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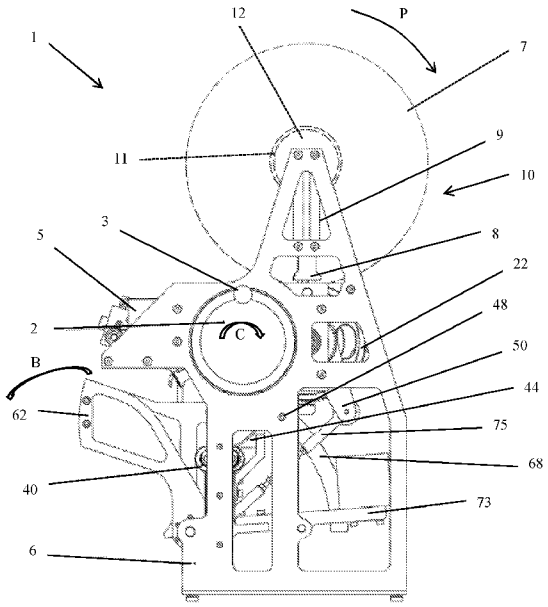


Fig. 2

(57) Abstract: Roll rewinder delivery mechanism, the roll rewinder being configured to wind a roll of sheet material from a bulk roll, the roll rewinder comprising a roll mandrel and a transfer mechanism; wherein the delivery mechanism includes a reciprocating carrier associated with the moll mandrel, an outward movement of which unloads said roll mandrel from said transfer mechanism, and an inward movement of which loads the roll mandrel towards said transfer mechanism; wherein the reciprocating carrier interacts with the transfer mechanism such that, during an unloading action of the delivery mechanism the reciprocating carrier causes elements of the transfer mechanism to move in a direction away from the roll mandrel at its winding position whereas during a loading action of the delivery mechanism, the reciprocating carrier causes elements of the transfer mechanism to move in a direction towards said roll mandrel at its winding position. The rewinder may comprise a user-actuated manual drive mechanism and may permit users to generate a roll having a selected quantity of sheet material. The roll rewinder may be self-threading and may be capable of operating with no external power source. The transfer mechanism may in particular comprise elements of a threading mechanism.

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Delivery mechanism in a roll rewinder

The present invention relates generally to an apparatus for winding a roll of sheet material. In particular, the present invention relates to an improved delivery mechanism at a roll rewinder device. The delivery mechanism allows retrieval of a wound roll of sheet material from within the rewinder device.

Industrial apparatus for winding rolls of sheet material is disclosed in US patent application 2005/0087647 or in EP1016608. According to these disclosures, a web of tissue material is supplied to a roll winding section of a rewinding machine thereby to generate logs of sheet material roll wound around a central core, wherein successive empty cores are supplied to a winding station in the machinery. The sheet material web is applied to successive cores using either adhesive means or compressed air for initiating winding of a free web end around each core. The logs of roll material may be divided into multiple individual rolls by cutting them up after winding. These known installations are intended for industrial scale production of sheet material rolls.

It has been observed that in certain circumstances, demand for rolls of sheet material products can be for very small quantities of such products. Typically, higher value-added sheet material products such as woven fabrics may be purchased in custom lengths dispensed and trimmed from a bulk roll or bolt. But sheet material products, especially such products for single use such as plastics film, aluminium foil or paper tissue, are generally sold in packaged rolls having a predetermined length and are often sold in multi-packs for convenience. The consumer price of such typical products is generally determined by the minimum price for the product quantity being sold. In some circumstances, the minimum product quantity supplied in the smallest typically available package is too large for certain users' needs and/or too expensive for some users to pay. It would be advantageous for certain consumers to be able to purchase rolls of sheet material products in smaller than standard roll sizes or in smaller numbers of rolls than in multi-pack sizes. Hitherto known equipment for producing sheet material rolls is unsuited to supplying small individual amounts of material in single rolls because of its scale. For example, the installations according to US patent application 2005/0087647 or EP1016608 would be wholly unsuitable for

provision at a customer point of sale. Moreover, according to these disclosures, sheet material is wound around central cores to form logs of wound sheet material. The wound logs are expelled from the winding apparatus by the simultaneous action of web cutting mechanisms and the rotating winding drums which contact the log during winding. Rolls may be delivered from the apparatus by expelling the wound logs without any need to displace any roll mandrel since no such mandrel is used.

In EP0694891, it has been suggested to provide a coin-operated dispenser for sheet material from a bulk supply roll, wherein the quantity of sheet material to be supplied by a motorised supply apparatus may be regulated by a timer which is controlled by a coin detector. In WO/0212103, it has been suggested to supply sheet material from a bulk roll using motorised supply rolls wherein the quantity of sheet material to be supplied can be selected via a control circuit. In both these latter disclosures, the sheet material is supplied unwound from a bulk roll.

An apparatus for winding a roll of toilet paper from incompletely utilised toilet paper rolls is disclosed in US patent application 2008/0048601. The apparatus comprises a winding spool fed directly from an unwinding spool. The unwinding spool is configured to receive a succession of partially consumed toilet paper rolls while the winding spool is configured to carry a roll core and to wind a single roll from multiple partial rolls. The apparatus, although conceived for small scale rewinding operations, is unsuited to the requirement for generating single rolls for consumers requiring sheet material because it requires multiple partially used rolls as an input starting material and because the product which it generates is not configured according to client expectations for a roll of sheet material. Moreover, the apparatus of US patent application 2008/0048601 is not constructed or configured for provision at a customer point-of-sale, nor can it offer the requisite supply of product because it relies on a supply of unfinished rolls – a starting material which cannot be supplied with any reliability for consumers. Finally, the requirement to join up successive partial roll material ends prevents the apparatus according to this document from providing a commercial solution to demand for small amounts of sheet material product. According to the construction of the rewinder which is disclosed, when a roll core is fully wound with sheet material from a number of partial rolls, it may be removed from

the rewinder apparatus by releasing a retaining means holding the core to a rewinding spool and removing the fully wound roll with its core from the rewinding spool. No delivery mechanism is required according to the construction of the disclosed apparatus, because the winding spool, being neither associated with a threading mechanism at the winding spool, or by a transfer mechanism at the spool, is directly accessible.

It is a general object of the present invention to provide an apparatus for supplying amounts of sheet material which may be of any material on a smaller than industrial scale, preferably on a scale capable of being implemented by end-users of a sheet material roll, preferably at a point of sale. Therefore, according to a further aspect, the present invention also relates to an apparatus for winding a single roll of sheet material from a bulk roll. The roll to be wound may in particular be an individual sized roll. Such an apparatus is not previously known. To this end, the present invention may provide a roll rewinder for winding individual rolls of sheet material from a bulk roll around a roll mandrel. Accordingly, the rewinder of the present invention comprises a transfer mechanism which is driven by a drive mechanism and which transports said sheet material from a bulk roll to the roll mandrel.

Accordingly, in one aspect, the invention may relate to a roll rewinder for winding a roll of sheet material, from a bulk supply roll, the roll rewinder comprising a roll mandrel, a sheet material transfer mechanism, and a drive mechanism wherein the drive mechanism drives said transfer mechanism which is configured to unwind the sheet material from a bulk roll and transfer it to the roll mandrel. The roll rewinder may in particular be configured to wind only a single individual roll of sheet material from a said bulk roll at any one time.

A roll rewinder in the context of the present invention may in particular be a device capable of winding rolls of thin sheet material, in particular from a sheet material bulk roll. Suitable sheet material for rewinding onto successive individual rolls may be thin material web such as for example nonwoven tissue material web, or nonwoven cloth web, or woven or knitted fabric web, or other thin sheet material such as paper or foil, in particular plastics or metal foils such as polythene or aluminium foil. The roll rewinder in the context of the present invention is of the type having a roll mandrel

onto which sheet material is wound by means of a web transfer mechanism which may preferably also comprise a threading mechanism for threading a free end of a web around a roll mandrel. The mechanism of the roll rewinder may in particular be accommodated within an outer housing. The rewinder of the present invention is configured to rewind sheet material which is thin and has very low stiffness.

The present invention is defined in appended claim 1. Further preferred features thereof are defined in appended subclaims 2-15.

According to the invention, it is desirable to facilitate unloading of a wound roll from within a roll rewinder device which may be of the type described in the preceding paragraphs. Hence, it is an object of the present invention to provide a delivery mechanism in a roll rewinder of the type which is configured with a roll mandrel and a transfer mechanism for web material.

According to the present invention, there is provided a delivery mechanism for a roll rewinder comprising a reciprocating carrier associated with a roll mandrel and co-operating with the transfer mechanism of the roll rewinder such that a movement of the carrier in a direction away from the transfer mechanism has the effect of moving the transfer mechanism away from its winding starting position at the roll mandrel while moving the roll mandrel away from the transfer mechanism. In a retracted position of the reciprocating carrier, the wound roll may be easily accessed and removed from the roll mandrel.

According to the invention, the roll rewinder may be configured to wind a single individual roll of sheet material web from a bulk roll delivery mechanism. The roll rewinder comprises a roll mandrel and a web transfer mechanism. The transfer mechanism may in particular include elements of a threading mechanism at said roll mandrel. The delivery mechanism includes a reciprocating carrier associated with the roll mandrel, an outward movement of which unloads the roll mandrel from the transfer mechanism, and an inward movement of which loads the roll mandrel towards the transfer mechanism. The reciprocating carrier interacts with the transfer mechanism such that, during an unloading action of the delivery mechanism the reciprocating carrier causes elements of the transfer mechanism to move in a direction away from

(i.e. clear of) roll mandrel winding position whereas during a loading action of the delivery mechanism, the reciprocating carrier causes the transfer mechanism to move in a direction towards the roll mandrel winding position. The transfer mechanism may comprise elements of a threading mechanism effective to guide web material around an empty roll mandrel, thereby initiating the winding action of web material around the roll mandrel. In this context, the winding position of the roll mandrel may, when the roll mandrel is empty of web material, typically correspond to a threading position at the roll mandrel in which elements of the threading apparatus are in position to aid the threading of a free end of a web of sheet material around the roll mandrel.

In a further aspect, the reciprocating carrier may comprise an arm pivoted about a swing axis and journalled in the rewinder. This enables the reciprocating carrier of the delivery mechanism to move through a defined path during use and ensures improved access to components which travel into and out of the rewinder when the delivery mechanism is actuated. Preferably, for optimum stability, the roll mandrel may rotate about a spindle mounted on the reciprocating carrier. In this way, access to the roll mandrel can be improved, in an opened position of the delivery mechanism.

In order to ensure an interaction between the delivery mechanism and movable components of the rewinder, the reciprocating carrier may optionally comprise a cam surface co-operating with a follower, sometimes called a rider at the transfer mechanism. In particular, the reciprocating carrier may comprise a curved surface which may be provided on a curved finger connected with the arm and which is configured to interact with the follower and which has its origin at the swing axis. This provides the advantage that components of the rewinder with which the cam surface interacts during motion of the reciprocating arm may alternately be both shifted in their position or held immobile during the passage of the cam surface or curve surface. This applies in particular in case the curve surface and the cam surface each form part of the reciprocating carrier and each move together with the reciprocating carrier.

