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(54) **DEVICE AND METHOD FOR AUTOMATICALLY REMOVING BINDING MATERIAL AROUND A BALE**

(57) Deze uitvinding betreft enerzijds een inrichting (1) voor het automatisch verwijderen van binddraden (2) uit een baal (3), omvattende: een opneemstation voorzien voor het opnemen van een baal (3); een snijinrichting (4) om automatisch de binddraden (2) door te snijden en een binddraadverwijderaar om de doorsgesneden binddraden (2) uit de baal te verwijderen, waarbij de binddraadverwijderaar een beweegbare wagen (5) omvat met twee op een afstand van elkaar geplaatste wikkeldoornen (6, 7), en waarbij de wagen (5) heen en weer beweegbaar is tussen een wachtpositie en een startpositie, waarbij in de startpositie, de eerste wikkeldoorn (6) zich uitstrekt in de baal onder de binddraden en de tweede wikkeldoorn (7) zich uitstrekt boven de binddraden. Anderzijds betreft deze uitvinding een werkwijze voor het automatisch losmaken en verwijderen van afbindmateriaal (2) van een dergelijke baal (3). This invention relates on the one hand to a device (1) for automatically removing binding wires (2) from a bale (3), comprising: a receiving station provided to receive a bale (3); a cutting device (4) in order to automatically cut through the binding wires (2), and a binding wire remover in order to remove the severed binding wires (2) from the bale, wherein the binding wire remover comprises a movable trolley (5) having two mutually spaced winding mandrels (6, 7), and wherein the trolley (5) is movable to and fro between a standby position and a start position, wherein, in the start position, the first winding mandrel (6) extends in the bale below the binding wires and the second winding mandrel (7) extends above the binding wires. On the other hand, this invention relates to a method for automatically releasing and removing binding material (2) from such a bale (3).

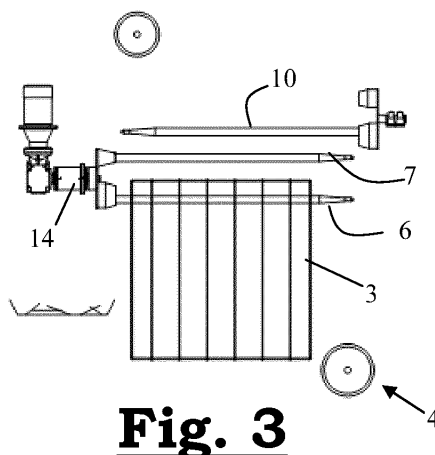
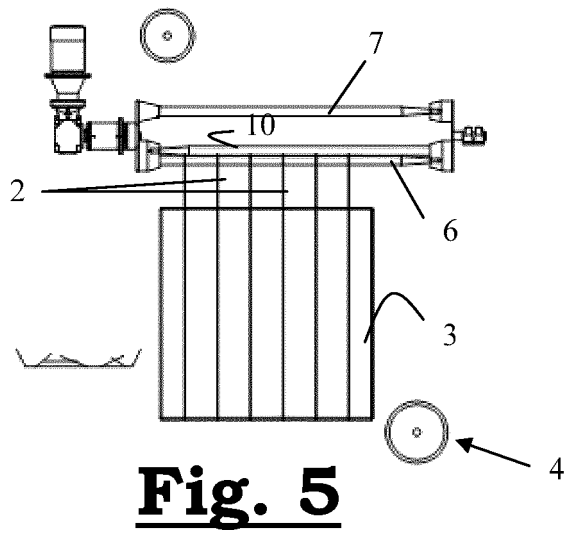
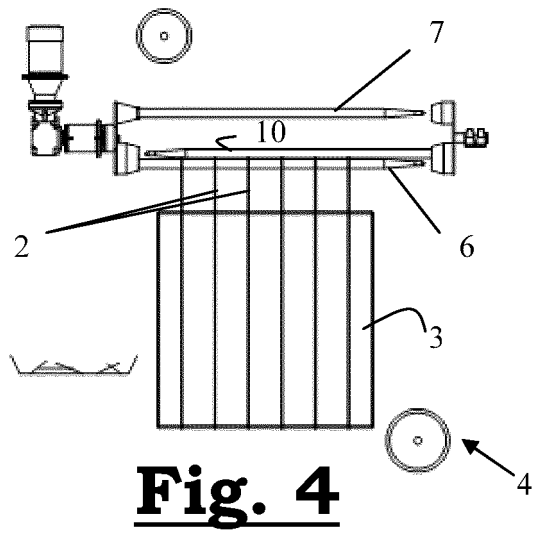


Fig. 3



Description

[0001] This invention relates on the one hand to a device for automatically releasing and removing binding material, such as binding wires of a bale entwined with binding material. On the other hand, this invention relates to a method for automatically releasing and removing binding material from such a bale.

