said fourth motor group (40),

and/or wherein the positioning movement of the spreading roller (30) by effect of the fourth motor group (40) is a rotation or a translation or a rototranslation,

and/or wherein the spreading roller (30) is configured to be moved by the fourth motor group (40), during the collection, by varying said operating distance that separates it from said collection roller (10), in such a way to keep constant, instant by instant, an optimal separation value equal to a distance between an outer operating surface (35) of the spreading roller (30) and an outer collection surface (15) of the collection roller (10), said optimal separation value being an operating parameter corresponding to the ideal distance at which keeping the spreading roller (30) with respect to the collection roller (10) for carrying out an optimal spreading of the fabric (F) which passes from the spreading roller (30) to the collection roller (10).

10. Take-down and/or collection group (1) according to any one of the preceding claims, wherein said plurality of motorized axes comprises:

- a pair of flattening rollers (80), rotatably mounted to the frame (2) preferably in substantial correspondence to an upper opening (4) of the frame (2) of the take-down and/or collection group (1) and configured to flatten or approach the fabric (F) coming from the textile head (T) in the shape of closed tubular fabric,
5 and said plurality of motor groups comprises:

- a fifth motor group (85), directly active on at least one roller of said pair of flattening rollers (80) in such a way that this roller is axially motorized, i.e. it is put in rotation around its own rotation axis (81) by said fifth motor group (85),

10 and/or wherein the flattening rollers (80) are arranged side by side in such a way to define a substantially straight passage for the fabric (F), such as to determine a substantial flattening of the tubular shape of the fabric along a diameter thereof, and/or wherein the flattening rollers (80):

- are oriented orthogonally to the longitudinal axis (5) of the frame (2) in case wherein the knitting machine (100) is of "open" type, and the fabric (F) is designed to be subsequently cut, opened and collected in a single layer;

15 - are oriented parallel to the longitudinal axis (5) of the frame (2) in case the knitting machine (100) is not of "open" type, and the fabric (F) is collected in tubular, i.e. in double layer.

11. Take-down and/or collection group (1) according to any one of the preceding claims, wherein each motorized axis comprises:

- a respective rod longitudinally extending between two ends and configured to determine a specific action on the fabric (F) in transit in the take-down and/or collection group;

20 - at least one support configured to support in rotation said rod, preferably two supports placed at the two ends of the rod,

and/or wherein in each motorized axis the respective rod has its own rotation axis coinciding with its longitudinal development, and/or wherein each motor group can comprise, downwards of the respective modular gearmotor (A), one or more additional mechanical organs interposed between the mechanical transmission (R) and the respective motorized axis, wherein said additional mechanical organs are configured to opportunely connect the mechanical transmission (R) to the motorized axis and can comprise one or more of the following components:

- toothed wheels;

30 - gears;

- angular drives.

12. Take-down and/or collection group (1) according to any one of the preceding claims, comprising at least a control unit configured to command the functioning of said operating organs (3),

and/or wherein said control unit is configured to:

- command the electric motors (M) of said motor groups (20; 40; 50; 75; 85) for controlling the functioning of each motorized axis (10; 30; 60; 70; 80);

- eventually make the different motor groups (20; 40; 50; 75; 85) communicate among them, in such a way to coordinate the functioning of the motorized axes (10; 30; 60; 70; 80),

5 and/or wherein said control unit is connected to said operating organs (3) for sending them command signals capable of modifying and controlling the operating configuration thereof,

and/or wherein said control unit is configured to carry out one or more of the following operations:

- sending to said first motor group (20) a command signal for progressively reducing said angular speed of the collection roller (10) as the radius (Y) of the collection roller (10) increases, in such a way to keep said tangential
10 speed of the collection roller (10) constant;

- sending to said second motor group (75) a command signal for putting in rotation the transfer roller (70) at a determined speed for taking-down and/or tensioning the fabric (F) and for addressing it towards the collection roller (10);

15 - sending to said third motor group (50) a command signal for putting in rotation the spreading roller (30) at a determined speed for generating a correct action of spreading and enlarging of the fabric (F) in transit on the spreading roller;

- sending to said fourth motor group (40) a command signal for moving the spreading roller (30) on the basis of the value of the radius (Y) of the collection roller (10), by varying said operating distance in such a way to keep constant, during the collection of the fabric, said optimal separation value;

20 - sending to said fourth motor group (40) a command signal for progressively increasing said operating distance as the radius (Y) of the collection roller (10), increases, by keeping constant, during the collection of the fabric (F), said optimal separation value.

13. Circular weft knitting machine (100) comprising:

25 - a textile head (T) provided with at least one needle-bearing organ (C) rotating around a central axis (X), having shape of needle-bearing cylinder or needle-bearing plate, with a plurality of needles movably mounted to said at least one needle-bearing organ, and with command organs adapted to selectively actuate said plurality of needles and for allowing the manufacturing of a fabric (F);

- a base (B) constituting the bearing structure of the knitting machine (100) and configured to support said textile head (T), said base (B) defining, below said textile head, a housing volume;

30 - a take-down and/or collection group (1) according to one or more of the preceding claims.

14. Circular knitting machine (100) according to claim 13, comprising supplying organs configured to electrically supply said motor groups (20, 40, 50, 75, 85), and/or wherein said supplying organs comprise a plurality of electric drives configured to supply the electric motors (M) of the modular gearmotors (A) of the motor groups (20, 40, 50, 75, 85) of the take-down and/or collection group (1), and/or wherein all the electric motors (M) of

the gearmotors (A) are supplied, by said electric drives, at low voltage, preferably at 48V, and/or wherein said electric drives are switched-mode power suppliers (switching).

15. Collection method of the fabric (F) manufactured by a circular weft knitting machine (100), the method comprising the steps of:

- 5 - arranging and operating a circular weft knitting machine (100) comprising at least:
 - a textile head (T) provided with at least one needle-bearing organ (C) rotating around a central axis (X), having shape of needle-bearing cylinder or needle-bearing plate, with a plurality of needles movably mounted to said at least one needle-bearing organ, and with command organs adapted to selectively actuate said plurality of needles and for allowing the manufacturing of a fabric (F);
- 10 - a base (B) constituting the bearing structure of the knitting machine and configured to support said textile head (T), said base (B) defining, below said textile head, a housing volume;
- arranging and operating a take-down and/or collection group (1) comprising:
 - a frame (2) mounted in a rotating manner to said circular knitting machine (100) in said housing volume;
 - 15 - operating organs (3) operatively associated to, and supported by, said frame (2) and comprising at least one collection roller (10), rotatably mounted to the frame (2), developing along a rotation axis (11) and longitudinally extending between two ends (12, 13), the operating organs (3) being configured at least to open and spread, or also eventually to draw it from said needle-bearing organ (C), the fabric (F) manufactured by the circular knitting machine (100), wrapping it continuously on said collection roller (10);
 - 20 wherein said operating organs (3) comprise:
 - a plurality of motorized axes (10; 30; 60; 70; 80), each of them being configured to selectively rotate around a respective rotation axis;
 - a plurality of motor groups (20; 40; 50; 75; 85);
 - 25 wherein each motorized axis is singularly associated to a respective motor group and actuated independently by the respective motor group;
 - independently actuating each motor group (20; 40; 50; 75; 85),
 - and/or wherein the step of independently actuating each motor group comprises a step of synchronizing the operating organs (3) on determined working parameters necessary to obtain:
 - 30 - the correct tensioning and the correct spreading of the fabric (F);
 - the correct collection of the fabric (F).