By way of example, in an advantageous construction, the curve surface may, in an unloading position of the roll mandrel, support a retracted position of the transfer mechanism or threading mechanism, thereby providing clearance for inspection or maintenance or repair.

In a further embodiment, the curve surface, in a loading position of the roll mandrel, may be associated with a closed position of the transfer mechanism or threading mechanism at the roll mandrel with the winding drum frictionally engageable therewith.

Preferably, a follower mounted in connection with the winding drum is alternately supportable by the cam surface of the retraction mechanism and by the curve surface on a curved arm of the delivery mechanism. This arrangement ensures that a shifting of components associated with the follower can occur during a pat but not all of the motion of the delivery mechanism, opening up the possibility to initiate a sequenced set of movements. Still further optionally, the displacement of the winding drum resulting from the action of the reciprocating carrier drives movement of the threading mechanism towards or away from the roll mandrel winding position via a linkage. Preferably, the displacement of the winding drum resulting from the action of the reciprocating carrier may drive movement of more than one threading mechanism element towards or away from the roll mandrel winding position via respective linkages. In one example, there may be provided two threading mechanisms and two linkages. In one aspect, the linkages which give rise to movement of threading components of the rewinder may be biasing linkages which may be pushed against their biasing direction by the action of the delivery mechanism.

Preferably, the delivery mechanism may be capable of bringing the roll mandrel into a position clear of the rewinder, such that a user may manually grasp an already wound roll and remove it from said roll mandrel.

In all aspects, the invention provides the advantages of allowing consumers to obtain small amounts of sheet material in the form of a roll without requiring the consumer to purchase multi-pack rolls or to purchase a greater quantity of sheet material than is required or without requiring consumers to purchase sheet material in its unwound form, which would be awkward to handle and which may significantly compromise the sheet material itself. It may also remove the need for packaging and can thereby provide both a cost benefit and an environmental benefit. The driven transfer mechanism ensures that the sheet material is wound in a controlled manner from a bulk supply roll into a neat and integral roll of sheet material product. In the context of the present invention, a bulk roll may be considered to having a starting capacity of

ten or more times the sheet quantity of a rewound roll, preferably twenty or forty or more times the sheet quantity of a rewound roll. By way of example, a bulk roll of single-ply tissue material may have a diameter of between approximately 25 and 50cm, more preferably between 30 and 50cm, still preferably between about 30-40 cm, while a rewound individual roll of that material may have a diameter between about 4cm and about 14cm, preferably between about 5cm and 12 cm. A width of the material to be rewound may vary considerably, depending on the material concerned. Textile or film in the form of a ribbon may have a width from about 1cm and above, while domestic tissue paper may have a width of approximately 8 to 12cm or approximately 10cm or approximately 18 to 30cm or approximately 20 to 26cm or approximately 20 to 24cm.

In the present context the term rewound roll is understood to designate a roll of sheet material which has integrity in the form of a roll and is to be distinguished from sheet material which is in the form of an unwound or loose web or in the form of a bundle. The transfer mechanism, driven by a drive mechanism, also ensures that the sheet material is handled during winding in a manner which is consistent with and adjusted to the properties of the sheet material, such as its strength, stiffness, thickness and texture. The driven transfer mechanism preserves the integrity and appearance of the sheet material during rewinding. In another aspect, the transfer mechanism may preferably comprise an unwinding drum driven in rotation by said drive system and configured to contact a bulk material roll for unwinding sheet material in a controlled and predictable manner. Still preferably, the transfer mechanism comprises a nip roll driven in rotation by the unwinding drum, which co-operates with the unwinding drum at its periphery and which ensures a stabilised supply speed of sheet material to the winding drum and roll mandrel. Also preferably, the winding drum is driven in rotation by the nip roll, such that the rotation speed of the winding drum is determined by the rotation speed of the nip roll. In this way it is ensured that the relative speeds of the unwinding action and of the winding action are precisely controlled.

A transfer mechanism may in particular comprise at least one winding drum co-operating with said roll mandrel and being driven in rotation by the said drive mechanism. In some aspects of the invention, the roll mandrel may be freely rotatable

while the winding drum may preferably be driven in rotation by a drive mechanism of the rewinder. Preferably, the roll mandrel peripheral surface may be in frictional contact with the peripheral surface of the winding drum when said roll mandrel is empty. The roll mandrel may be driven in rotation by the rotation of the winding drum.

Preferably, the rewinder of the present invention is configured to enable the winding of sheet material rolls having varying lengths of sheet material. Preferably, a user operating the rewinder of the present invention may choose the length of sheet material on a roll being wound or on a roll to be wound. Preferably, in embodiments of the rewinder of the present invention, the rewinder may be configured to allow a user to generate rolls of small quantities of sheet material. The length of sheet material on any given roll may be determined by the number of turns of the roll mandrel, which may in turn be determined by the number of turns of an actuator such as a manual drive wheel or drive motor or the number of turns of a winding or unwinding drum within the transfer mechanism. Preferably, the rewinder of the present invention is configured to generate single rolls, i.e. it may be operated to generate one roll at a time. Each roll generated by the rewinder of the present invention may in particular be an individual roll. An individual roll is a roll of sheet material which constitutes a roll having a size for use by an end-user of the sheet material.

In a further aspect, the roll rewinder may comprise a metering device for monitoring the length of sheet material wound onto the roll mandrel from the bulk roll and for displaying an output which is indicative of the metered amount of sheet material on the roll mandrel. In accordance with a feature of the invention, the quantity of sheet material being rewound into a roll may be gauged using a suitable metering device. In one embodiment, a metering device may measure the diameter of the roll being wound. In another embodiment, a metering device may measure the weight of a roll being wound. Preferably, in one embodiment, the metering device may monitor the length of sheet material in a wound material roll. The gauge may in particular display a visible reading, preferably at the rewinder itself and preferably which can be seen by a user during or after operating the rewinder. Preferably, the gauge may be a fully mechanical gauge not requiring any power supply. In embodiments, the length metering mechanism may be driven by the turning action of a rotating drum in the

transfer mechanism of the rewinder. Preferably, the gauge may display a number which is representative of the length of sheet material wound around the roll mandrel. Optionally, the display may be reset by a user of the rewinder. Preferably, the display may be reset only after completion of a rewinding operation, for example, after moving the dispensing mechanism to a roll removal position.

The rewinder according to the invention may be end-user operated. In particular, it may be configured to be placed at a point of sale such as in a convenience store and/or it may be configured as a vending machine in particular such as a coin- or token-operated vending machine. Preferably, in embodiments of the rewinder of the present invention, the rewinder may be configured to allow a user to generate rolls of small or very small quantities of sheet material. Such quantities may in particular include quantities which are smaller or significantly smaller (e.g. half the amount or less) than the quantity contained in a hitherto standard single consumer roll of comparable sheet material. Preferably, said roll rewinder may be configured to be actuated in operation by a user each time a successive roll is to be wound.

Preferably, the roll rewinder may be capable of operating with no external power source. In preferred embodiments, the rewinder may be configured such that it is fully manually operable, in particular, it may be operable in the absence of any external power supply. Accordingly, in a still further aspect, the drive mechanism for the roll rewinder may be a user-actuated manual drive mechanism. As such, some or all elements of the rewinder may be mechanical. In embodiments of the rewinder, there may be neither electrical components nor other powered components. All components may consist of either fixed parts or manually driven mechanical moving parts. In some embodiments of the rewinder there may be battery powered parts. In some embodiments there may be neither external power nor battery power. In preferred embodiments of the rewinder of the invention, the drive means for operating the rewinder, and in particular for effecting the rewinding operation, may be manual mechanical drive means operated by user. Suitable manual drive means may be for example a manually manipulated drive wheel or reciprocating drive lever or other suitable manual drive mechanism for imparting rotational movement to elements of the transfer mechanism. Preferably, the rewinder may require no power supply for some

or all operations including unwinding a bulk roll, threading a free material end through the transfer mechanism, threading a free material end around a roll mandrel and winding sheet material onto a roll mandrel. According to alternative embodiments, the drive mechanism of the rewinder may be driven with an electrical motor or a motor supplied by compressed air.

In a further aspect, the roll mandrel may be a coreless mandrel, and the transfer mechanism may be configured to wind the sheet material directly on to the roll mandrel. Accordingly, in a further aspect, after completion of roll winding on to a roll mandrel, the wound roll may be removable from the mandrel by sliding the sheet material roll off the mandrel. According to still further embodiments of the invention, the rewinder may be configured for winding coreless rolls of sheet material. Accordingly, the sheet material may be wound around a roll mandrel which is configured for winding rolls of sheet material without a core. In particular, the transfer mechanism may be configured to wind sheet material drawn from a bulk roll directly around a roll mandrel. A roll mandrel may be comprised as part of the rewinder of the invention. In particular, a roll mandrel may be mounted within the rewinder such that it is generally fixed to the rewinder. Preferably, the rewinder is configured such that the roll mandrel axis is fixed, i.e. not moving or shifting, during winding operation. According to alternative embodiments of the invention, the apparatus of the invention may generate a rewound roll of material around a core. Such a core may be any suitable core and it may in particular be tubular, it may be re-usable or disposable, it may be made from cardboard or plastics or metal or any other suitable material. According to one embodiment, a core may be placed over the roll mandrel prior to operating the rewinder. Accordingly, a free end of a length of sheet material to be wound may be applied to the core during initiation of the rewinding operating in the same way as it would be applied to the coreless roll mandrel. In particular, the apparatus of the present invention may be capable of generating a rewound roll of sheet material onto a core or directly onto a coreless roll mandrel.

Preferably, the roll rewinder is self-threading, i.e. by the operation of the rewinder by a user, a free end of a sheet material will be led unassisted from a bulk roll and threaded through the transfer mechanism of the rewinder. Additionally or alternatively, a free

end of a sheet material may be wound around a roll mandrel by the action of the transfer mechanism in combination with a self-threading mechanism at the roll mandrel. The self-threading mechanism may in particular be a retractable mechanism arranged to be proximate the roll mandrel when it is empty and configured to progressively retract from the roll mandrel as the sheet material is wound around it. Preferably, the rate of retraction of the self-threading mechanism is greater than the rate of increase of the overall diameter of the roll mandrel as sheet material is progressively wound around it. In this context, the term 'unassisted' also signifies that threading of a free material sheet end is achieved without the use of external aids such as for example adhesive or compressed air or suction nozzles or clamping means. The threading of the free end of the sheet material web may in particular be achieved according to the invention using the action of one or more rollers, one or more drums and the mandrel as well as the action of one or more guide plates.

Preferably, at least one component of the self-threading mechanism is in contact with the roll mandrel when the mandrel is empty and progressively retracts away from the mandrel after a first turn of sheet material is wound on to the roll mandrel and as the roll of sheet material accumulates around the roll mandrel. Optionally, more than one component of the self-threading mechanism may be progressively retractable away from the mandrel roll as the sheet material accumulates around it.

