

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
26 October 2006 (26.10.2006)

PCT

(10) International Publication Number  
**WO 2006/111168 A2**

(51) International Patent Classification:

**G02B 6/44** (2006.01) **H02G 1/06** (2006.01)  
**G02B 6/46** (2006.01) **B65H 54/00** (2006.01)

(21) International Application Number:

PCT/DK2006/000210

(22) International Filing Date: 21 April 2006 (21.04.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

|            |                            |    |
|------------|----------------------------|----|
| 60/673,383 | 21 April 2005 (21.04.2005) | US |
| 60/677,413 | 4 May 2005 (04.05.2005)    | US |
| 60/691,268 | 17 June 2005 (17.06.2005)  | US |

(71) Applicant (for all designated States except US):  
**MIDTVEST BREDBÅND A/S** [DK/DK]; Hostrupsvej 9,  
DK-7500 Holstebro (DK).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **REILEV, John**  
[DK/DK]; Stentofterne 18, DK-7600 Struer (DK).

(74) Agent: **INSPICOS A/S**; Bøge Allé 5, P.O. Box 45,  
DK-2970 Hørsholm (DK).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

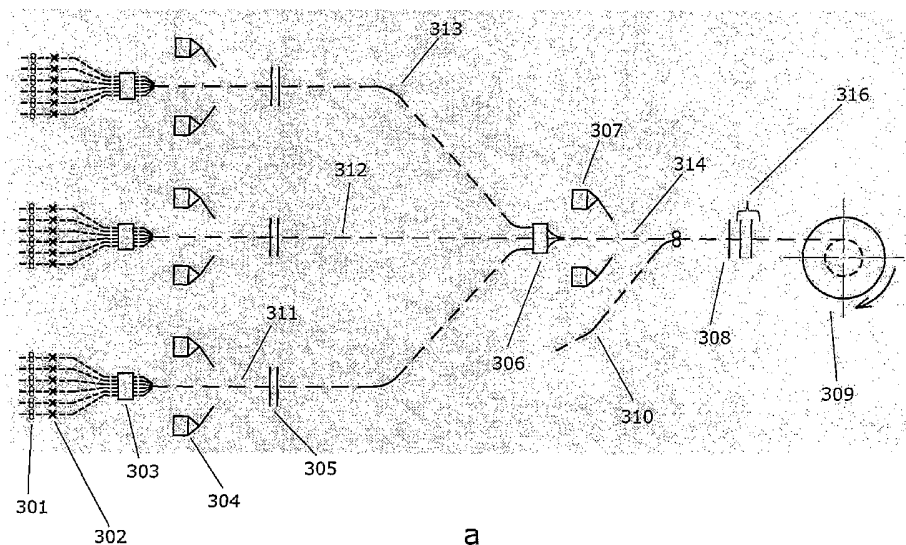
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: APPARATUS AND METHOD FOR GROUPING SUPPLY MEANS



(57) Abstract: The present invention relates to an apparatus and to a method for grouping a plurality of supply means, such as optical fibres, electrical cables, telephone wires, antenna cables, water conduits, drain pipes, sewers or any other flexible supply means, in an effective and flexible manner. The present invention further relates to a method for grouping a plurality of supply means.

## APPARATUS AND METHOD FOR GROUPING SUPPLY MEANS

## FIELD OF THE INVENTION

The present invention relates to an apparatus or machine for grouping a plurality of supply means, such as optical fibres, electrical cables, telephone wires, antenna cables, water  
5 conduits, drain pipes, sewers or any other flexible supply means. The apparatus or machine can be implemented in a stationary configuration or it can be implemented in a mobile configuration where the supply means are grouped while the apparatus or machine moves along a trench in the soil. The present invention further relates to a method for grouping a plurality of supply means prior to positioning the grouped supply means in a trench in the  
10 soil.

## BACKGROUND OF THE INVENTION

A variety of machines for burying pre-fabricated cables or pipes in the soil are widely disclosed in the patent literature. An example of such a machine or apparatus is disclosed in WO 02/33180.

15 WO 02/33180 discloses an apparatus for burying pre-fabricated cables or pipes in the soil. The apparatus suggested in WO 02/33180 includes a support structure adapted for moving across a surface of soil. A water jetting machine is provided for producing a source of pressurized water. At least two jetting arms are in fluid communication with the source of pressurized water. The jetting arms have a vertical adjustment structure for varying at least  
20 the vertical position of each jetting arm relative to the support structure so as to adjust for varying soil conditions. A method for burying pre-fabricated cables and pipes in soil is also disclosed WO 02/33180.

Thus, the apparatus of WO 02/33180 is adapted for burying pre-fabricated cables or pipes – i.e. for burying cables or pipes that have been grouped or bundled beforehand. The pre-  
25 fabricated cables or pipes are positioned on the soil where the cables or pipes are intended to be buried. The apparatus of WO 02/33180 picks up the rolled out pre-fabricated cable or pipe, digs a trench in the soil using pressurized water and positions the pre-fabricated cable or pipe in the trench.