[0002] In order to simplify the storage and transport of certain (bulk) goods, such as, for example, wool, flax, straw, cotton, paper, etc., it is commonly known to compress such goods into bales. In order to hold the formed bales together, these are tied up (entwined) by means of binding material, such as, for example, binding wires or straps.

[0003] At the moment at which the goods packed into bales are further processed, it is first necessary to remove the binding wires. In the past, this was often realized manually by cutting through the binding wires with the aid of a cutting tool, for example a knife. This way of working is time-consuming, however. Moreover, there is a high risk of injuries, since the taut binding wires, after having been severed, break loose with a certain force.

[0004] In order to solve the abovementioned problems, the process of stripping bales of their binding wires was automated. At present, a number of devices for automatically cutting through the binding wires with which bales are entwined are already known. Thus American patent publication US 5,199,841 describes a device for removing binding wires around a bale with the aid of a rotatable cutting disc provided on a movable trolley. According to this publication, the binding wires are severed at the level of the top side of the bale. During the cutting, the bale and cutting disc are moved relative to each other under the influence of a compressive force, whereby the cutting disc and the bale are moved closer together. In this way, the binding wires can be severed relatively easily without the need to apply too much pressure to the bale. When the bales are stripped of their binding wires in this way, the risk of injuries to bystanders by flying wires remains. Moreover, in this publication there is no solution described for the removal of the severed binding wires.

[0005] Systems which combine this process of cutting through the binding wires and removing these are also known. Thus it is known to supply a bale entwined with binding wires via, for example, conveyor rails, to cut through the wires on the bottom side with the aid of a cutting device in order then to pull the severed wires out of the bale on the opposite side with the aid of a movable hook-shaped element, which will move over the length of the bale and is provided to grip the various severed wires and subsequently pull these out of the bale. Since the wires are severed on the bottom side, the own weight of the bale ensures that the wires can no longer fly off. This system has the drawback, however, that it is less reliable, given that it often happens that not all severed binding wires are grasped, with the result that a binding wire is often left in the bale.

[0006] Another solution is described in German patent publication DE 35 45 659. According to this publication, a movable trolley having two mutually spaced winding mandrels (needles) provided on a rotatable holder is utilized. The trolley is movable to and fro between a standby position and a start position, wherein, in the start position, the first winding mandrel extends in the bale below the binding wires and the second winding mandrel extends above the binding wires. By rotation of the winding mandrels, wires which have been cut loose are pulled out of the bale and wound around the winding mandrels. This solution is inadequate, however, as the cut-loose wires can slip during the wind-on operation.

[0007] Given that for certain applications (for example recycling) it is important that there are no longer any binding wires present in the bale, the object of this invention is to provide a device which allows the binding wires of a bale to be automatically severed and subsequently allows virtually all severed wires to be automatically removed from the bale, and this without slippage of the severed wires during the removal thereof.

[0008] The object of this invention is achieved by providing a device for automatically releasing and removing binding wires of a bale entwined with binding wires, comprising: a receiving station provided to receive a bale entwined with binding wires; a cutting device provided to automatically cut through the binding wires of the bale placed in the receiving station; a binding wire remover, which is provided to remove the severed binding wires from the bale, wherein the binding wire remover comprises a movable trolley, provided with a first rotatable holder, which is rotatable about its axis and has two mutually spaced winding mandrels, wherein the trolley is movable to and fro between a standby position and a start position, wherein, in the start position, the first winding mandrel extends in the bale below the binding wires and the second winding mandrel extends above the binding wires, and wherein the receiving station comprises a clamping mandrel, which is provided on a second rotatable holder rotatable about its axis, and which is provided to avoid slippage of the binding wires and is arranged such that, as the binding wires are wound on, they are clamped between the first winding mandrel and the clamping mandrel.

[0009] Since the first winding mandrel extends below all (severed) binding wires, such a device allows all (severed) binding wires to be pulled out of and removed from the bale. In the device according to the invention, the winding mandrels extend preferably horizontally.