In order to permit easy withdrawal of a rewound roll from a roll mandrel, the mandrel surface may in particular comprise a low friction coating or the mandrel surface may be made from a low friction material. An example of a suitable low friction coating or material may be PTFE although any other suitable known low-friction materials may be used. Accordingly, the rewinder according to the invention may be advantageously configured such that removal of rewound rolls of sheet material takes place by sliding a completed roll off the roll mandrel after winding is complete. Accordingly, a user may grasp the wound roll on the mandrel and slide it in the direction of the longitudinal axis of the roll mandrel until it is free of the roll mandrel. In some embodiments, the circumferential surface of the roll mandrel may be mounted such that it is retractable, defining a first circumference in a winding state of the roll mandrel and a second, smaller circumference in a retracted, roll removal state of the roll mandrel. In still

further embodiments, there may be applied local friction pads to the smooth surface of the roll mandrel for improved grip of the sheet material during winding. Such local friction pads may be limited in their extent in order to permit easy removal of the sheet material from the roll mandrel after winding. Preferably, no more than ten per cent of the outer surface of the roll mandrel may be covered with an increased friction material.

In a further aspect, in the roll rewinder of the invention, the bulk roll unwinding station may comprise a holder or restraining device permitting rotation of the bulk roll about its own central axis. The bulk roll holder may be configured such that the bulk roll central axis may shift in the bulk roll holder. Preferably, the position of the bulk roll axis shifts in the holder as the bulk roll is progressively unwound. This may be achieved in particular in that the bulk roll holder is configured to movably accommodate the bulk roll central axis. In an embodiment of this aspect, the bulk roll holder may allow movement of the bulk roll central axis by gravity through a vertical component. In aspects of the invention, the bulk roll holder may rest on an unwinding drum, the progressive rotation of which causes the unwinding of the sheet material from the bulk roll and consequent reduction in its overall diameter. Contact between the bulk roll and unwinding drum periphery may be maintained by the gradual movement of the bulk roll central axis in the bulk roll holder in the direction of the unwinding drum. To this end, the bulk roll may be subject to biasing means ensuring movement of its central axis as it is progressively unwound. Preferably, the movement of the bulk roll towards the unwinding drum is ensured by gravity.

Optionally, the bulk roll holder may comprise a channel or groove which is configured to accommodate an end of a central pinion of a bulk roll. Optionally, such a groove or channel may comprise opposing grooves or channels, each accommodating a pinion end protruding from either side of a bulk roll.

In another aspect, the roll rewinder of the invention may be configured such that the sheet material winding speed at the roll mandrel during winding is marginally greater than the sheet unwinding speed at the bulk roll. Preferably, the speed of the sheet material at the roll mandrel may be 0.1-10% greater than its speed at the bulk roll unwinding station. This speed differential ensures a slight tension is applied to the

web of material during winding of a roll thereby to generate a neatly wound material roll having an adequate level of integrity for ease of handling by a user. Still preferably, the speed of the sheet material at the roll mandrel may be 0.2%-5% greater than its speed at the bulk roll unwinding station. Still preferably, the speed of the sheet material at the roll mandrel may be 0.5%-4% greater than its speed at the bulk roll unwinding station. Still preferably, the speed of the sheet material at the roll mandrel may be 0.8%-3% greater than its speed at the bulk roll unwinding station. For certain materials such as e.g. aluminium foil, the speed of the sheet material at the roll mandrel may preferably be 0.1%-1% greater than its speed at the bulk roll unwinding station.

The apparatus of the present invention is intended to be suitable for handling thin sheet material such as material sheets having a thickness of about 2mm or less. Preferably, the apparatus of the present invention is capable of handling material sheets having a thickness of about 1mm or less. Still preferably, the apparatus of the present invention is capable of handling material sheets having a thickness of about 800µm or less. Still preferably, the apparatus of the present invention is capable of handling material sheets having a thickness of about 600µm or less. Still preferably, the apparatus of the present invention is capable of handling material sheets having a thickness of about 400µm or less. Still preferably, the apparatus of the present invention is capable of handling material sheets having a thickness about 150µm or less or about 120µm or less or about 80µm or less. The apparatus of the present invention may be capable of handling material sheets having a thickness as thin as from 50µm and above.

The rewinder of the present invention may be capable of handling webs of sheet material which has relatively high tensile strength such as plastics film or metal foil or textiles which may be woven or nonwoven. Nevertheless, the rewinder of the present invention is advantageously also capable of performing very well when handling low strength or delicate materials such as tissue. The term low-strength may be understood to apply to sheet materials having cross-machine direction tensile strengths from as low as 30N/m or above and machine direction tensile strength from as low as 60N/m and above.

Additional features of the invention are explained by way of examples with reference to non-limiting embodiments shown in the appended drawings, in which:

Fig. 1 shows an orthogonal view of a roll rewinder according to aspects of the invention

Fig. 2 shows a side view of the rewinder of Fig. 1

Fig. 3 shows an orthogonal view of elements of a transfer mechanism according to aspects of the invention

Fig. 4 shows a side view of the rewinder of Fig. 3

Fig. 5 shows an alternative orthogonal view of elements of the transfer mechanism of Fig. 3

Fig. 6 a winding drum of a transfer mechanism according to aspects of the invention

Fig. 7 shows a biasing element in accordance with aspects of the invention

Fig. 8a shows a section view of a roll mandrel according to Fig. 8b

Fig. 8b shows a side view of a roll mandrel according to aspects of the invention

Fig. 9 shows an orthogonal view of a dispensing mechanism according to aspects of the invention

Fig. 10 shows a side view of the dispensing mechanism according to Fig. 9

Fig. 11 shows an orthogonal view of elements of a threading mechanism for a roll rewinder according to the invention

Fig. 12 shows an orthogonal view of a threading shoe according to aspects of the invention

The roll rewinder 1 as illustrated in Figs. 1 and 2 comprises a frame 6 which supports the various elements of the rewinder, including a bulk roll unwinding station 10, a drive system 4 with an actuator 3, a transfer mechanism 20 comprising a series of driven

transfer elements in the form of drums and a dispensing mechanism 60. When the actuator 3 is turned, for example in the direction shown by arrow C, the unwinding drum rotates in a direction as shown by arrow J. Although not part of the apparatus, a bulk roll 7 is indicated in Fig 2 at the unwinding station. The bulk roll core 11 surrounds an inner spindle 12 which co-operates with and is received in the bulk roll holder 9 by means of its groove 14. In the embodiment illustrated, a roll mandrel 80 (not visible in Fig. 1 or 2) for receiving sheet material from the transfer mechanism 20 and around which a roll of sheet material may be wound is associated with the dispensing mechanism 60. Also included in the roll rewinder 1 are a biasing mechanism 73, a meter 5 and a threading or winding bed 40. Sheet material to be wound onto the roll mandrel 80 may in particular follow a path indicated by arrow A in Fig. 1 when a bulk roll 7 is received in the unwinding station 10. The illustrated type of rewinder may be known as a fully mechanical rewinder. A user may generate a wound roll of sheet material by manually actuating a mechanical drive, such as a drive wheel. The drive wheel 2 may provide rotational motion to a transfer mechanism 20 which unwinds sheet material from a bulk roll and winds it around a roll mandrel 80.

The principle mechanisms in the roll rewinder 1 include the bulk roll unwinding station 10 which provides a supply of sheet material to be rewound; the drive system 4 which in the embodiment illustrated may provide the sole power input to the rewinder mechanism; the transfer mechanism 20 which is mechanically driven by a drive system or drive mechanism 4 having a drive input 2 and which draws sheet material from the unwinding station 10 and feeds it around a roll mandrel 80; a dispensing system 60 which permits retrieval of the wound sheet material roll after winding and which enables the roll mandrel 80 to be re-loaded into the rewinder 1; a threading system including rolls and guide plates for enabling a free end of the sheet material to be automatically wrapped and wound around the roll mandrel 80; a retraction mechanism for retracting elements of the threading system from the roll mandrel 80 during roll rewinding; and a biasing mechanism 73 which ensures frictional contact between the driven elements of the transfer mechanism 20 and the freely rotatable roll mandrel during winding. Many aspects of the embodiment described herein are optimised for use in a roll rewinder 1 with no internal or external power supply. All

mechanisms may be mechanical and may be configured for use without electric or electronic components such as sensors or powered drive means.

Some components of the roll rewinder which is illustrated perform more than one function, that is to say, they form part of more than one mechanism. In particular, some elements of the biasing mechanism 73 also form part of the retraction mechanism, while some elements of the self-threading system also form part of the transfer mechanism 20, some elements of the transfer system form part of the retraction mechanism, and some elements of the dispensing system 60 also perform a retraction function of the self-threading mechanism.

Figs. 3-6, which mainly show elements of the transfer mechanism 20, show an unwinding drum 22 which in the case illustrated is driven in rotation by an input drive wheel 54. The unwinding drum 22 may advantageously be provided at its surface with a friction enhancing coating or as illustrated, with sections of its periphery being covered with a friction-enhancing material such as friction rings 31 which may preferably be arranged to protrude beyond the surrounding surface of the drum thereby to provide localised grip at one or more places along the extent of the drum periphery when butted against a nip roll 26 configured to co-operate with the unwinding drum friction material. The nip roll 26 may preferably be driven by an output drive wheel 56 of the unwinding drum, as illustrated. This ensures a stable supply speed of the sheet material into the roll rewinder for winding onto a mandrel 80. The stabilisation of the sheet material speed in this way has been found to allow the provision of single individual rolls which are neatly wound and presentable for customer purchase. Still preferably, as illustrated, the winding drum 24 is driven in rotation in direction L (Fig. 3) by the nip roll drive wheel 58 which engages with the winding drum drive wheel 59. The precise co-ordination in this way between unwinding drum speed and winding drum speed further contributes to the provision of neatly wound rolls. It also significantly increases the predictability of the rewinding operation, thereby significantly limiting the number of winding errors. In cases where manual drive is envisaged, such that individual users may actuate and drive the rewinder, the stability of the winding operation within the apparatus is a great

advantage because it ensures constant rewinding parameters even when users differ in their manner of using the apparatus.

Although not part of the transfer mechanism, the roll mandrel 80 is indicated in Fig. 4 in position abutting the winding drum 24 and proximate a threading shoe 45. This corresponds to a starting position of the roll mandrel 80 in its empty state and in relation to the winding drum 24. In operation of the rewinder, the roll mandrel is caused to rotate in the direction indicated by arrow D. The assembly in Figs 3-5, showing transfer mechanism 20 also exhibits elements of a self-threading apparatus and elements of a retraction mechanism for the self-threading apparatus. Also shown is a push rod 75 which is both a linkage in a retraction mechanism for parts of the self-threading apparatus shown in Fig. 11 and also a part of a biasing system linkage which ensures good contact between the winding drum 24 and the roll mandrel 80 during winding action.

An embodiment of the roll mandrel 80 is shown in Fig. 8a and 8b. In this embodiment, the roll mandrel 80 is freely rotating on a spindle 84 which may be mounted to any suitable component or to the frame 6. In the embodiment shown, the roll mandrel spindle 84 is fixed to the retractable dispensing mechanism 60. It comprises a cylindrical winding surface 85 mounted on a free running bearing 87 held in place by a recess at an anchoring end of the roll mandrel 80 and by a locking ring 83 at the distal end. A flange nut 82 combined with a locking pin 81 at teach end of the spindle 84 hold the roll mandrel in place on the spindle and the spindle 84 in place on the dispensing mechanism 60. Whilst the surface 85 of the roll mandrel 80 may be made from a low friction smooth material in order to help easy axial removal of a wound roll from the mandrel 80, there may nevertheless be provided an amount of friction material 89 at the roll mandrel surface 85 in order to minimise slippage of the sheet material on the mandrel. Since rotation of the mandrel 80 is by means of its circumferential interaction with the winding drum 24, then any reduction of friction or slippage between the mandrel 80 and sheet material during winding would be detrimental to the winding process. In order to minimise the interference between the friction material 89 and the axial movement of a wound roll of sheet material after winding, it is preferable for the friction material to be recessed in the roll mandrel

surface 85 so that it does not protrude above the roll mandrel surface 85. In embodiments of the invention, it is envisaged that the roll mandrel should rotate freely with no drive components other than the drive action resulting from radial contact with the winding drum 24.