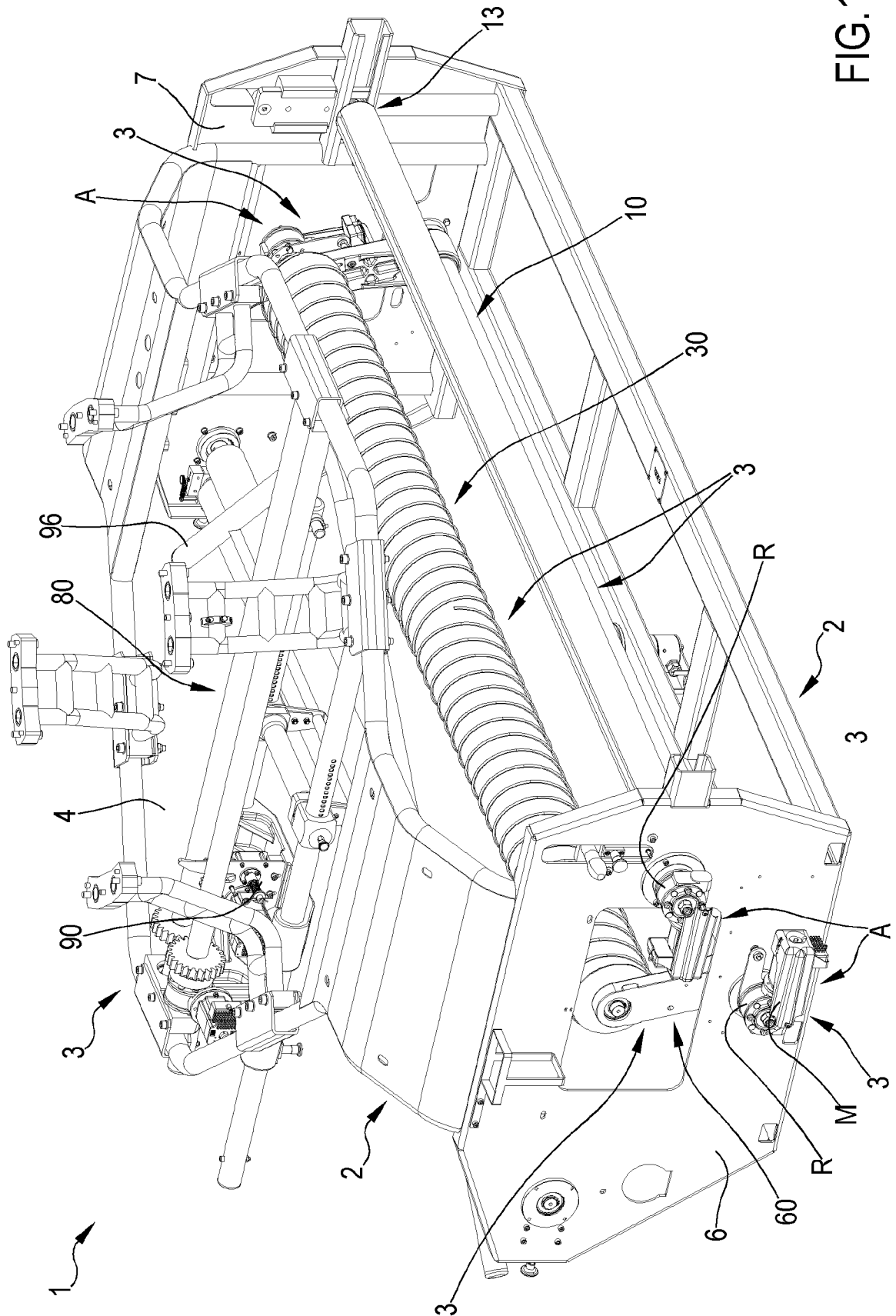
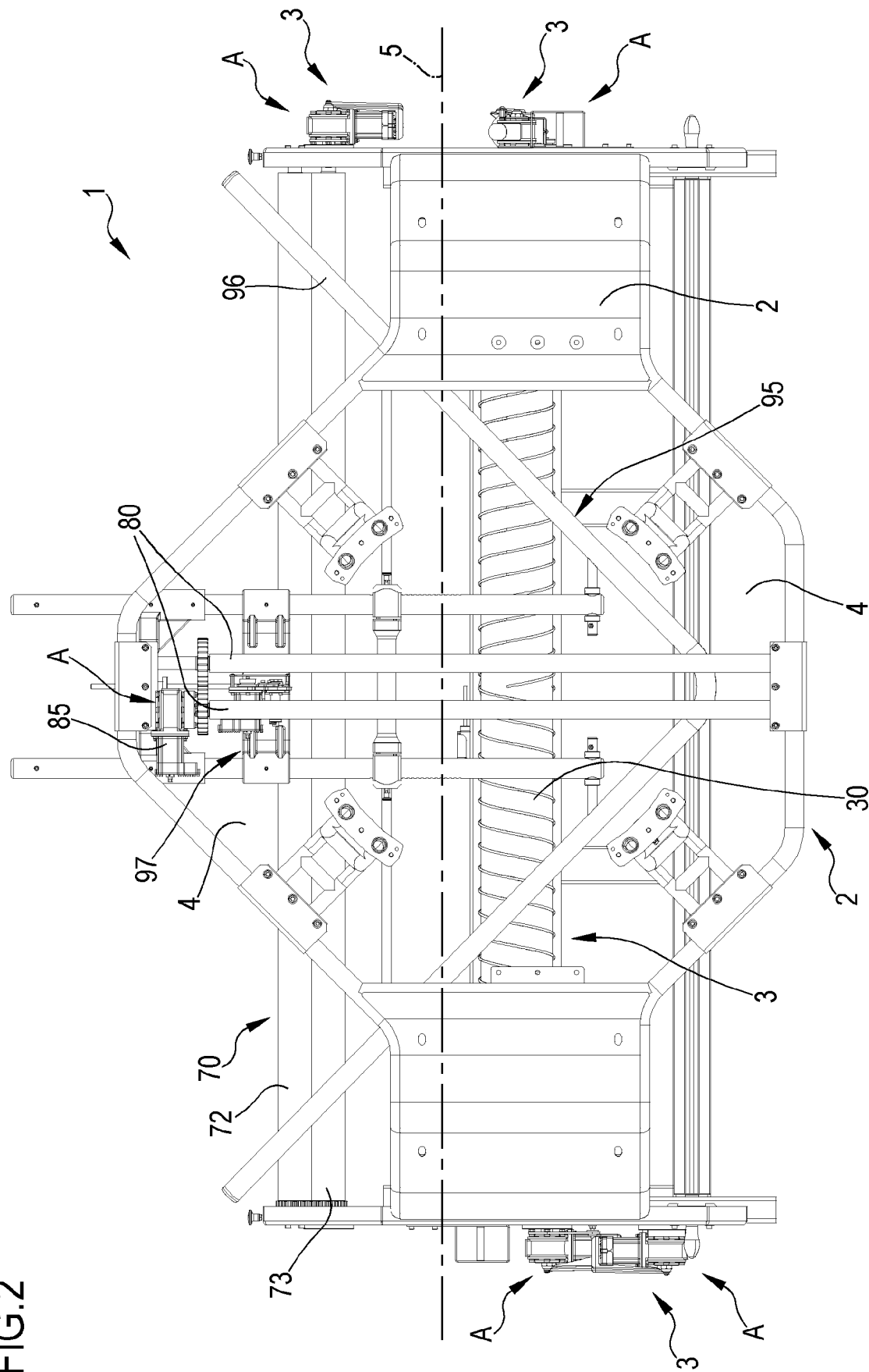