[0010] Within the framework of this invention, by the term 'mandrel' should be understood an elongated shaft which at its one (free) end is provided with a pointed projection and is preferably made of metal. The winding mandrels have a length which is at least the length of a bale placed in the receiving station. Standardly, the length of the winding mandrels will be between 200 and 500 mm longer than the bale.

[0011] Through the presence of the clamping mandrel,

slippage of the binding wires will be avoided. The clamping mandrel has in principle the same shape and length as the winding mandrels, the difference being that the clamping mandrel is disposed on the side situated opposite that where the aforementioned trolley is disposed. The clamping mandrel is in particular provided on the second rotatable holder.

[0012] The arrangement of the clamping mandrel with respect to the first winding mandrel is chosen such that a certain clamping force is applied to the binding wire. Preferably, the spacing between the first winding mandrel and the clamping mandrel is adjustable. In principle, the winding and clamping mandrel can bear one against the other or maintain a minimal distance apart as a function of the thickness of the binding wires. However, if the binding wire with which a bale is entwined comprises two knots, it can happen that this spacing is chosen somewhat wider (for example maximally 5 mm) without any need to clamp, though it is still necessary for the spacing to remain smaller than the thickness of the knots which join the ends of the binding wire together.

[0013] In the standby position, both winding mandrels are located outside the zone bounded by the receiving station. In the start position, the first winding mandrel is disposed below the second winding mandrel and the first winding mandrel extends below the binding wires, whilst the second winding mandrel extends above the binding wires. The vertical spacing between the two winding mandrels is preferably between 100 and 300 mm.

[0014] In a preferential embodiment of the device according to the invention, the binding wire remover is movable up and down between the start position and a wind-on position, wherein the binding wire remover is provided to, during the displacement from the start position into the wind-on position, pull the binding wires received by the first winding mandrel partly out of the bale.

[0015] In a more preferential embodiment of the device according to the invention, the two mutually spaced winding mandrels are provided on the first rotatable holder, which is rotatable about its axis in order to pull the binding wires received by the first winding mandrel further out of the bale and wind them around the said winding mandrels. The further pulling out of the bale and the winding of the binding wires around the winding mandrels will preferably take place in the wind-on position. The winding mandrels are fixedly (rigidly) mounted by their one end, via for example a weld joint or clamping joint, on this first holder, which in turn sits mounted on the movable trolley.

[0016] During the wind-on operation, high winding stresses are sometimes generated and exerted on the two winding mandrels. As a result, the (free) ends of the winding mandrels are drawn together as it were, and there is a danger that they begin to bend or even break off. In order to avoid this, the receiving station of the device according to the invention comprises, in one particular embodiment, a first and second receiving disc provided to receive the (free) end of respectively the first and second winding mandrel. These receiving discs are

preferably of conical construction in order to centre the end of the mandrels. By placing the ends of the first and second winding mandrels in a receiving disc prior to commencement of the wind-on operation, the winding mandrels are held in position during the wind-on operation and a situation in which the winding mandrels begin to bend as a result of the generated stresses is avoided.

[0017] More particularly, the said receiving discs are provided on the second rotatable holder, which is rotatable about its axis. During use, the second rotatable holder will co-rotate with the first holder. In this case, either the second rotatable holder is arranged such that it is freely rotatable, or the second holder, in an alternative embodiment, is driven. A driven second holder has the advantage that a controlled positioning of the second holder is possible, and also that, in the event of high wind-on torques, the mechanical load on the mandrels is reduced.

[0018] In a preferential embodiment of the device according to the invention, the clamping mandrel is an expansion shaft. Expansion shafts are known per se and are provided to expand and, in this way, to apply clamping force to the binding wires as these are wound on.

[0019] In an advantageous embodiment of the device according to the invention, the device further comprises a stripper provided to remove the binding wires from the first and second winding mandrel. The removal of the binding wires takes place once all severed binding wires have been pulled out of the bale and have been wound around the winding mandrels. At that moment, the first rotatable holder (with winding mandrels) will rotate into a position such that the two winding mandrels are disposed horizontally next to each other. After this, the trolley will move back from the wind-on position into its standby position. During this return movement, the stripper is placed between the two horizontally arranged winding mandrels. As a result, the wound-on binding wires come into contact with the stripper, whereby they are removed from the winding mandrels. The stripper can additionally be equipped with a cutting element in order to make the binding wires smaller. The stripped binding wires can be collected in a receptacle in order to be later carried off.