The threading of a free end of a piece of possibly thin sheet material though a rewinding mechanism 1 is of particular importance in the present invention because it is anticipated that the apparatus will require re-threading after each use by a user, such that at least the windings around the roll mandrel require to be re-initiated with every use of the apparatus. Known industrial scale roll winding installations generally use adhesive, compressed air, clamping means or sophisticated cutting and grasping mechanisms for the purpose of initiating threading of free material ends around successive cores. It should be emphasised that prior art solutions in this context appear to rely on the use of cores and also on the use of sophisticated automated and powered equipment. There may be advantages to a self-threading system which is reliable and uncomplicated for users and which can be implemented in a low-power or no-power apparatus on a smaller scale than industrial equipment.

Referring to Figures 3-6 and 11, when the drive mechanism 4 is operating so that the transfer mechanism 20 is in operation, and when a length of sheet material is fed between the unwinding drum 22 and the nip roll 26, in the direction of arrow A, with the unwinding roll rotating as shown by arrow J while the nip roll rotates as shown by arrow K, the free end of the sheet material passes between the preventer 36 and the unwinding roll 22 until it reaches the threading guide plate 44. Advantageously, the unwinding drum 24 may be provided with ribs 33 and grooves 34. These may co-operate with teeth or protrusions 38 formed at the leading edge of the guide plate 45, which reach underneath the outer rib surface of the unwinding drum to ensure that the sheet material free end is led towards the roll mandrel 80 and not between the guide plate 44 and the unwinding drum 22.

Although not visible from Fig. 1 or 2, according to the illustrated embodiment, the roll mandrel 80, fixed to a part of the dispensing mechanism 70, in a starting position thereof i.e. in an empty state, makes direct frictional contact with the peripheral surface of the winding drum 24. Also in its starting position, the roll mandrel 80

contacts a threading bed 40 which co-operates with the threading guide 44. In the embodiment shown, the threading bed 40 constitutes a threading guide and is comprised of a pair of threading rolls 17, 18 on a movable carriage 19. These threading rolls 17, 18, in the illustrated embodiment, both exhibit mutually interlocking ribs 37 and grooves 41 thereby reducing the depth of the trough at their intersection. The effect of the winding drum 24, which forms part of the transfer mechanism 20 and which is driven by the driving mechanism 4, on the roll mandrel 80 is to cause it to rotate. Friction elements such as friction rings 28 at the winding drum surface may increase this effect, especially in an empty state of the roll mandrel 80. The rotation of the empty roll mandrel 80 in turn causes the threading rolls 17, 18 to rotate, aided by friction elements applied to ribs 37 on the threading roll surfaces. The rotation of the threading rolls 17, 18, together with the rotation of the roll mandrel 80, causes the free end of a sheet material web having passed across the face of the threading guide 44 to become drawn through the nip between them.

As the free end of the sheet material emerges from the nip between the second threading roll 17 and the roll mandrel 80, it moves against the surface of a threading shoe 45, whose forward protrusions 46 pass below the outer peripheral surface of the threading roll 17 as they interact with the ribs and grooves 37, 41 of the roll 17. This ensures that the free end of the sheet material web is drawn along the guide surface of the threading shoe 45 and moves further around the roll mandrel as it is passed between the roll mandrel 80 and the threading shoe. As the free end of the sheet material passes across the full extent of the threading shoe 45 surface, whose trailing edge is also provided with a toothed profile 39 which inter-engages with the ribs 27 and grooves 29, it is led to the nip formed between the roll mandrel 80 and the winding drum 24. The further action of the nip between the winding drum 24 and the roll mandrel 80 on the sheet material passing through it results in the free end of the sheet material being fed further round the roll mandrel 80 until it re-joins the moving web threaded between the roll mandrel 80 and the threading rolls. At this point the free web end is wound fully around the roll mandrel 80 so that further rotation of the roll mandrel 80 tends to wind the sheet material on further, creating a progressively accumulating thickness of sheet material wound around the roll mandrel 80. The roll mandrel 80, after the first sheet winding turn onto it is complete, loses its direct contact

with its drive means, i.e. the winding drum 24. In order to ensure the continued rotation of the roll mandrel 80 during winding, a biasing mechanism is provided to ensure that the winding drum continues to apply enough circumferential pressure against the roll mandrel 80 to ensure the continued rotation of the latter and thereby the continued winding around the roll mandrel 80 as the device is actuated further.

The biasing action of the roll rewinder mechanism which ensures the reliable winding operation of the winding drum 80 even when it is wrapped in sheet material, is ensured via a biasing linkage applied to a peripheral arm 50 of a control plate 55 mounted freely rotatable about the unwinding drum 22 rotation axis. In the example shown, the control plate 55 is provided in duplicate, concentric with the unwinding drum rotational axis and at each end thereof, joined together by the preventer 36 wherein the winding drum 24 is journalled between the two opposing elements of the control plate 55, in effect creating a control cage. The biasing action of the biasing linkage tends to urge the rotatable control plate 55 in one rotational direction, which tends to urge the winding drum 24 against the roll mandrel 80, creating enough pressure and friction to maintain the driving action of the winding drum on the roll mandrel throughout winding.

The biasing action in the mechanism according to the invention may be provided as illustrated, notably in Figs. 2-7. A biasing element 78 such as a spring or a weight is connected with a biasing arm 72 hinged on a pivot axis 77. As shown in Fig. 7, the biasing effect of the illustrated embodiment is created by virtue of the gravity force acting on the weight 78, which, by virtue of the pivot axis 77 and the arm 72, places an upward force at the slotted arm end 79. That effect is countered by the winding action of the rewinder 1 when in operation, which then tends to apply forces, in particular via the push rod 75 acting through the biasing linkage axis 74 in a downward direction G of the slotted arm end 79 and thereby in an upward or anticlockwise direction N of the biasing member 78. In return, the biasing member 78, via the arm 72 tends to urge the push rod 75 in the opposite direction, i.e. against a clockwise movement of the control plate 55. At the same time, also via the biasing linkage axis 74, the carriage 19 of the roll mandrel threading bed 40 is urged upwards, guided by guide slots 42 at each end of the carriage 19. This tends to ensure good contact between the guide

rolls 17, 18 and the roll mandrel 8, thereby further enhancing the threading effect on a free end of a sheet material web.

It will be appreciated that the self-threading mechanism, in order to be effective, is arranged so that all its components arranged about the roll mandrel 80 are positioned either very close to the roll mandrel, in the case of guide plate type elements 44, 45 or contacting the roll mandrel 80, as in the case of guide rolls 17, 18 or the winding drum 24. As sheet material builds up around the roll mandrel 80, the self-threading elements tend to pose an obstruction to the desired build up of sheet material windings. It will also be appreciated that, with the exception of the winding drum 24, from which the roll mandrel derives its rotational motion, after the initial winding has been wound around the roll mandrel 80, there is no further need for the self-threading elements of the threading mechanism such as the threading shoe 45, the guide plate 44 or the guide rolls 17, 18.

Therefore, according to other inventive aspects of the roll rewinder, it has been sought to provide and to optimise the retraction of certain threading components away from the roll mandrel 80 after the sheet material has made an initial turn around it. According to the present invention, it has been considered advantageous to provide a solution which may be simple and reliable and which may be implemented in an apparatus which has low external power requirements or no external power requirement.

With these requirements in mind, it has been found, surprisingly, that a retraction mechanism can be implemented which is powered solely by the action of the gradual build-up of sheet material around the roll mandrel 80. During operation of the rewinder of the present invention, the roll mandrel 80 may in particular be fixed in position in the rewinder 1. In the embodiment which is illustrated, the roll mandrel is fixed to an arm of a reciprocating carrier 70 of the roll dispensing mechanism. The reciprocating carrier 70 and the entre dispensing mechanism may in particular remain stationary during roll winding so that the roll mandrel 80 remains fixed albeit freely rotatable. With reference in particular to Fig. 2, it can be seen that as successive windings accumulate around the roll mandrel 80 there will be a tendency for the winding drum 24 to be progressively pushed upwards by the layers of sheet material.

Since the winding drum 24, rotating about its axis 23 is received in the control plate 55 or control cage, which itself is freely rotatable about the unwinding drum axis 21fixed in the rewinder 1, it can be seen that the winding drum will describe a circular path, concentric with the unwinding drum, as it is urged progressively away from the roll mandrel 80 in the approximate direction of arrow H. In doing so, the winding drum urges the control plate 55 against the biasing action of the biasing mechanism, in the opposite direction to the biasing action of the biasing mechanism. The control arm 50 is thereby moved in the direction of arrow F, which causes the push rod 75, connected to the control arm 50 via connector pin 76 to move against the biasing direction so that the biasing linkage axis 74 is pushed in direction G. Since the push rod 75 is connected to the carriage 19 with its threading guide elements 40, 44, the movement of the push rod 75 thereby generates a movement of the threading bed 40 and of the threading guide 44, away from the mandrel roll 80. By appropriately selecting the length of the push rod 75 and its angular relationship to the motion path of the control arm 50, it is ensured that the motion of the carriage 19 away from the roll mandrel takes place at a greater rate than the rate of build up of material thickness in a radial direction around the roll mandrel 80. This, in turn, ensures that after the first winding has been passed around the roll mandrel 80, the guide rolls 17, 18 become progressively more retracted from the roll mandrel 80 with its growing roll of sheet material, thereby preventing any interference with the winding process of any obstruction thereof.