FIG.2



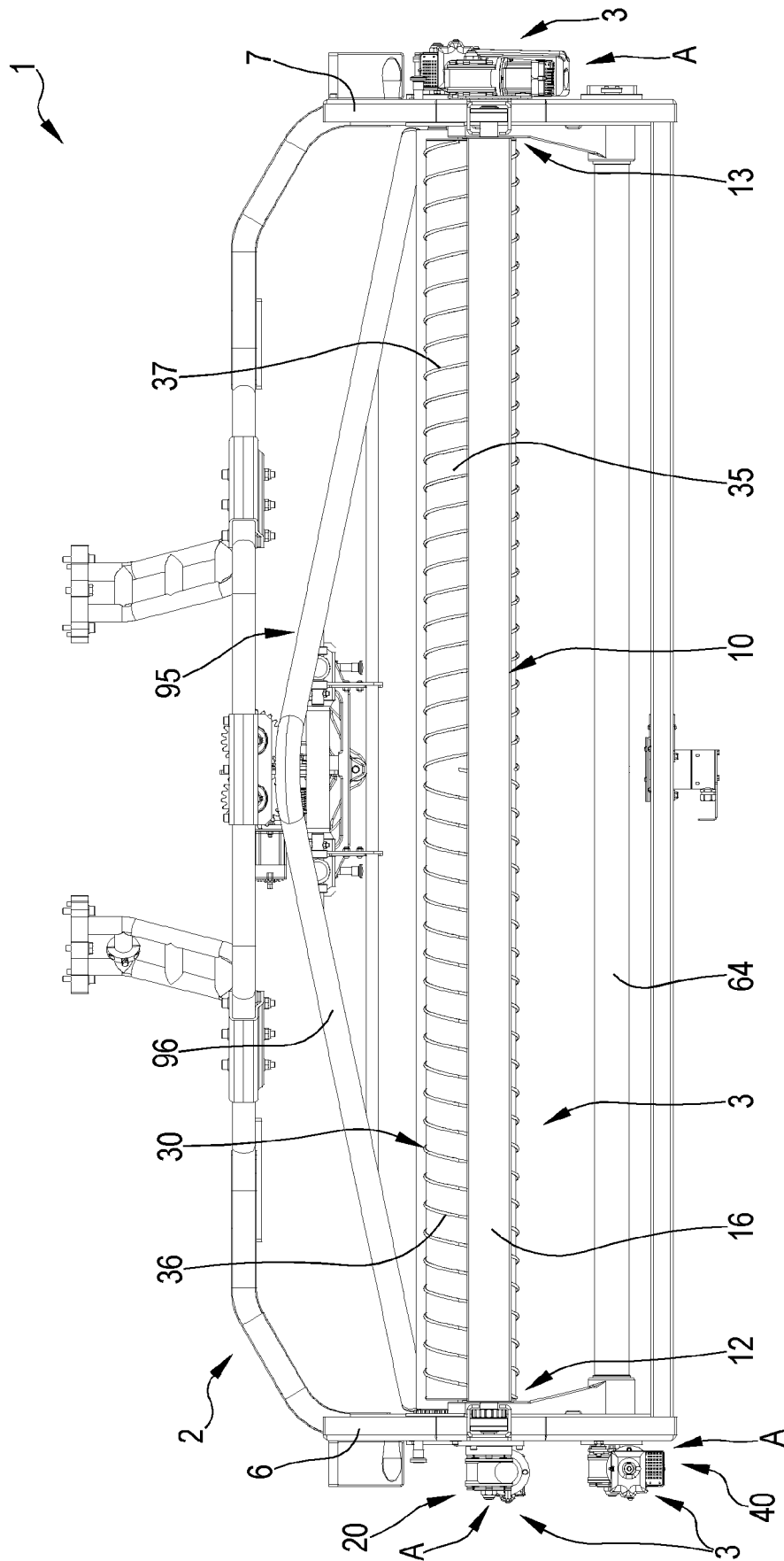


FIG. 3

FIG.4

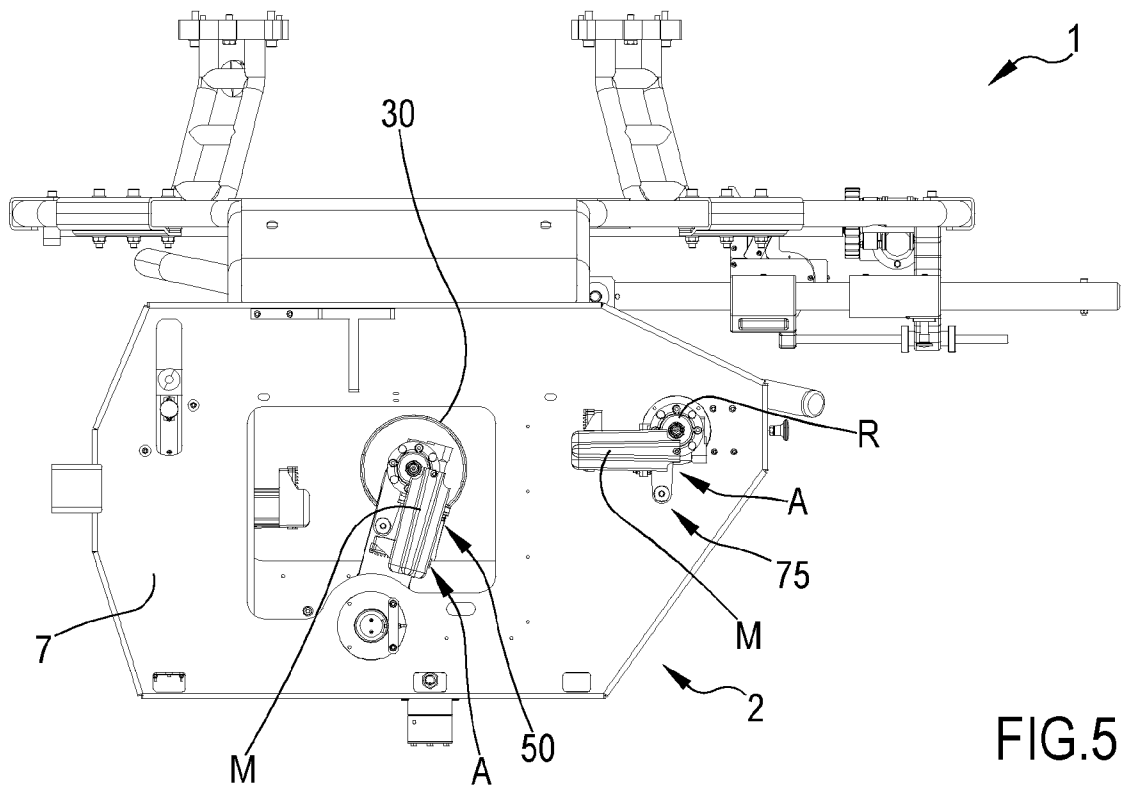
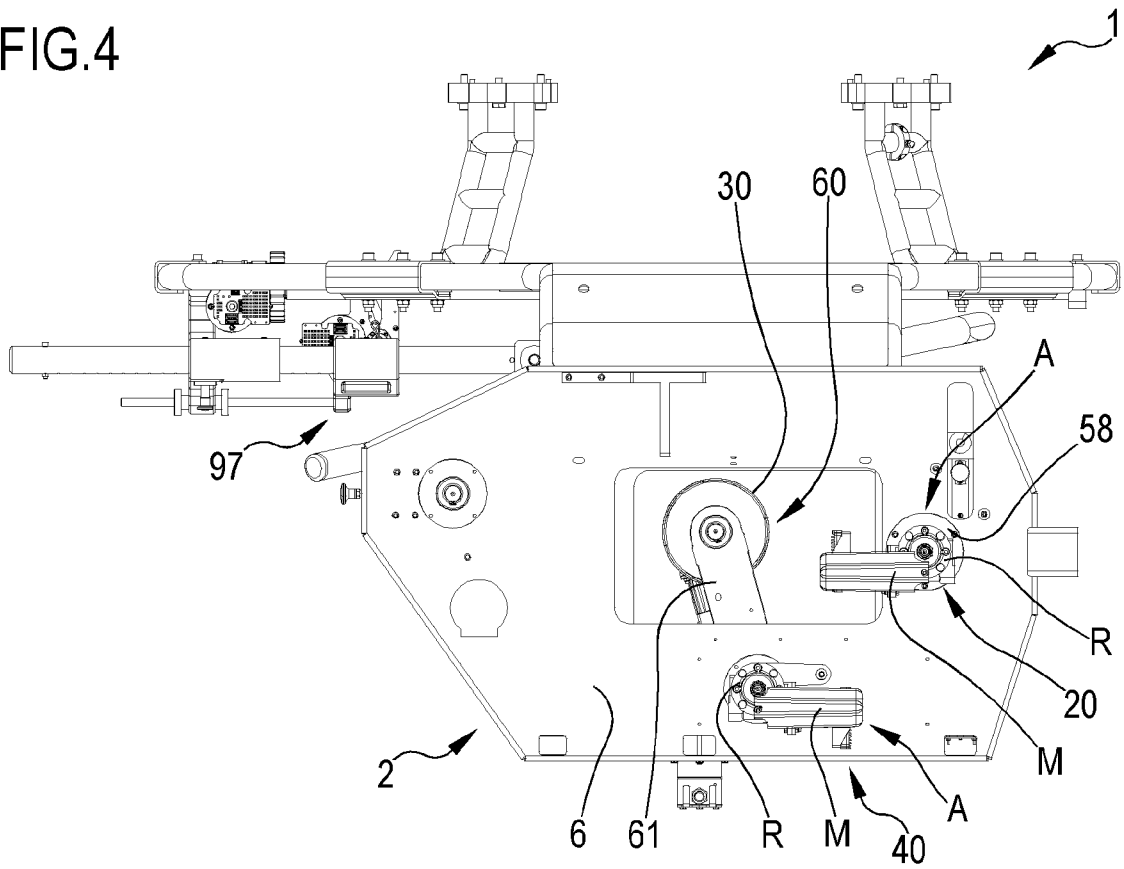