[0020] The device according to this invention can further be provided with conveying means, for example a conveyor belt or conveyor rail, which are provided to convey the bales entwined with binding wires to the receiving station.

[0021] Another subject of this invention relates to a method for automatically releasing and removing binding wires of a bale entwined with binding wires, comprising the following steps:

- the supply of a bale entwined with binding wires;
- the severance of the binding wires, along one side;
- the movement of a trolley, comprising two mutually spaced winding mandrels, from a standby position into a start position, in which the first winding mandrel extends in the bale below the severed binding wires

- on the opposite side and in which the second winding mandrel extends above the severed binding wires;
- the upward movement of the said trolley into a clamping position, in which the first winding mandrel sits positioned against a clamping mandrel in order to avoid a situation in which the severed binding wires would slip during the wind-on operation;
 - the further upward movement of the said trolley into a wind-on position in order to pull the binding wires received by the first winding mandrel partly out of the bale;
 - the rotation of the said winding mandrels so that the binding wires are pulled further out of the bale and are wound around the first and second winding mandrel;
 - the return movement of the trolley into its standby position, wherein the binding wires are removed from the first and second winding mandrel.

[0022] The method according to this invention is in particular suitable for application to a device according to the invention as described above.

[0023] In order to further illustrate the characteristics of this invention and to indicate additional advantages and particularities thereof, there now follows a more detailed description of the device and method according to this invention. It should be clear that nothing in the hereinafter following description can be interpreted as a limitation of that protection for this invention which is claimed in the claims.

[0024] In this description, reference is made by means of reference numerals to the hereto appended drawings, wherein:

- **Figure 1:** is a side view of a schematic representation of the device according to the invention;
- **Figures 2 to 8:** show the various steps for automatically releasing and removing binding wires from a bale entwined with binding wire, with the aid of a device according to the invention.

[0025] The appended figures are a schematic representation of a possible embodiment of the device (1) according to the invention. The figures illustrate the method of automatically cutting through the binding wires of a bale.

[0026] The device (1) according to the invention is preferably used for processing bales composed of biological material, such as, for example, straw, dried cutting waste, soil improvers, ... and which are tied up with a binding material (2) such as, for example, wire, strapping, cord, wires made of natural or synthetic fibres, metal wire, ... Standardly, the bales have a bar shape, though bales having a different external shaping, such as, for example, round, can also of course be processed with this device. In principle, the binding wire(s) is/are fitted after the pressing of the bale. During the binding, the ends of the binding wire are joined together, whereby, depending on

the type of binding, one or two knots is formed.

[0027] If the bales (3) are going to be processed for further applications, for example recycling, the bales must be stripped of their binding wires (2). In this case, it is important that all binding wires are removed, so that no foreign materials are left behind in the 'bale material'. With the device (1) according to the invention, it is possible to pull all binding wires (2), once severed, out of the bale (3) and automatically remove them.

[0028] To this end, the device (1) according to this invention comprises:

- a receiving station provided to receive a bale (3) entwined with one or more binding wires;
- a cutting device (4) provided to automatically cut through all binding wires of the bale (3) placed in the receiving station;
- a binding wire remover, which is provided to pull the severed binding wires (2) out of the bale (3), to wind them up and to remove them.

[0029] In order now to remove all (severed) binding wires from the bale, the binding wire remover comprises a movable trolley (5) having two mutually spaced winding mandrels (6, 7). The trolley (5) is movable to and fro between a standby position and a start position, wherein, in the start position, the first winding mandrel (6) extends in the bale (3) below the severed binding wires (2) and the second winding mandrel (7) extends above the severed binding wires (2). The said winding mandrels (6, 7) are provided on a first rotatable holder (14), which is rotatable about its axis and sits mounted on the movable trolley. As will be illustrated further, the trolley (5) is further movable up and down. For the execution of the toing and froing movement, the up and down movement and the rotating movement of the first holder (14), the device (1) is provided with various motors, one for each movement.

[0030] The bales (3) provided with binding wire can be supplied to the receiving station via a conveying means, such as, for example, a conveyor belt or conveyor rail. Once the bale (3) is in the receiving station (as represented in Fig. 2), on one side (in principle the bottom side) the mutually adjacent binding wires are severed. This will normally be realized automatically with the aid of a cutting device (4), which is movable to and fro at least over the full length of the bale. Since the bale (3) rests on an underlying supporting surface (in principle this is the top surface of the conveying means), the own weight of the bale (3) ensures that the severed binding wires (2) remain in position.