As for the threading shoe 45, in order to be effective during threading, it requires to be at a distance of the order of one millimetre from the mandrel roll circumference. This is necessary in order to ensure that the thin material of the material web does not collapse, bunch or otherwise become entangled as it passes between the guide shoe wall 45 and the outer roll mandrel wall. Moreover, as the overall diameter of the roll mandrel 80 and its layers of sheet material grows, so the concave surface of the threading shoe 45 could constrain the growing roll mandrel 80 and seriously interfere with it, damaging the roll of sheet material wound thereon. The retraction mechanism of the present invention therefore provides a further linkage in the form of a stay arm 49 pivotable about a fixed pivot axis 48 and connected to the threading shoe carrier 47. The threading shoe carrier 47 is rotatable about the winding drum main axis 23,

held on the control plate 55 so that the threading shoe carrier 47 and the threading shoe can, if otherwise unconstrained, in effect perform a rocking action about the winding drum axis 23. The threading shoe carrier 47 extends radially in opposite directions away from the winding drum axis 23 and the threading shoe 45 is connected at an end of the shoe carrier 47 which is on an opposite side of the winding drum axis 23 from the connection to the stay arm 49, along a threading shoe control axis 51. By selecting respective relative distances between the winding drum axis 23 and the threading shoe control axis 51 as a first distance and between the winding drum axis 23 and the threading shoe 45 as a second distance, the constraining effect which the stay arm 49 imposes on the movement of the threading shoe carrier 47, and the desired retraction action of the threading shoe 45 can be achieved. Namely, it is achieved that the resulting movement of the threading shoe 45 is greater than the displacing movement of the build-up of web windings between the roll mandrel 80 and the winding drum 24. In particular, as can be seen from Fig. 4, the threading shoe follows a path indicated approximately by arrow E, while the winding drum 24 follows a path indicated approximately by arrow H. By the appropriate configuration of the pivot points 51, 23, on the threading shoe carrier 47, it can be achieved that the movement E of the threading shoe is a magnification of the movement of the winding drum H, caused by the build up of sheet material between the roll mandrel and the winding drum. Preferably, the path travelled by the threading shoe 45 as a result of the effect of the build up of sheet material windings between the fixed mandrel roll 80 and the relatively movable winding drum 23 is at least 5 percent greater than the path travelled by the winding drum away from the roll mandrel. Still preferably, the path travelled by the threading shoe 45 as a result of the effect of the build up of sheet material windings between the fixed mandrel roll 80 and the relatively movable winding drum 23 is at least ten percent greater than the path travelled by the winding drum away from the roll mandrel. Still preferably, the path travelled by the threading shoe 45 as a result of the effect of the build up of sheet material windings between the fixed mandrel roll 80 and the relatively movable winding drum 23 is at least fifteen percent greater than the path travelled by the winding drum away from the roll mandrel.

In order to optimise the effectiveness of the rewinder of the present invention, it is desired to ensure that successive rolls are wound neatly and can be easily extracted

from the apparatus after winding without impairing the wound roll. Furthermore, it is desirable that users can easily initiate and conclude their use of the rewinder 1 in order to obtain the roll of material which they desire. The apparatus is thereby required to allow different sizes of wound rolls to be produced. Still further, in case of a rewinder 1 which has no external power supply or which is partially or fully powered by a user, it inevitable that different users will have a different usage characteristic of the apparatus. It is desired to ensure that the apparatus operates consistently when used by different users or for different product amounts and it is desired that the apparatus should be so easy to operate that very few people would be excluded from using it.

To these ends, it is proposed to provide an improved delivery mechanism 60, also known as a dispensing mechanism, allowing easy initiation and completion of rewinding operations. The roll rewinder 1 therefore comprises a delivery mechanism 60 for the wound single rolls of sheet material. The removal of rewound rolls of sheet material from the rewinder 1, after completion of winding, may thereby be facilitated by incorporating a delivery mechanism 60 in the roll rewinder 1. The delivery mechanism 60 may in particular include a retractable arm 70 on which the roll mandrel 80 is mounted. The roll mandrel 80 may thereby be movable between a winding position in which the transfer mechanism 20 is operative to wind sheet material around the roll mandrel 20 and a roll removal position, in which a wound roll may be removed from the roll mandrel 80, in particular by hand, and in particular by a user of the roll rewinder 1. The retractable arm 70 may oscillate between a closed position, in which the roll mandrel 80 is in its winding position, and an open position, in which the roll mandrel 80 is in its roll removal position. In particular, the retractable arm 70 of the dispenser mechanism 60 may be moved manually by a user between its closed and its open position. The retractable arm 70 may in particular be pivotable about a swing axis 64, allowing the dispenser to rock between a loaded position of the roll mandrel 80 and a dispensing position of the same, corresponding to a respective closed and retracted position of the retractable arm 70.

According to the invention, there is provided a roll rewinder 1 having a transfer mechanism 20 for winding sheet material from a bulk roll 7 on to a roll mandrel 80,

wherein the roll rewinder 1 additionally comprises a delivery mechanism 60 having a reciprocating carrier 70 with which the roll mandrel 80 is associated, the reciprocating carrier 70 being movable between a loaded position in which the roll mandrel 80 is held in an operative position in relation to the transfer mechanism 20 and an unloaded position in which the roll mandrel 80 is readily accessible to a user for removing a wound roll from said mandrel 80 and in which said reciprocating carrier 70 maintains elements of said transfer mechanism 20 spaced apart from a said operative position. This arrangement of the delivery mechanism 60 ensures that by a simple action of the reciprocating carrier 70, a user can alternately engage the roll mandrel 80 inside the rewinder 1 for carrying out winding operations and disengage the roll mandrel 80 from the transfer mechanism 20 to allow removal of a wound roll. In the rewinder apparatus 1, in which the winding of sheet material is carried out in a controlled manner, as determined by the transfer mechanism 20, there are necessarily a considerable number of sheet material conveying components proximate and around the roll mandrel 80. The removal of the roll mandrel 80 for extraction of a wound roll is nevertheless made simple by the apparatus of the invention, as is the replacement of the roll mandrel 80 at its winding location in communication with the transfer mechanism 20.

Preferably, in embodiments of the invention, elements of the transfer mechanism 20 which are brought into a retracted position when the delivery mechanism is placed in its unloading position include elements of the self-threading mechanism. Preferably, in embodiments of the invention, and as it is illustrated, the roll mandrel 80 may be fixedly attached to the delivery mechanism, and in particular, to the reciprocating carrier 70. Attachment can be by any suitable means and may include the roll mandrel 80 being mounted on a spindle 84 fixed to and extending from the reciprocating carrier 70. The reciprocating carrier 70 is mounted on a pivoting swing axis 64 in the rewinder 1 and is capable of being easily manipulated by a user. To that end, it may be associated with further elements of the dispensing mechanism 60 such as a grasping handle 62 or additional stabilising plates shown in the drawings.

The reciprocating carrier may in particular comprise an arm 71 attached at its base to said swing axis 64 which may advantageously be journalled in the frame 6. In a

preferred embodiment, as illustrated, the arm is associated with a finger 68 having a support surface 69 and a cam surface 66. The support surface 69 and the cam surface 66 are preferably continuous. In a preferred arrangement, the finger 68 exhibits a support surface 68 which describes an approximate arc having its geometric origin at the swing axis 64. The cam surface 69 extends in a continuation of the support surface 69 in a direction generally tending towards the swing axis 64. When the arm 71 is pivoted, for example by a user opening or closing the dispenser mechanism 60 i.e. unloading or loading the roll mandrel, the cam surface 66 and the support surface 69 may interact with components of the rewinder 1 which co-operate with the said surfaces 66, 69, to cause the components to follow the path described by the respective surfaces as they move in relation to the components. As can be seen from Figs. 9, 10 and 5 the surfaces 66 and 69 are positioned to interact with a cam follower in the shape of a bead 67 mounted at the transfer mechanism 20, and more specifically, mounted on the control plate 55 of the transfer mechanism.

In the case illustrated, the cam surface 66 and the support surface 69 interact with the follower 67 fixed to the control plate 55. In a closed position of the delivery mechanism 60, i.e. a retracted position of the reciprocating carrier 70 in which the roll mandrel 80 and the transfer mechanism 20 are in an operative engaged starting position for winding on an empty mandrel, the follower 67 may either rest very lightly on a recessed portion of the cam surface 66 or, more preferably, it may be disengaged from the cam surface 66 altogether, allowing the transfer mechanism 20, the control plate 55 and the winding drum 24 all to adopt their default operative positions in relation to the roll mandrel 80, that is to say, the winding drum 24 will be in frictional contact with the roll mandrel 80. When the delivery mechanism 60 is actuated, e.g. by a user grasping the gripping handle 62 and pulling on it, into its open position (see arrow B in Fig. 2), corresponding to an extended position of the reciprocating carrier 70, allowing access by a user to the roll mandrel 80, the cam surface 66 of the finger 68 from its disengaged position in relation to the follower 67, gradually approaches and then contacts the follower 67. As the delivery mechanism 70 is further drawn into its open position, the follower 67 is engaged by the cam surface 66 and moved gradually out of its operational starting position. The movement of the follower 67 caused by the interaction with the cam surface 6 causes

a movement in rotation of the control plate(s) 55. This movement corresponds to the same movement of the control plate 55 and of elements of the transfer mechanism 20, which occurs when sheet material is being progressively wound on to the roll mandrel 80 during operation of the rewinder 1. It causes the same set of reactions in the threading elements and in the biasing mechanism 73 as would ordinarily result during winding. The difference in case of interaction between the reciprocating carrier 70 and the follower, is that the retraction of the various transfer mechanism and threading and biasing components takes place in a swift motion as the delivery mechanism is actuated. When the portion of the cam surface 66 which interacts with said follower 67 is at the boundary between the cam surface and the support surface 69, the extent of the retraction of the rewinder components reaches its maximum extent. Preferably, the support surface 69, when moved in relation to the follower 67, has no effect in retracting components of the rewinder 1 from the roll mandrel 80 winding location, instead ensuring, by its interaction with the follower 67, that the components which were retracted by the action of the cam surface 66 remain in their retracted position as the delivery mechanism is moved further towards its fully open position, i.e. towards an extended position of the reciprocating carrier 70. In some embodiments, the support surface 69 and cam surface 66 may be a single surface presenting a gradually increasing or decreasing spacing between the swing axis and the finger 68. It will be appreciated that when the roll mandrel 80 is partially or fully wound on with sheet material, the follower 67 will inevitably disengage from the cam surface 66 in proportion to the quantity of sheet material on the mandrel 80 because it will have been moved out of the closed position of the transfer mechanism 20 - i.e. the starting position with an empty roll mandrel 80 - by the action of the progressive winding on of sheet material around the roll mandrel 80.

One additional effect of the support surface 69, in maintaining components of the rewinder 1 in a retracted position in relation to their winding starting position, or closed position, in addition to enabling the unobstructed passage of the roll mandrel 80 and the roll wound on it out from the rewinder, is to allow access, if necessary, to components of the threading mechanism or transfer mechanism, e.g. for maintenance or servicing purposes.

In a not illustrated embodiment, a core such as a removable tubular core may be placed over the roll mandrel 80 before beginning a rewinding operation. The wound roll of sheet material may be suitably removed from the roll mandrel 80 after winding by sliding the core off the roll mandrel 80 along its longitudinal axis.

Claims

1. Roll rewinder delivery mechanism, said roll rewinder being configured to wind a roll of sheet material from a bulk roll, the roll rewinder comprising a roll mandrel and a transfer mechanism;

wherein said delivery mechanism includes a reciprocating carrier associated with said roll mandrel, an outward movement of which unloads said roll mandrel from said transfer mechanism, and an inward movement of which loads the roll mandrel towards said transfer mechanism;

wherein said reciprocating carrier interacts with said transfer mechanism such that, during an unloading action of the delivery mechanism the reciprocating carrier causes elements of said transfer mechanism to move in a direction away from the roll mandrel winding position whereas during a loading action of said delivery mechanism, said reciprocating carrier causes elements of said transfer mechanism to move in a direction towards said roll mandrel winding position.

2. Delivery mechanism according to claim 1, wherein said transfer mechanism includes a threading mechanism at said roll mandrel and wherein the elements of the transfer mechanism which are moved by the action of the reciprocating carrier include elements of said threading mechanism.