FIG.5

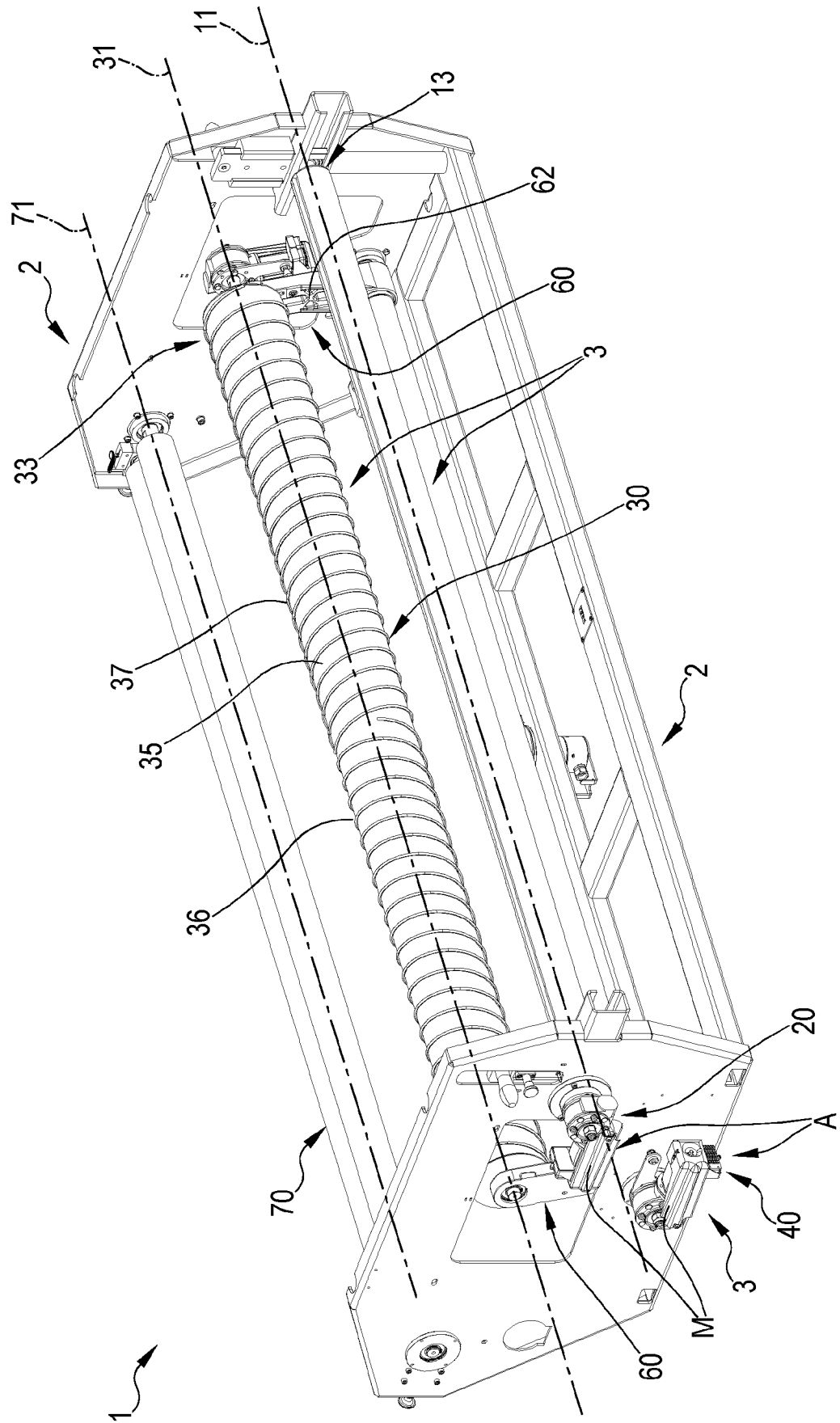


FIG.6

FIG.7

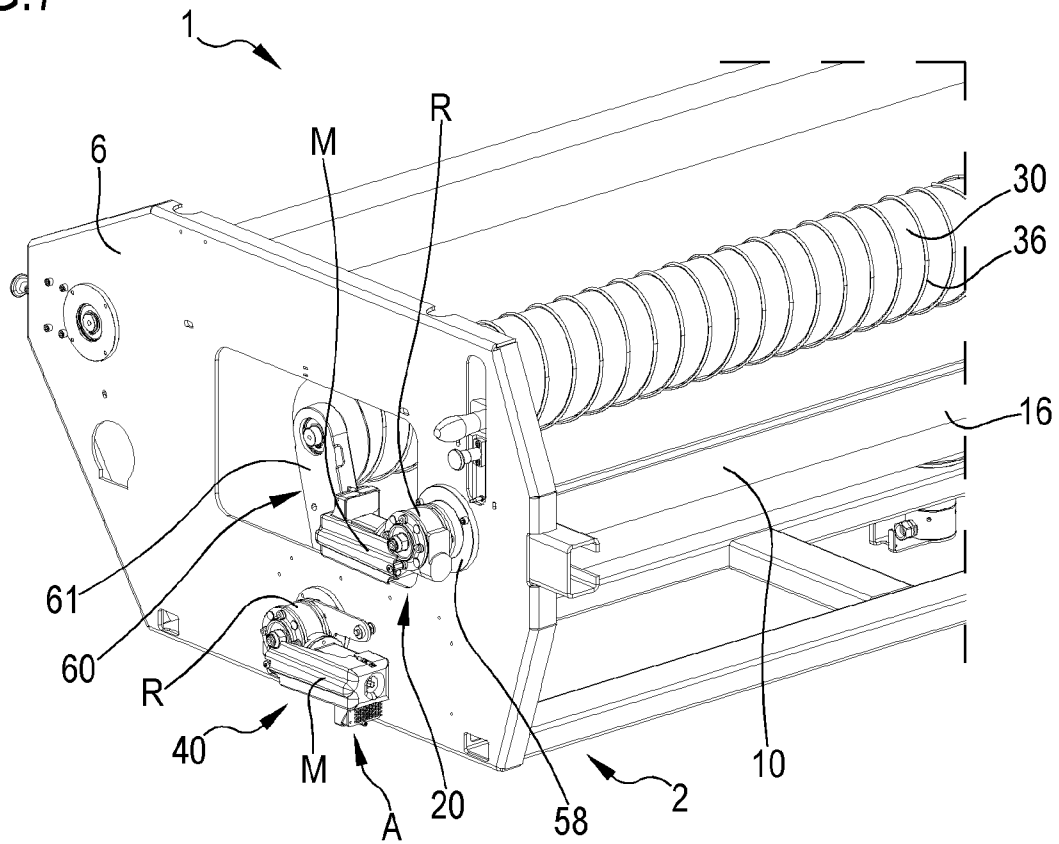
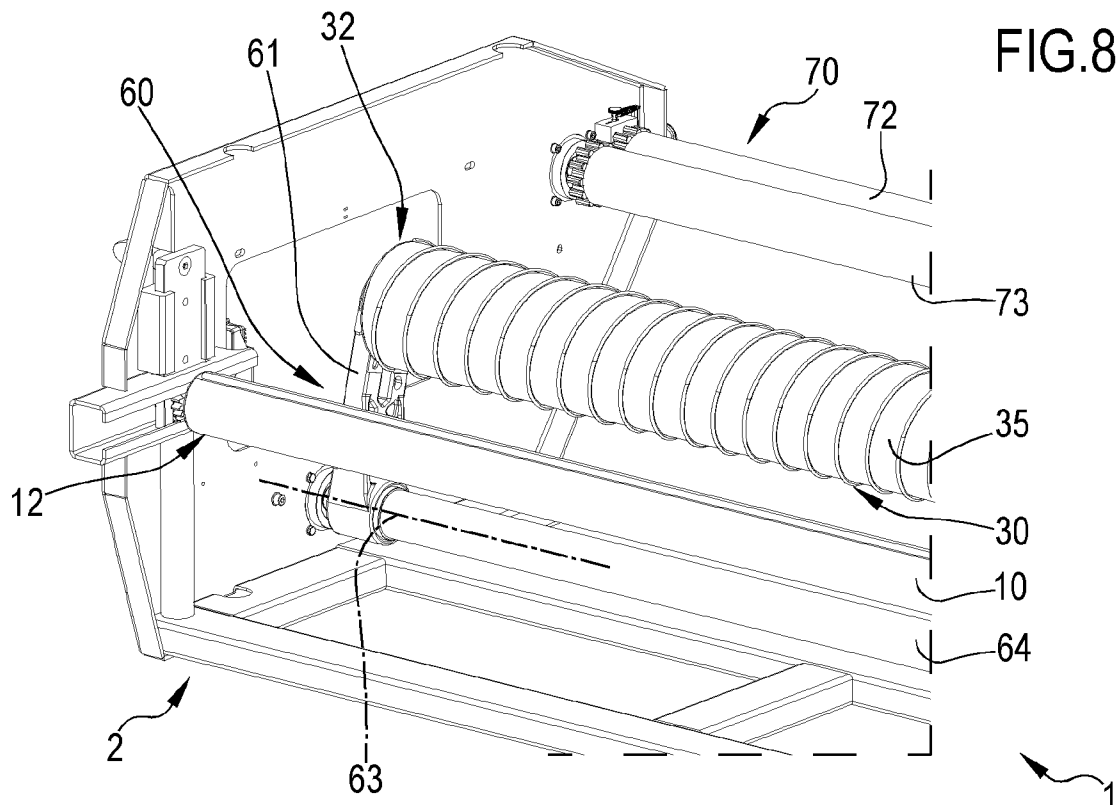