[0031] The cutting device (4) is provided with a cutting blade having two cutting surfaces. In this way, the binding wires of the first supplied bale, for example, will be severed by the movement of the cutting device from left to right and the binding wires of a following supplied bale can be severed by the movement of the cutting device from right to left.

[0032] During the severance of the binding wires, the

trolley (5), just like the winding mandrels (6, 7), are arranged next to the bale (3). The stripper (11) too is in a rest position, outside the path in which the trolley (5) is movable to and fro.

[0033] After the wires have been severed, the trolley (5), as shown in Figure 3, will move towards the bale (3). At that moment, the winding mandrels (6, 7) lie vertically one above the other. The arrangement of the trolley (5) with respect to the bale (3) in the receiving station is such that, after the trolley shifts into its start position, the lowermost winding mandrel (6) (hereinafter referred to as the first winding mandrel) extends below all severed binding wires (2), and the uppermost winding mandrel (7) (hereinafter referred to as the second winding mandrel) extends above the severed binding wires. The first (6) and second (7) winding mandrel have minimally the length of the bale (3) present in the receiving station. In this way, the first winding mandrel (6) certainly extends below all severed binding wires (2).

[0034] Once all severed binding wires (2) have been received by the first winding mandrel (6), the trolley moves upwards until a clamping position (see Figure 4) is reached. During this upward movement, the severed binding wires will be pulled partly out of the bale (3). In the appended figures, the clamping will be realized by moving the first winding mandrel (6) against a clamping mandrel (10). Other forms of clamping are likewise possible. The clamping will take place in order to avoid a situation in which the binding wires (2) would slip during the wind-on operation. In order to obtain still better clamping, the clamping mandrel (10) can be constructed as an expansion shaft.

[0035] In order to generate additional clamping, the surface roughness of the second winding mandrel (7) can be increased so that this is higher than the surface roughness of the first winding mandrel (6). By increasing the roughness, the frictional force increases to the extent that slippage is precluded. In order to increase the surface roughness of the second winding mandrel (7), the second winding mandrel (7) is provided with micrograins. This can be realized by, for example, providing the second winding mandrel (7) with a rougher lining layer, such as, for example, abrasive paper, or spraying it with metal particles.

[0036] Subsequently, the trolley moves onward (sideways) until the wind-on position is reached (see Fig. 5). The wind-on operation itself (represented in Figures 6 and 7) is realized by rotation of the first rotatable holder (14), and thus also of the winding mandrels (6 and 7) mounted thereon. During the wind-on operation of the binding wires (2), high winding stresses will be generated and exerted on the two winding mandrels, whereby the winding mandrels (6, 7) are drawn closer together and can begin to bend or even break off. In order to avoid this, the receiving station of the device (1) according to the invention comprises a first (8) and second (9) receiving disc provided to receive the end of respectively the first (6) and second (7) winding mandrel. These receiving

discs (8, 9) are preferably of conical construction. The receiving discs (8, 9) sit mounted on a second rotatable holder (15), which either is freely rotatable, so that it can co-rotate with the first holder (14), or is driven by a motor in order, in this way, to obtain better wind-on results. By placing the ends of the first and second winding mandrels in a receiving disc prior to commencement of the wind-on operation, the winding mandrels, during the wind-on operation, are held in position and a situation in which the winding mandrels (6, 7) begin to bend as a result of the generated stresses is avoided. To make it absolutely clear, the clamping mandrel (10) too is fastened on the second rotatable holder (15).

[0037] Once all binding wires (2) have been pulled out of the bale (3) and are wound around the winding mandrels (6, 7), the trolley (5) will move back. At the moment when the trolley (5) will move back, where appropriate the clamping with the clamping mandrel (10) is released and the winding mandrels (6, 7) are arranged next to each other in a horizontal plane. At the same time, the stripper (11) will shift from its rest position into a stripping position, wherein it is disposed in the path in which the trolley (5) is movable to and fro. During the return movement of the trolley (5), wound-on binding wires (2) will pass along the stripper and be stripped off the winding mandrels (6, 7). The stripper (11) can possibly be provided with a cutting element (12) in order to make the binding wires (2) smaller. The stripped-off (and possibly diminished) binding wires fall subsequently into a receptacle (13). After the wires have been removed, the trolley moves back downwards into the standby position.