3. Delivery mechanism according to any previous claim, wherein said reciprocating carrier comprises an arm pivoted about a swing axis in said roll rewinder.

4. Delivery mechanism according to any previous claim, wherein said roll mandrel rotates about a spindle mounted on said reciprocating carrier.

5. Delivery mechanism according to any previous claim, wherein said reciprocating carrier comprises a cam surface co-operating with a follower at said transfer mechanism.

6. Delivery mechanism according to any previous claim, wherein said reciprocating carrier comprises an arcuate surface configured to interact with a follower and having its origin at said swing axis.

7. Delivery mechanism according to claim 6, said arcuate surface and said cam surface each forming part of said reciprocating carrier and each moving together with said reciprocating carrier.

8. Delivery mechanism according to claim 6 or 7, said curve surface, in an unloading position of said roll mandrel, being in a position supporting said transfer mechanism in a position remote from a winding initiating position of said transfer mechanism.

9. Delivery mechanism according to any claim 6-8, said curve surface, in a loading position of said roll mandrel, being associated with a closed position of said transfer mechanism at said roll mandrel with said winding drum frictionally engageable therewith.

10. Delivery mechanism according to any previous claim, wherein a follower mounted in connection with said transfer mechanism is alternately supportable by the cam surface of said retraction mechanism and by the curve surface on a curved finger of said delivery mechanism.

11. Delivery mechanism according to any previous claim, wherein displacement of said winding drum by the action of said reciprocating carrier drives movement of said threading mechanism towards or away from said roll mandrel via a linkage.

12. Delivery mechanism according to any previous claim, wherein displacement of said winding drum by the action of said reciprocating carrier drives movement of more than one threading mechanism towards or away from said roll mandrel via respective linkages.

13. Delivery mechanism according to any previous claim, wherein said delivery mechanism may be manually actuated.

14. Delivery mechanism according to any previous claim, wherein said roll mandrel and said threading mechanism are configured for winding a coreless roll of said sheet material.

15. Delivery mechanism according to any previous claim, said delivery mechanism being capable of bringing said roll mandrel into a position clear of said rewinder, such that a user may manually grasp a wound roll and remove it from said roll mandrel.

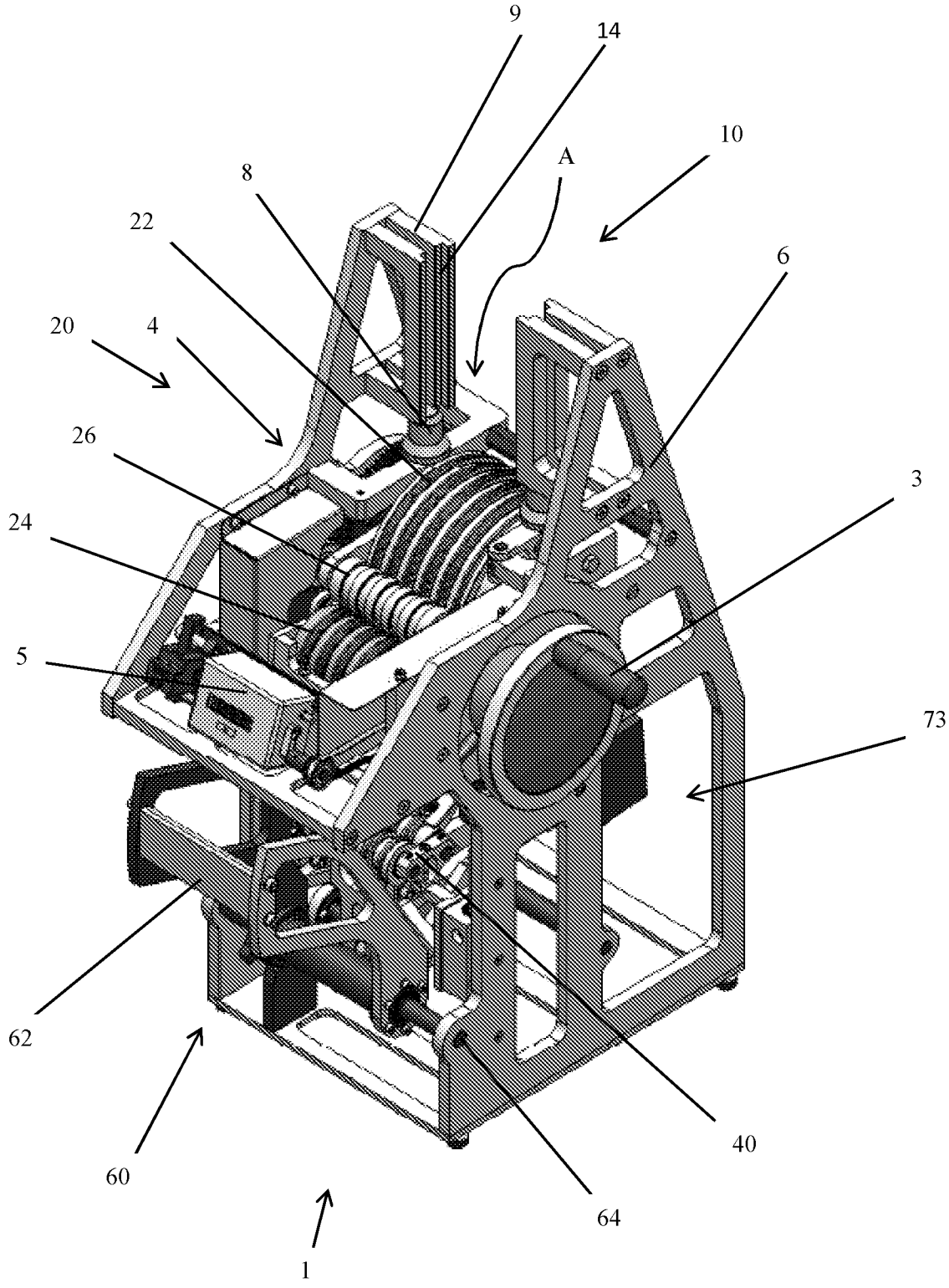


Fig. 1

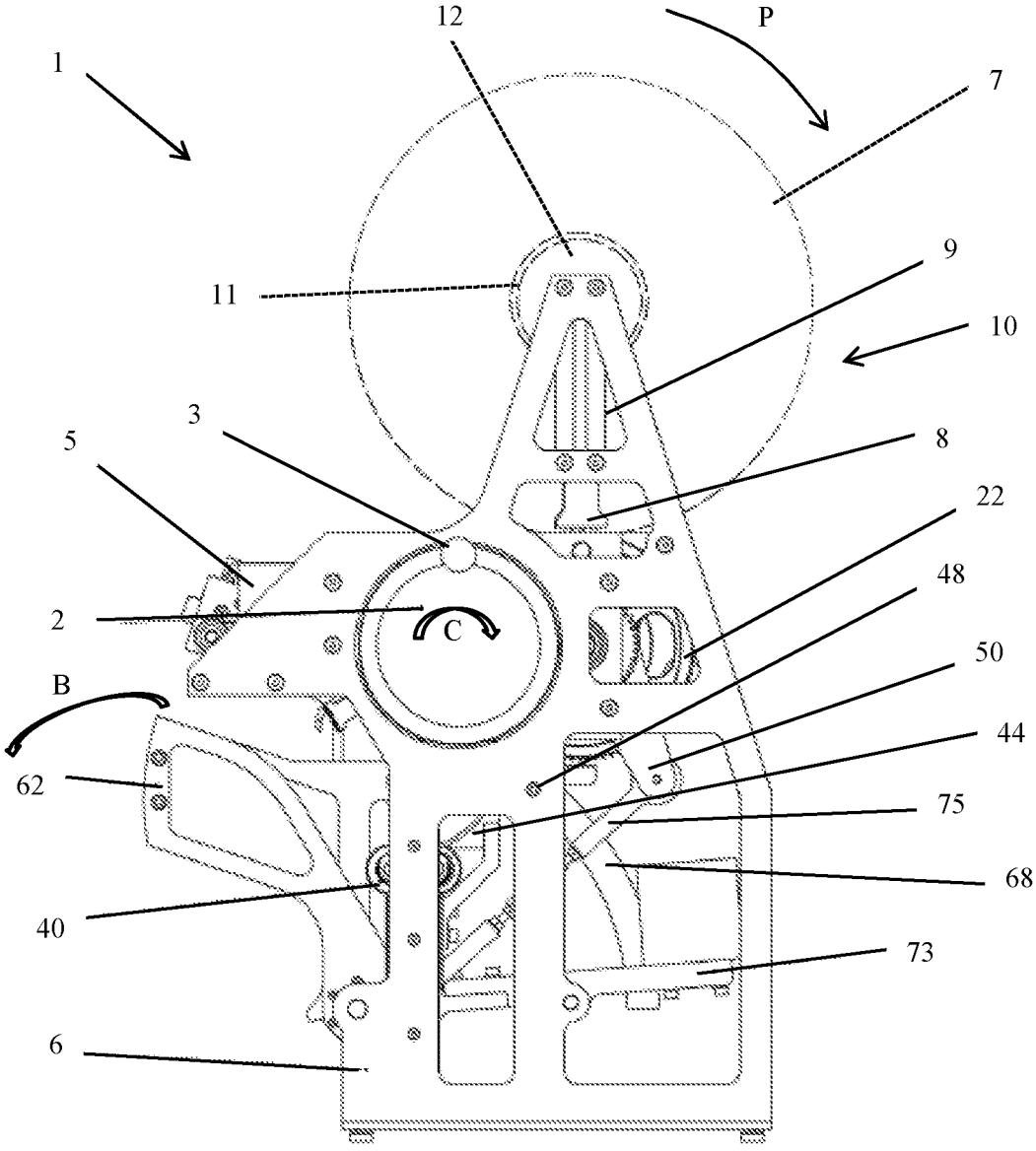
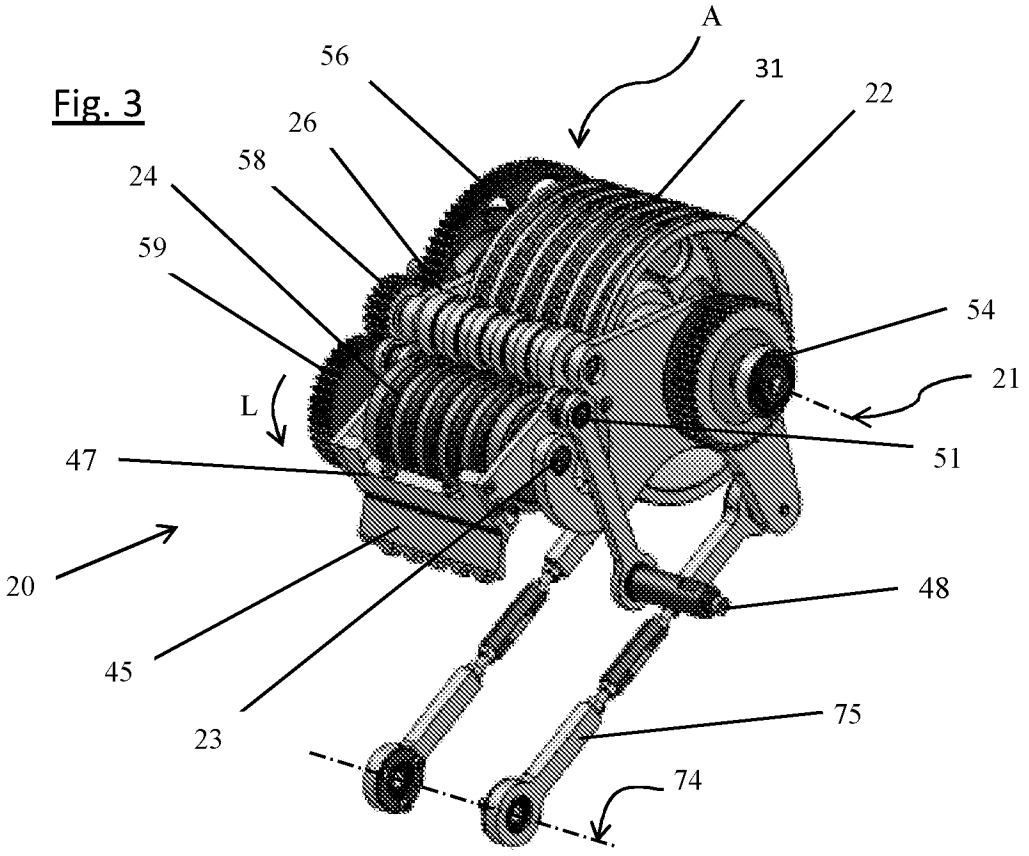