FIG.8



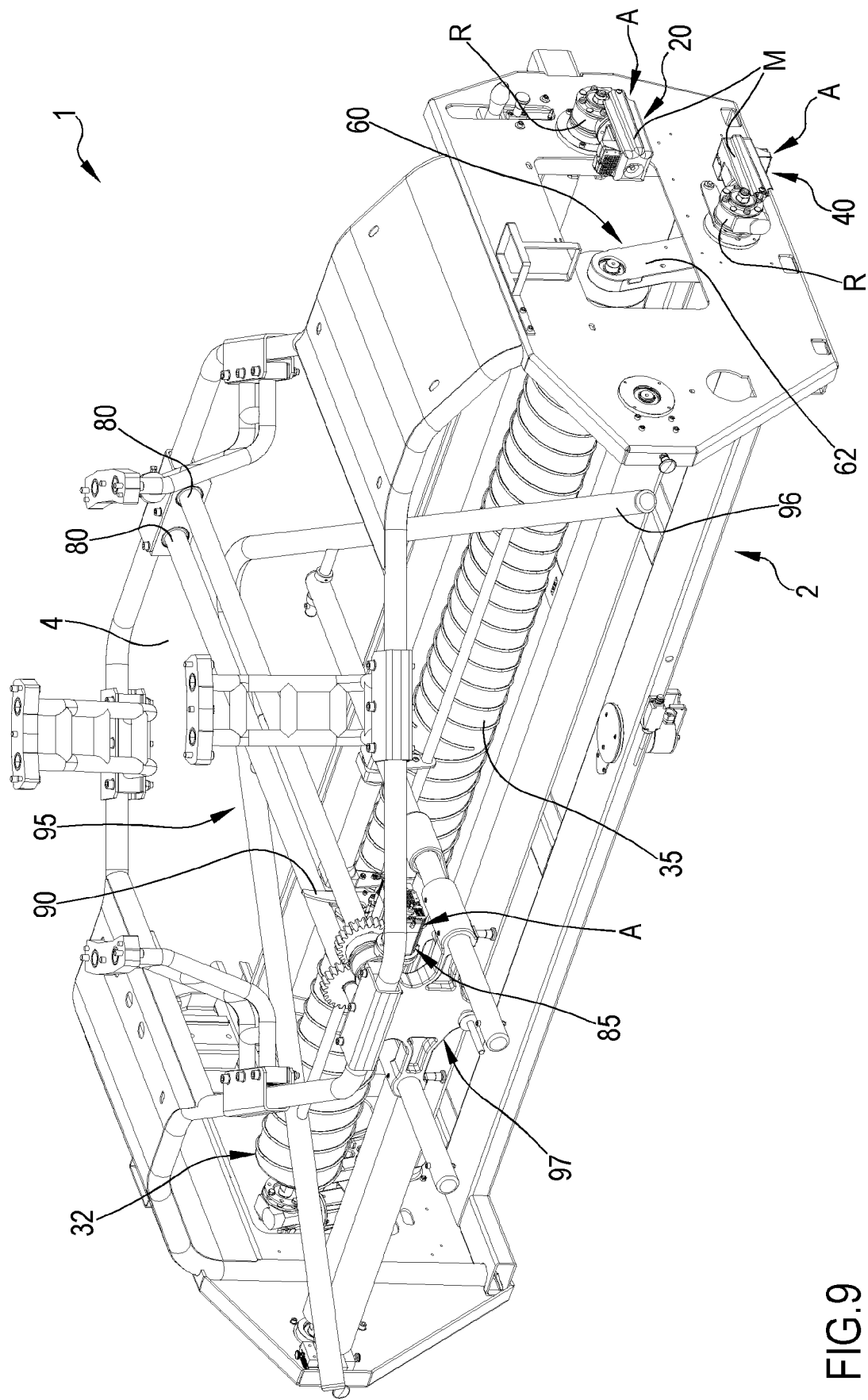


FIG.9

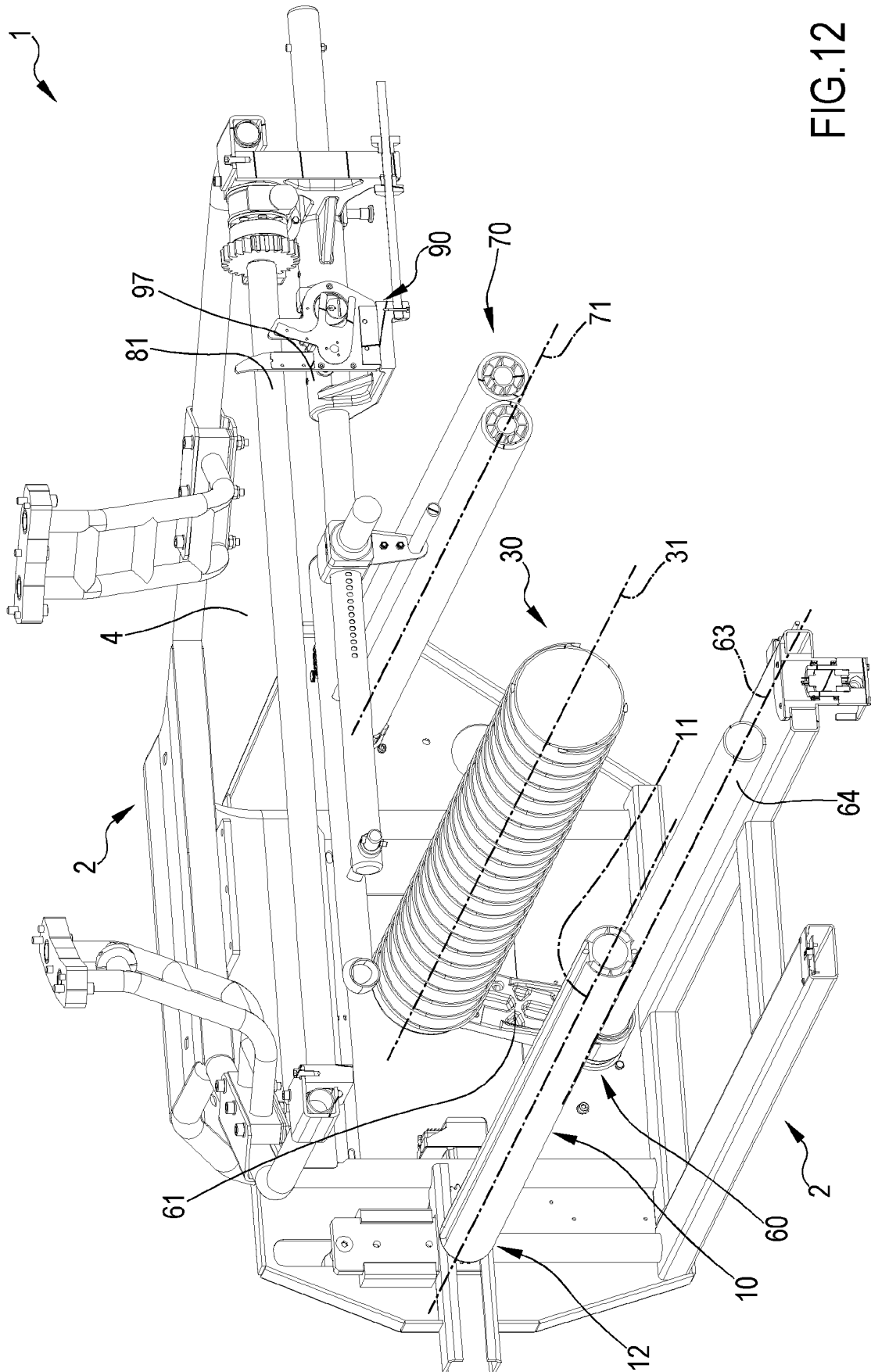