Claims

1. Device (1) for automatically releasing and removing binding wires (2) of a bale (3) entwined with binding wires, comprising:
 - a receiving station provided to receive a bale (3) entwined with binding wires;
 - a cutting device (4) provided to automatically cut through the binding wires of the bale (3) placed in the receiving station;
 - a binding wire remover, which is provided to remove the severed binding wires (2) from the bale (3), wherein the binding wire remover comprises a movable trolley (5), provided with a first rotatable holder (14) which is rotatable about its axis and has two mutually spaced winding mandrels (6, 7), wherein the trolley (5) is movable to and fro between a standby position and a start position, wherein, in the start position, the first winding mandrel (6) extends in the bale (3) below the binding wires (2) and the second winding mandrel (7) extends above the binding wires (2),

characterized in that the receiving station compris-

es a clamping mandrel (10), which is provided on a second rotatable holder (15) rotatable about its axis, and which is provided to avoid slippage of the binding wires (2) and is arranged such that, as binding wires (2) are wound on, they are clamped between the first winding mandrel (6) and the clamping mandrel (10).

2. Device (1) according to Claim 1, **characterized in that** the binding wire remover is movable up and down between the start position and a wind-on position, wherein the binding wire remover is provided to, during the displacement from the start position into the wind-on position, pull the binding wires (2) received by the first winding mandrel (6) partly out of the bale (3). 5
3. Device (1) according to Claim 1 or 2, **characterized in that** the two mutually spaced winding mandrels (6, 7) are provided on the first rotatable holder (14), which is rotatable about its axis in order to pull the binding wires (2) received by the first winding mandrel (6) further out of the bale (3) and wind them around the said winding mandrels (6, 7). 10
4. Device (1) according to one of the preceding claims, **characterized in that** the receiving station comprises a first (8) and second (9) receiving disc provided to receive the end of respectively the first (6) and second (7) winding mandrel. 15
5. Device (1) according to Claim 4, **characterized in that** the said receiving discs (8, 9) are provided on the second rotatable holder (15), which is rotatable about its axis. 20
6. Device (1) according to one of the preceding claims, **characterized in that** the second rotatable holder (15) is freely rotatable or drivable. 25
7. Device (1) according to one of the preceding claims, **characterized in that** the spacing between the first winding mandrel (6) and the clamping mandrel (10) is adjustable. 30
8. Device (1) according to one of the preceding claims, **characterized in that** the clamping mandrel (10) is an expansion shaft. 35
9. Device (1) according to one of the preceding claims, **characterized in that** the device (1) further comprises a stripper (11) provided to remove the binding wires (2) from the first (6) and second (7) winding mandrel. 40
10. Device (1) according to Claim 9, **characterized in that** the stripper (11) comprises a cutting element (12) in order to make the stripped binding wires smaller. 45

11. Method for automatically releasing and removing binding wires (2) of a bale (3) entwined with binding wires, comprising the following steps:

- the supply of a bale (3) entwined with binding wires;
- the severance of the binding wires, along one side;
- the movement of a trolley (5), comprising two mutually spaced winding mandrels (6 and 7), from a standby position into a start position, in which the first winding mandrel (6) extends in the bale (3) below the severed binding wires (2) on the opposite side and in which the second winding mandrel (7) extends above the severed binding wires (2);
- the upward movement of the said trolley (5) into a clamping position, in which the first winding mandrel (6) sits positioned against a clamping mandrel (10) in order to avoid a situation in which the severed binding wires (2) would slip during the wind-on operation;
- the further upward movement of the said trolley (5) into a wind-on position in order to pull the binding wires (2) received by the first winding mandrel (6) partly out of the bale;
- the rotation of the said winding mandrels (6 and 7) so that the binding wires (2) are pulled further out of the bale (3) and are wound around the first (6) and second winding mandrel (7);
- the return movement of the trolley (5) into its standby position, wherein the binding wires are removed from the first (6) and second (7) winding mandrel. 50

12. Method according to Claim 11, **characterized in that** the method is suitable for application to a device (1) according to one of Claims 1 to 10. 55