Fig. 2

Fig. 3


A
56
31
22
26
58
24
59
54
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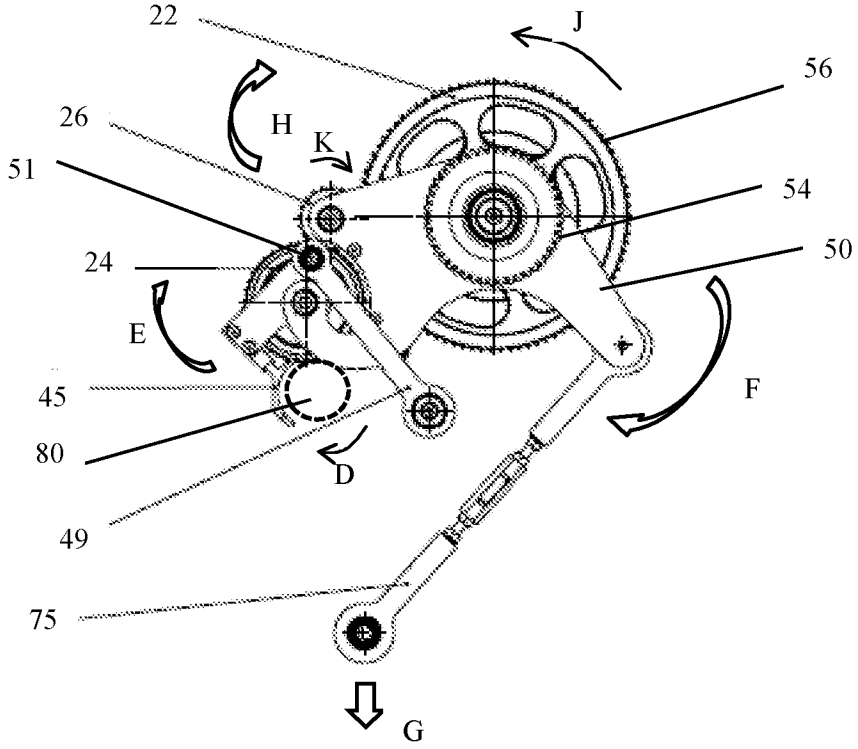

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Fig. 4

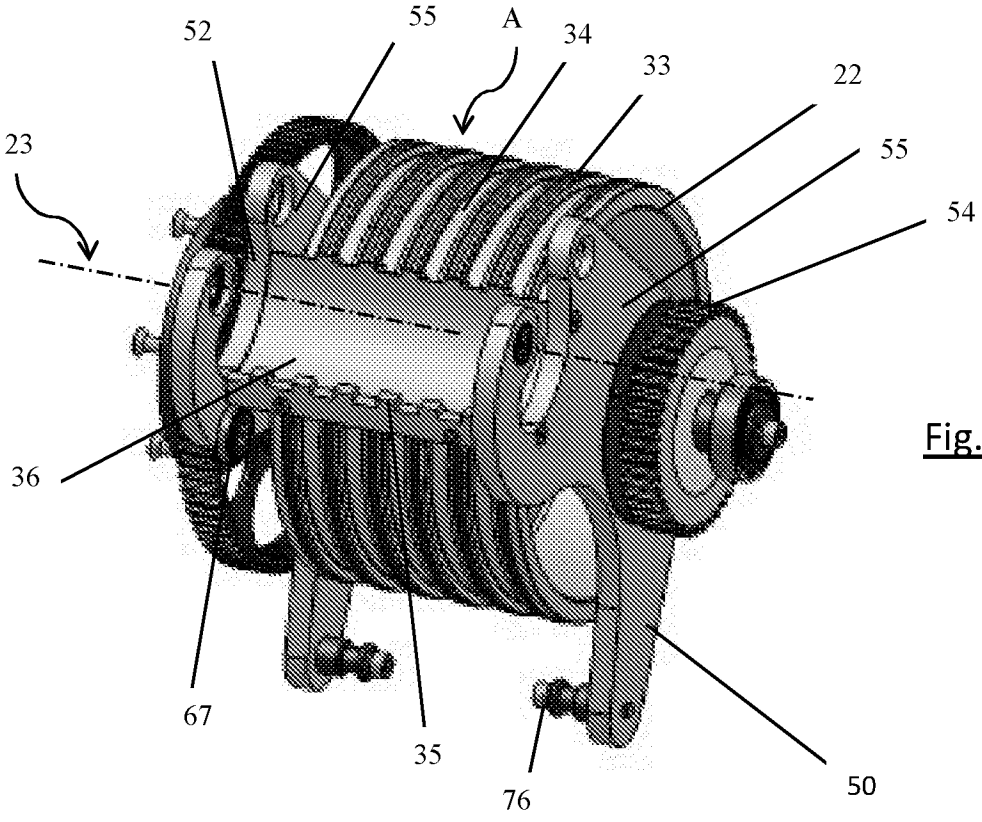


Fig. 5

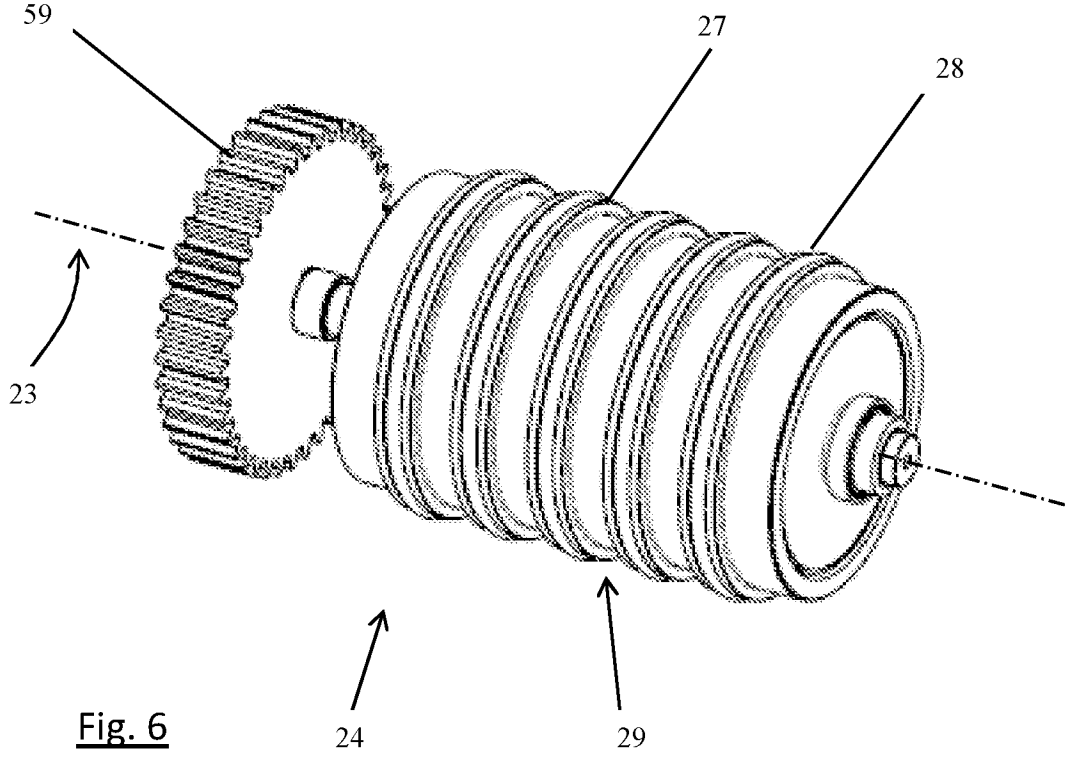
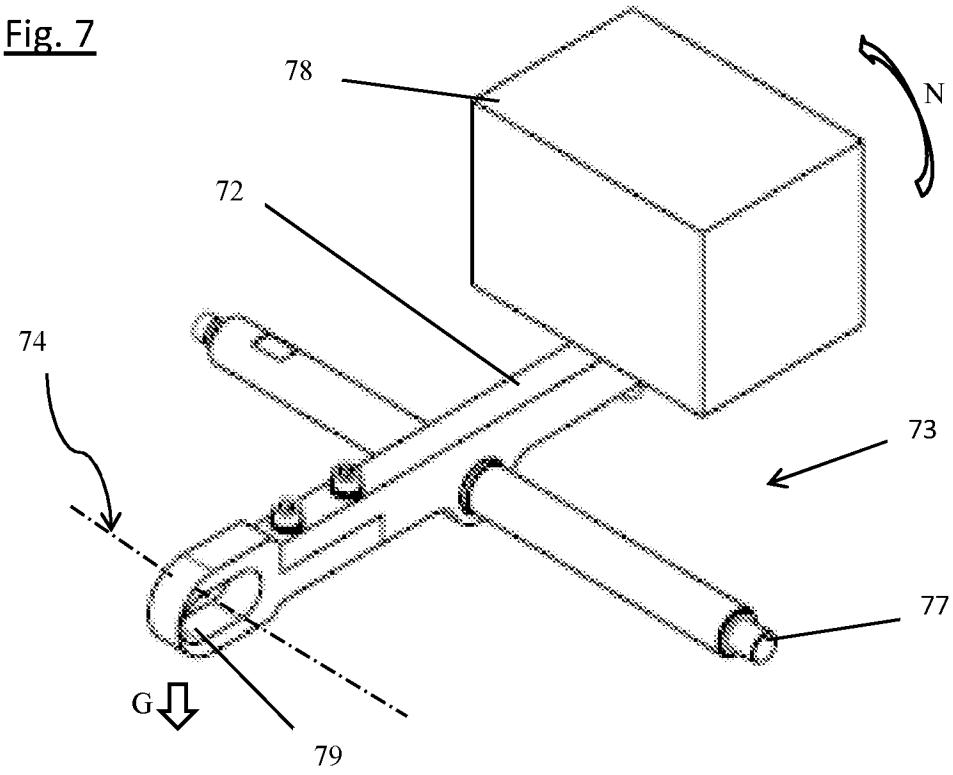