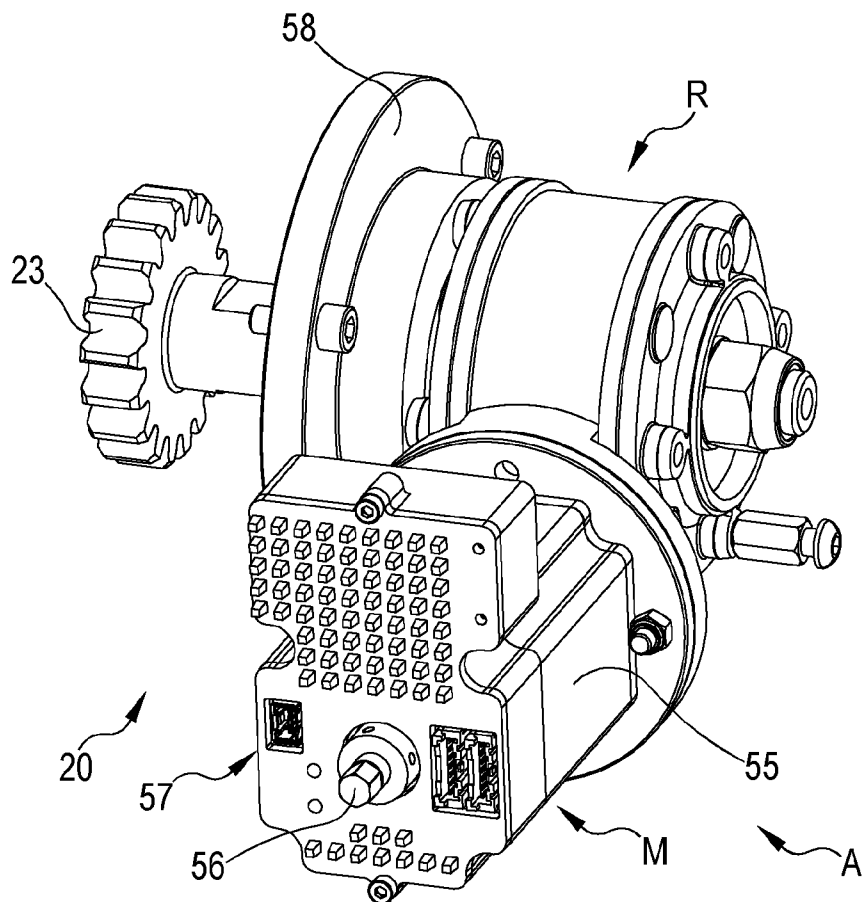
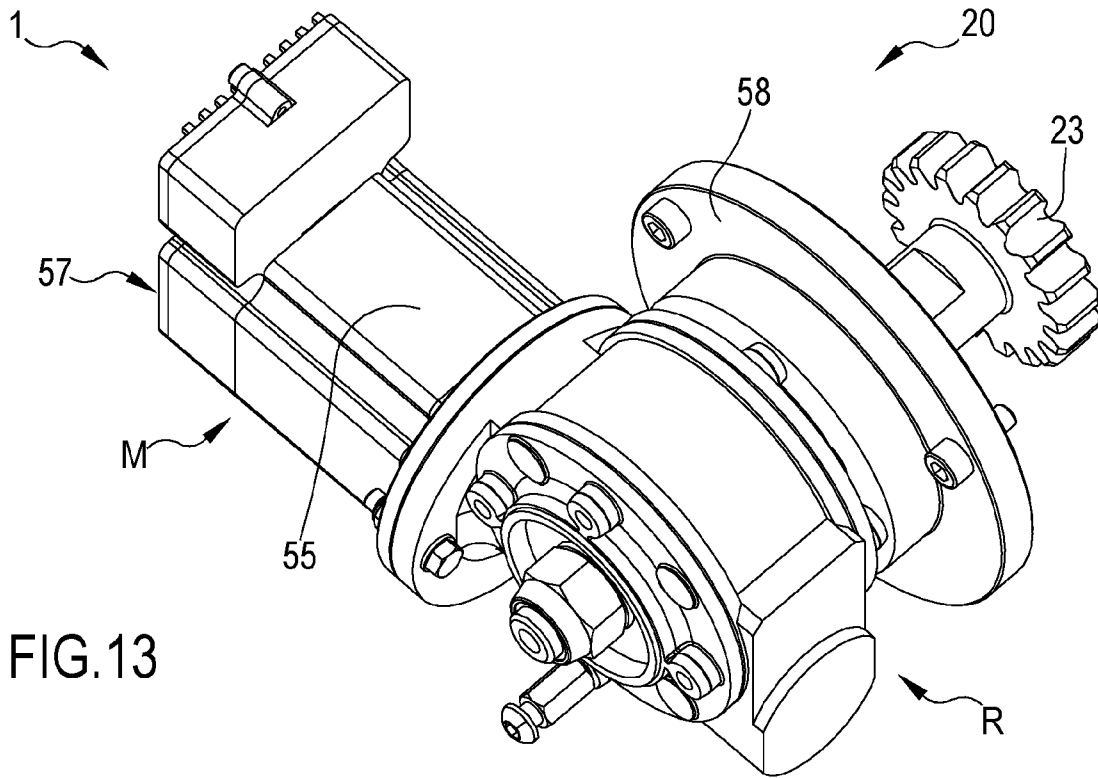