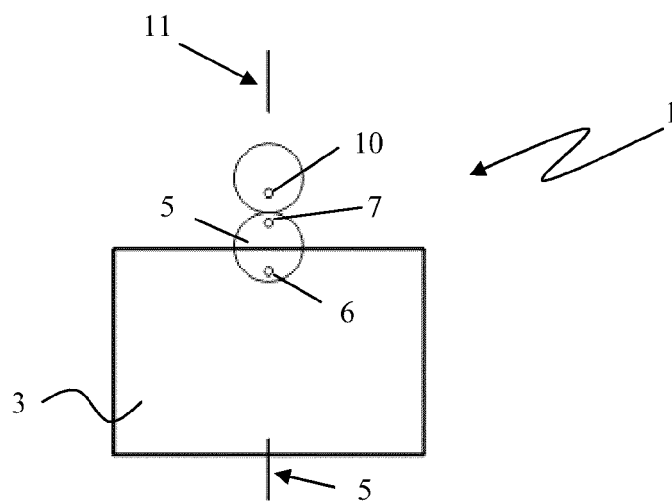


Fig. 1

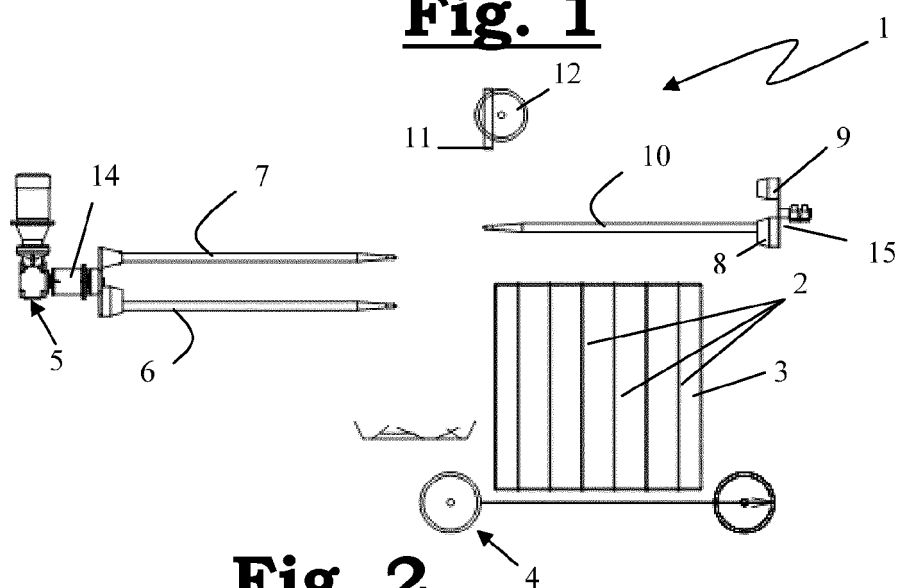


Fig. 2

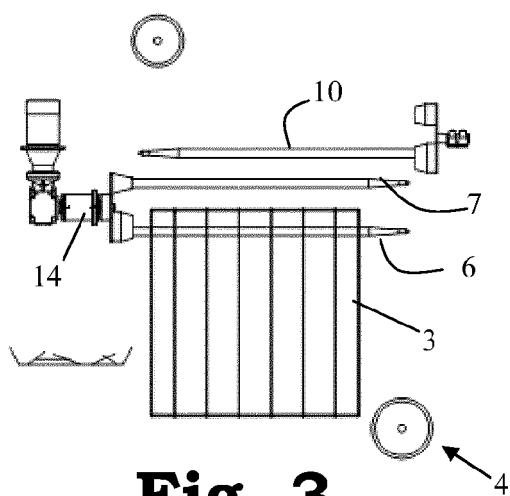
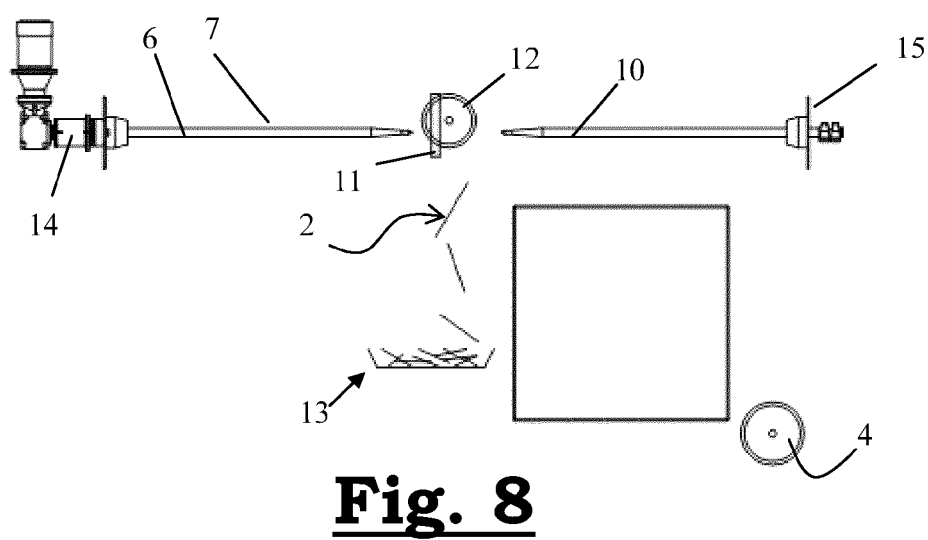
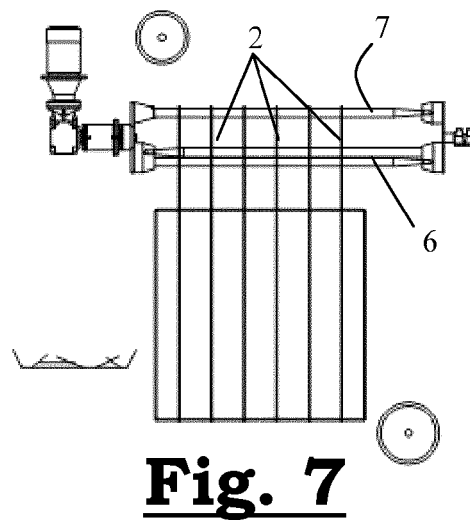
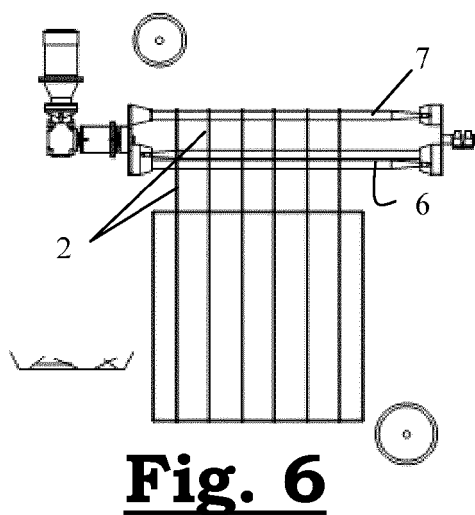
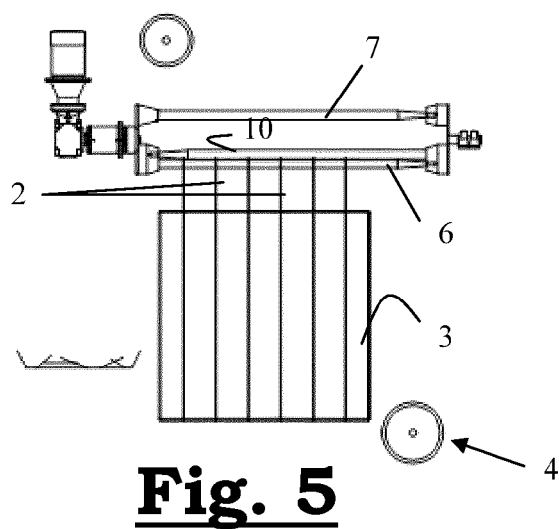
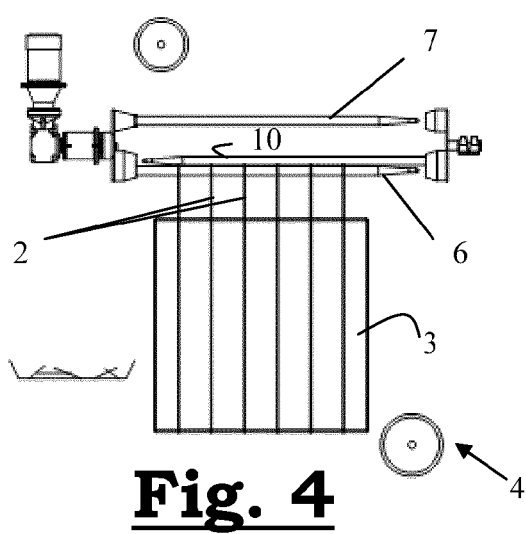


Fig. 3





EUROPEAN SEARCH REPORT

Application Number
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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
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Place of search Munich		Date of completion of the search 1 February 2016	Examiner Schelle, Josef
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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