Fig. 6

Fig. 7



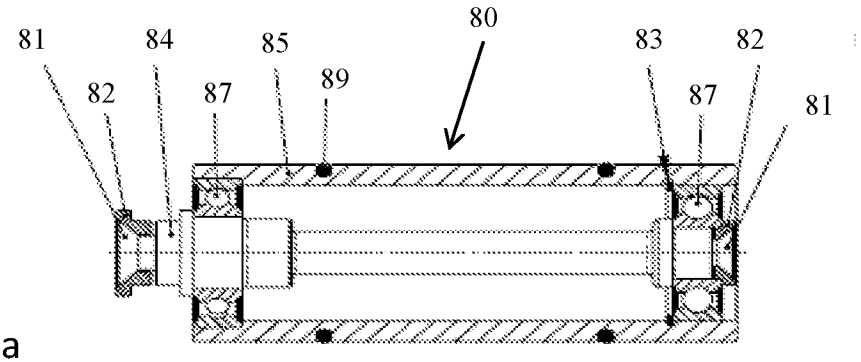


Fig. 8a

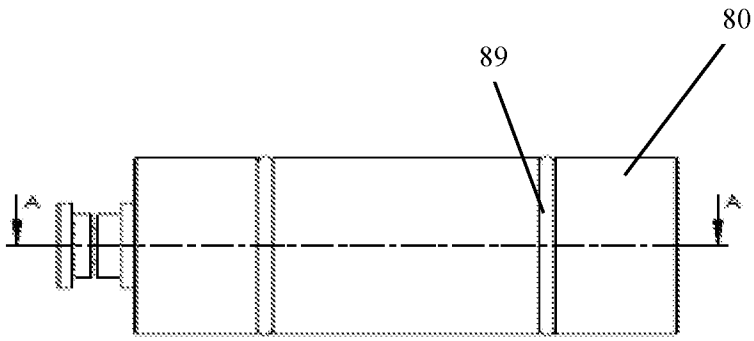


Fig. 8b

Fig. 9

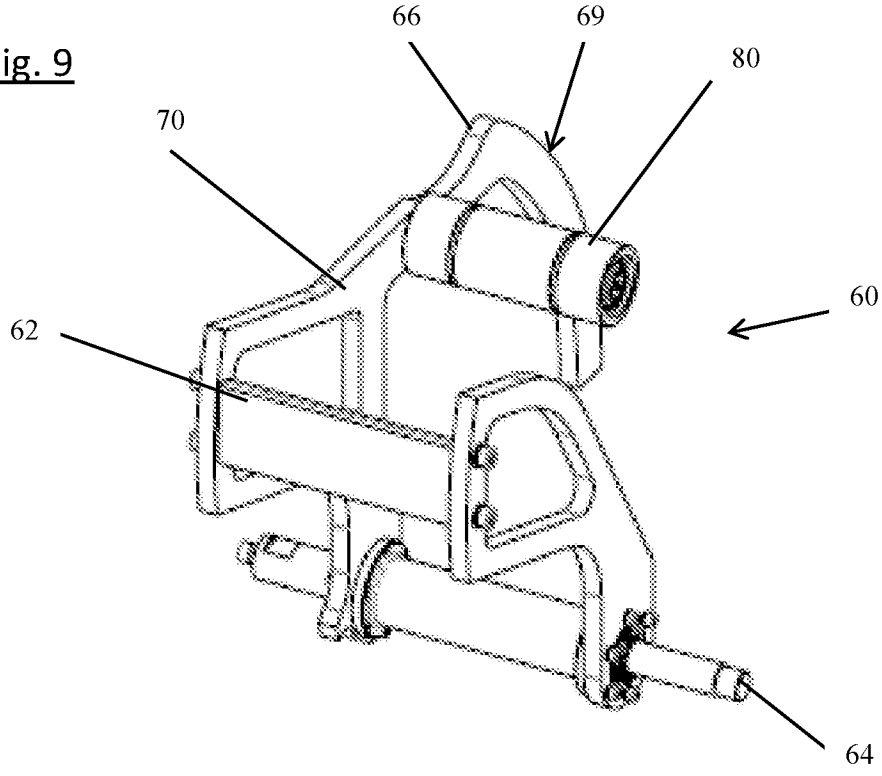


Fig. 10

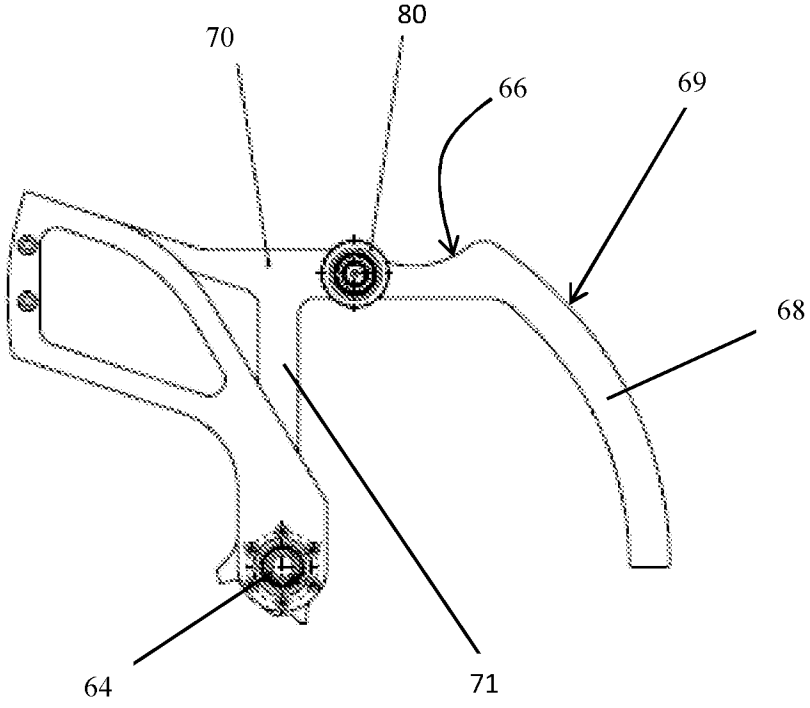
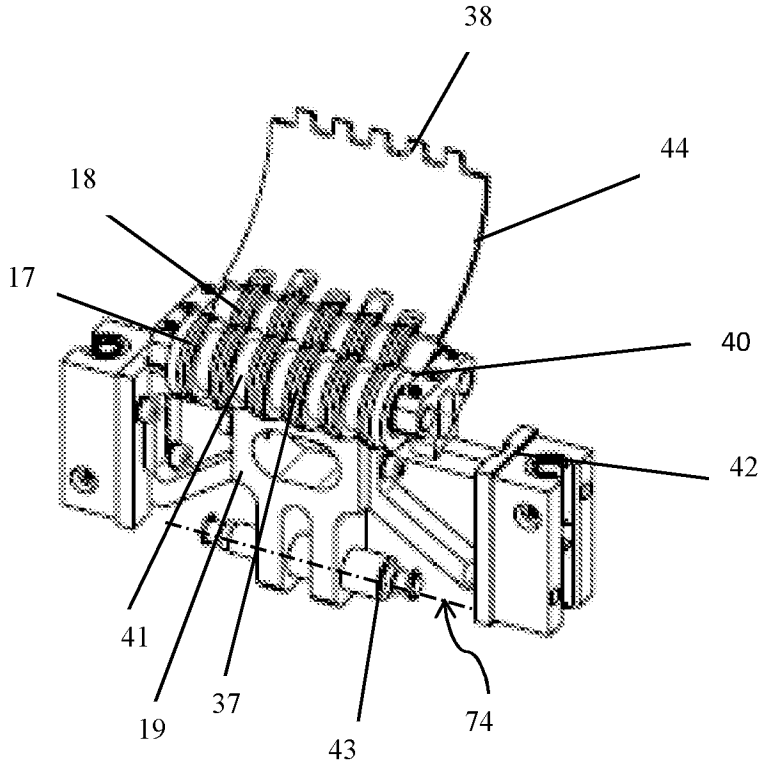


Fig. 11



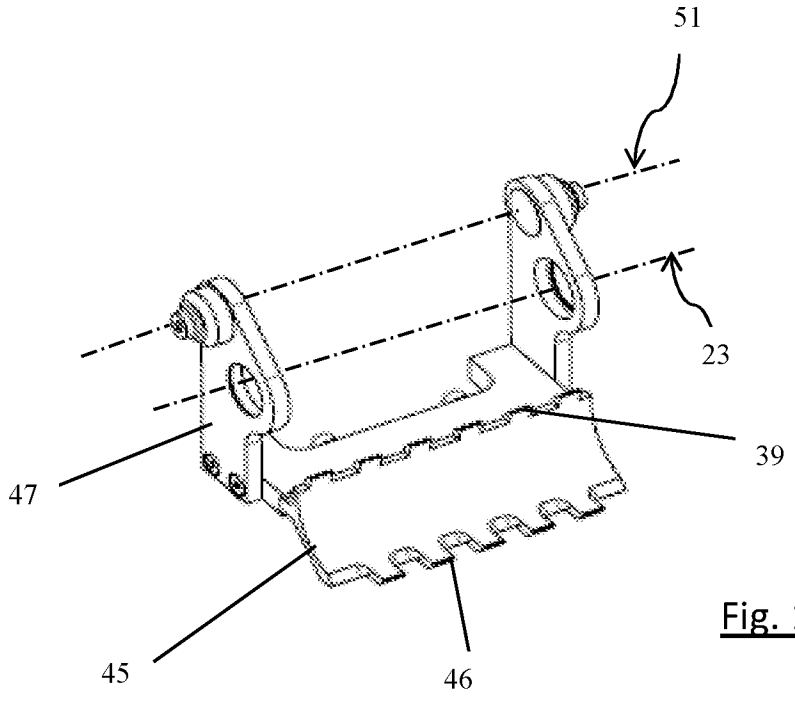


Fig. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2012/051235

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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)

IPC: B65H

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4055313 A (YAMAGUCHI TOSHIAKI ET AL), 25 October 1977 (1977-10-25); abstract; column 1, line 37 - line 68 --	1-15
A	EP 0838071 B1 (FLEURY ANNETTE), 29 April 1998 (1998-04-29); figure 2; claim 6 --	1-15
A	US 4280669 A (LEANNA DALE D ET AL), 28 July 1981 (1981-07-28); column 20, line 65 - column 21, line 14; figures 1-6 --	1-15
A	EP 0694891 A1 (PETROPENEDES SL), 31 January 1996 (1996-01-31); whole document --	1-15

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"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	Date of mailing of the international search report
09-08-2013	12-08-2013

Name and mailing address of the ISA/SE	Authorized officer
Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Katarina Ekman Telephone No. + 46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2012/051235

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 0212103 A1 (HENRIKSEN ASBJOERN), 14 February 2002 (2002-02-14); abstract; figures 2,3 -- --------	1-15

International application No.
PCT/SE2012/051235

Continuation of: second sheet

International Patent Classification (IPC)

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B65H 18/10 (2006.01)
B65H 35/00 (2006.01)

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				CA	2227028	A1 30/01/1997
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