FIG.12



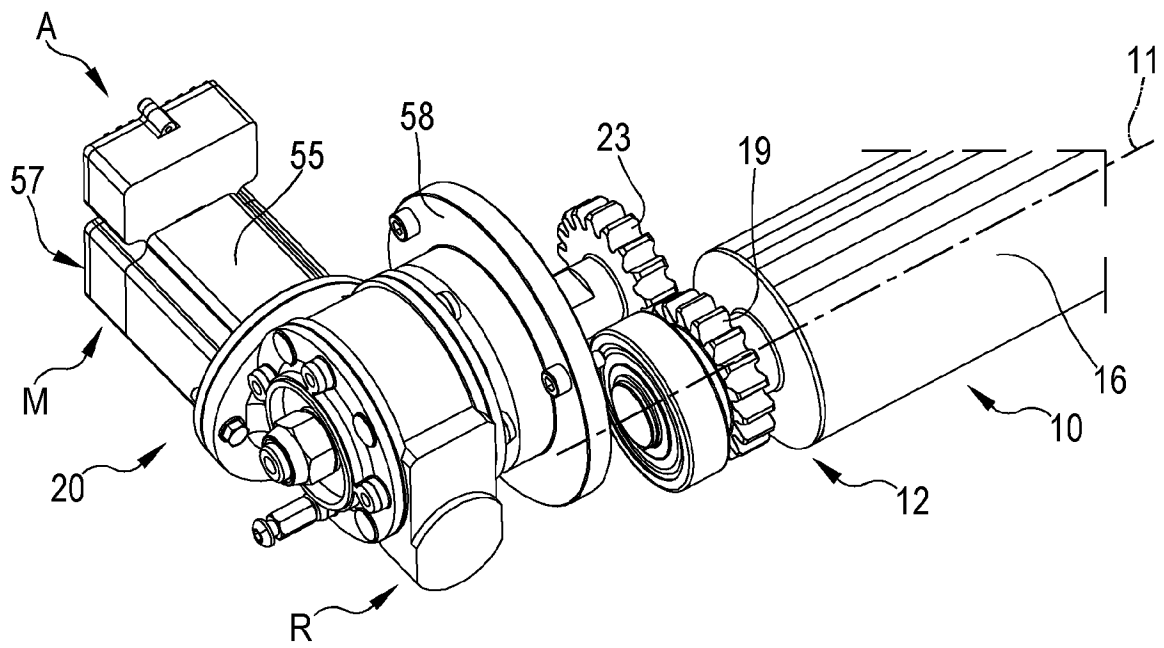


FIG.15

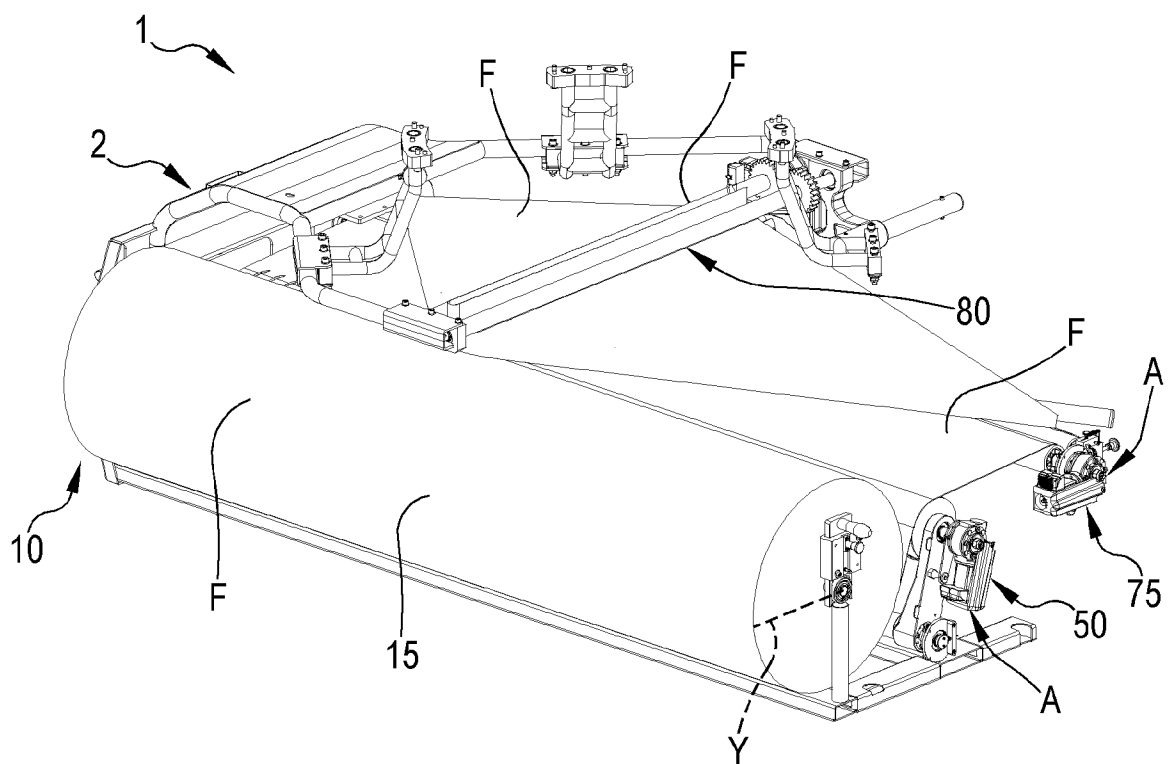
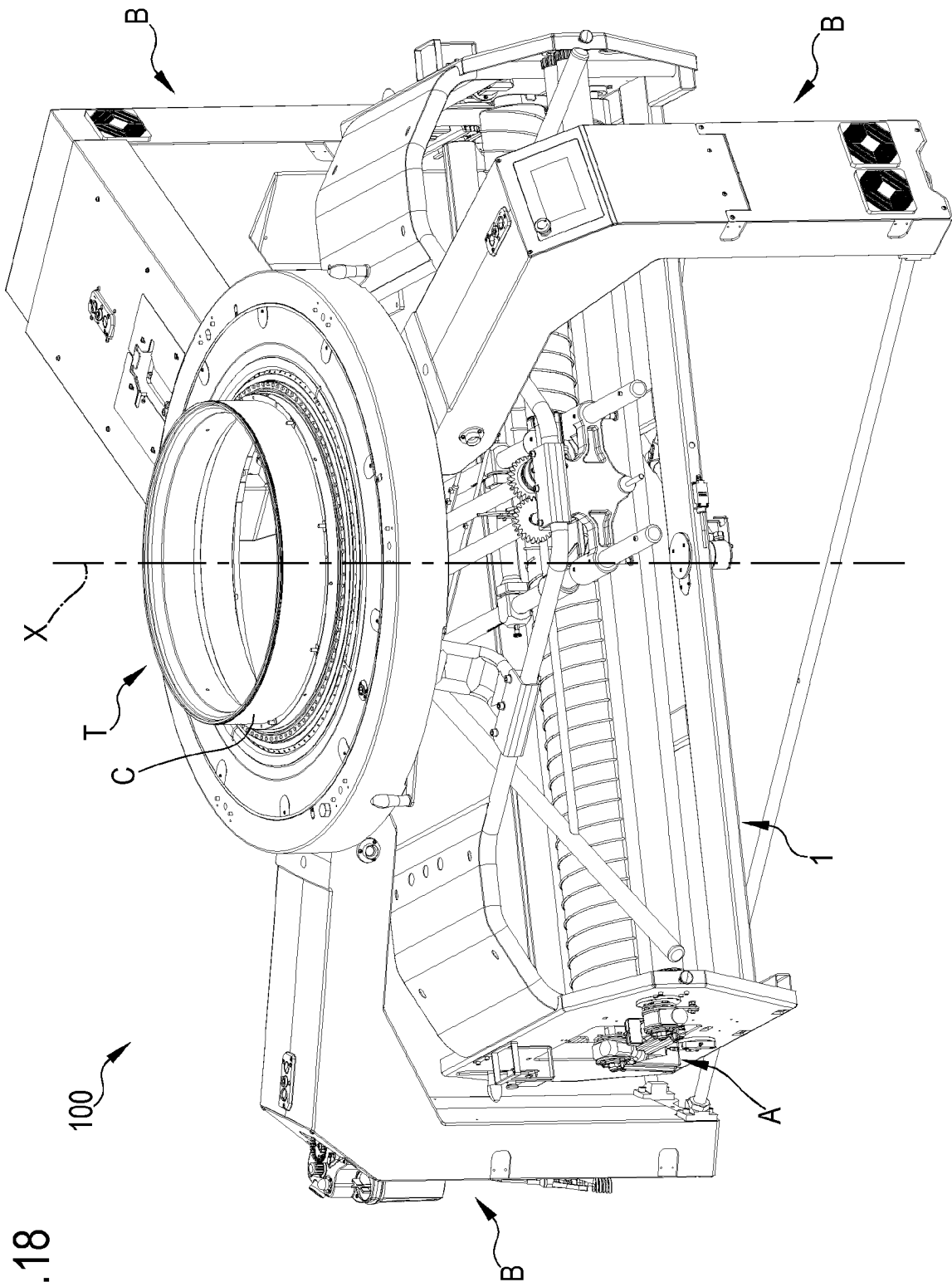


FIG.16



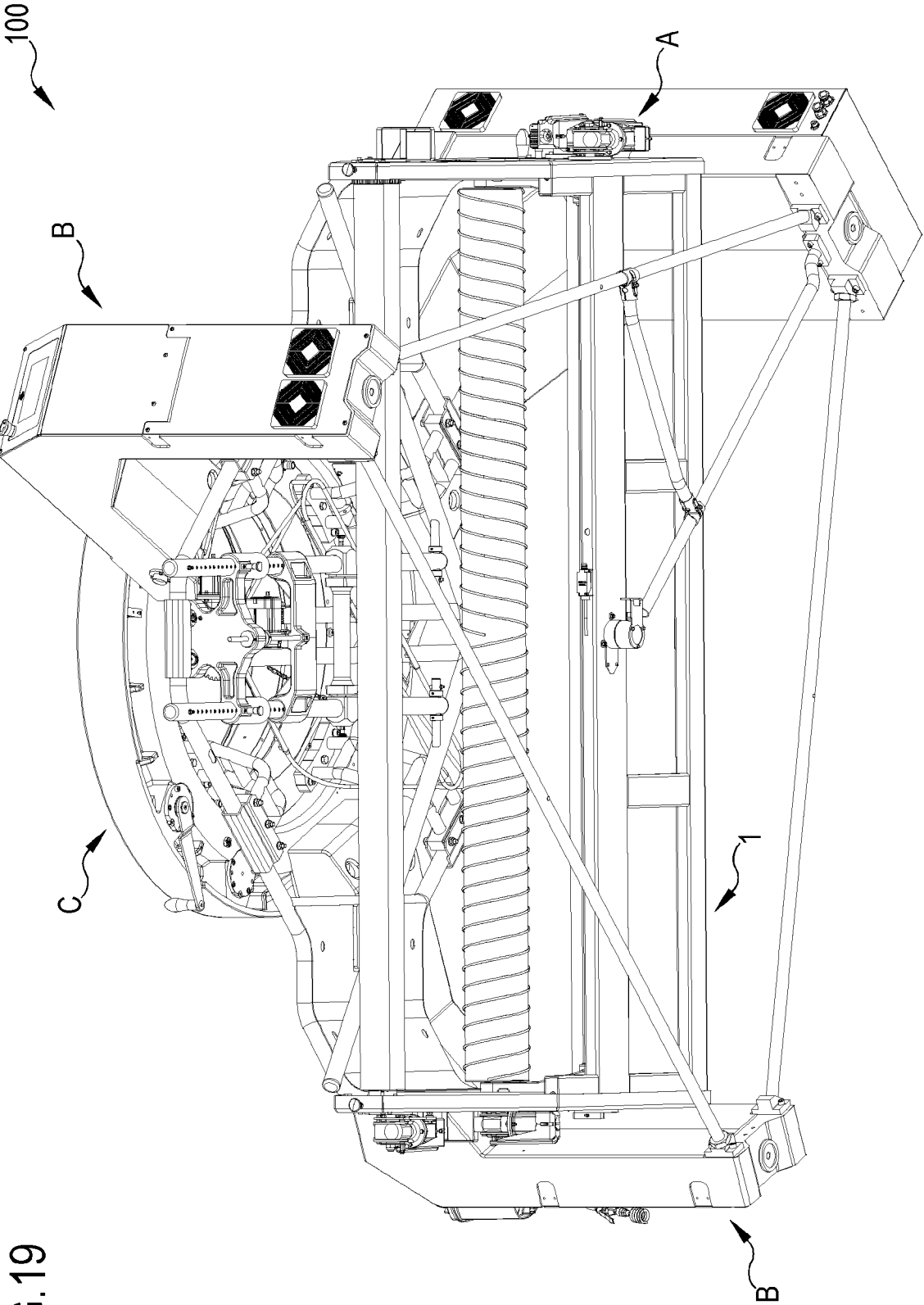


FIG.19

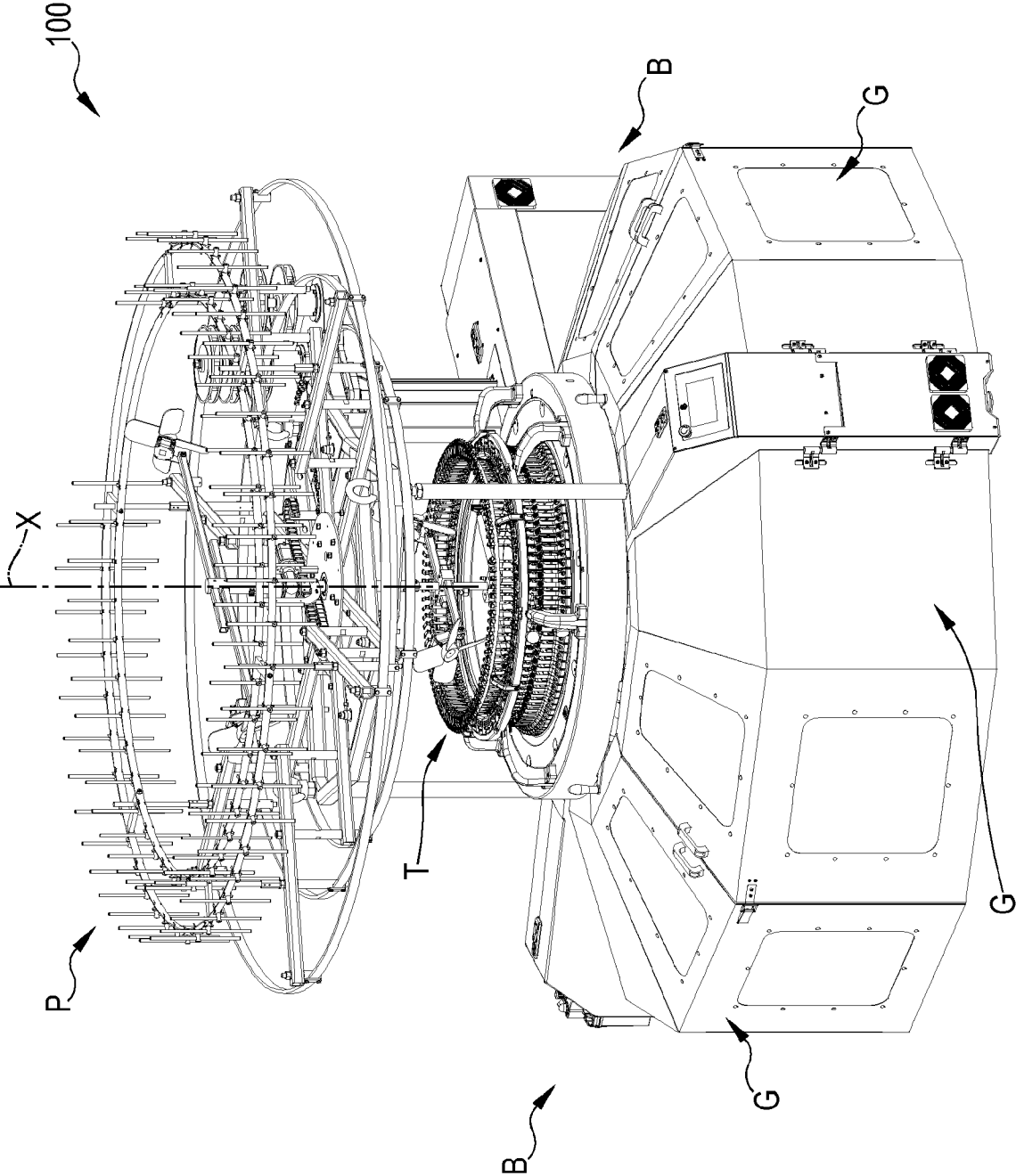


FIG. 20

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2024/055500**A. CLASSIFICATION OF SUBJECT MATTER**

INV. D04B15/88

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/283648 A1 (LONATI TIBERIO [IT]) 20 November 2008 (2008-11-20)	1-5, 8, 10, 11, 13-15
A	paragraphs [0015], [0016], [0019], [0032], [0039], [0040]; claim 1; figures 1, 2 -----	6, 7, 9, 12
X	US 2017/268140 A1 (LONATI ETTORE [IT] ET AL) 21 September 2017 (2017-09-21)	1, 2, 5, 11, 13-15
A	paragraph [0070]; claim 1; figure 1 -----	6, 7, 9, 12
A	CN 209 619 581 U (SHAOXING XUNZHEN TEXTILE CO LTD) 12 November 2019 (2019-11-12) figure 1 -----	9



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

7 August 2024

Date of mailing of the international search report

16/08/2024

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Authorized officer

Messai, Sonia

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2024/055500

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