JP 3124208 discloses a boat for positioning cables on a seabed. Three cable cores are fed out  
30 sequentially through caterpillar carriers mounted on three cable towers arranged on a laying boat. The three cable cores are bound together with cloth tape or metal tape by means of a

CONFIRMATION COPY

taping machine. The bounded cable core is sequentially fed into the sea water through a caterpillar feeding machine and a sheave and laid on seabed by means of a burying machine.

Thus, the apparatus suggested in JP 3124208 is adapted for laying a bounded cable on a seabed from a laying boat.

5 Today, cables bundles are laid into trenches in the soil by individually positioning the cables in the trenches. Thus, cable bundles are formed by building up the bundles in the trench. This is a very cumbersome and costly process in that every cable to be included in the bundle has to be rolled out on the soil and subsequently positioned in the trench where it is bounded to the other cables in order to build up the cable bundle.

10 It is an object of the present invention to provide an apparatus or machine and a method for grouping a plurality of supply means, such as optical fibres, electrical cables, telephone wires, antenna cables, water conduits, drain pipes, sewers or any other flexible supply means, in an effective and flexible manner.

15 It is a further object of the present invention to provide an apparatus or machine and a method for grouping a plurality of supply means, such as optical fibres, electrical cables, telephone wires, antenna cables, water conduits, drain pipes, sewers or any other flexible supply means, on-the-fly – i.e. grouping the supply means while the apparatus or machine moves across the soil.

20 It is a still further object of the present invention to provide an apparatus or machine and a method for laying a bundle of supply means, such as optical fibres, electrical cables, telephone wires, antenna cables, water conduits, drain pipes, sewers or any other flexible supply means, into a trench in the soil.

#### SUMMARY OF THE INVENTION

25 The above-mentioned objects are complied with by providing, in a first aspect, an apparatus or a machine for grouping supply means, the apparatus comprising a support structure arranged to be moved across a surface of soil, the apparatus further comprising

- means for holding a plurality of replaceable drums, said holding means being arranged on the support structure of the apparatus, each drum being arranged to support a rolled up supply means, and

- means for forming a first bundle of supply means by grouping together supply means from at least two drums.

The supply means may in principle be any kind of flexible supply means, such as optical fibres, electrical cables, telephone wires, antenna cables, water conduits, drain pipes or  
5 sewers or a combination thereof. Thus, a bundle of supply means may be constituted by a number of identical supply means or it may be constituted by different supply means. Thus, a bundle of supply means may be constituted an optical fibre, an electrical cable and a water conduit. Naturally, other combinations of supply means would also be allowed within the scope of the present invention.

10 The drum supporting a rolled up supply means may be a separate and independent drum. Alternatively, a drum may be divided into a plurality of sections where each section is adapted to support a rolled up supply means.

The apparatus or machine may further comprise means for forming a second, a third and a fourth bundle of supply means, the second bundle being formed by grouping together supply  
15 means from drums other than the drums used for forming the first bundle, the third bundle being formed by grouping together supply means from drums other than the drums used for forming the first and second bundles, the fourth bundle being formed by grouping together supply means from drums other than the drums used for forming the first, second and third bundles.

20 Evidently, the apparatus or machine may also comprise means for forming a fifth, a sixth and a seventh bundle of supply means. In fact the number of bundles of supply means may be even higher.

Even further, the apparatus or machine may comprise additional means for grouping together the first, second, third and fourth bundles in a final bundle of supply means. If more than  
25 four bundles of supply means exist these additional bundles of supply means will also be included in the final bundle of supply means. The grouping of the supply means may be obtained by sewing the supply means together with coloured bands or ribbons or any other suitable material. The means for grouping together the first, second, third and fourth bundles may further comprise means for measuring the velocity with which the final bundle of supply  
30 means leaves the additional means for grouping together the first, second, third and fourth bundles.

In order to control the rotation of the drums the holding means may comprise, for each drum or for each supply means, an arrangement allowing the speed of a rotating drum to be

controlled, such as slowed down. The arrangement allowing the speed of a rotating drum to be slowed down may comprise a pneumatic or an electric brake. The holding means may further comprise, for each drum or for each supply means, a sensor arrangement for detecting breakage of the supply means or detecting if a drum needs to be replaced because it is empty. Such sensor may be an optically-based sensor where a light emitter and a light detector are positioned on opposite sides of the supply means. If the supply means breaks or the drum runs out of supply means a light beam from the light emitter can propagate freely to the light detector whereby an alarm signal is generated. Alternatively, the sensor arrangement for detecting breakage of the supply means may comprise a capacitive sensor aligned with each of the supply means being provided to a specific means for grouping together a plurality of supply means. If the supply means breaks an alarm signal is generated. This alarm signal may be an electrical signal provided to a control which is capable of performing an appropriate action. Such appropriate action may be a complete shut down of the machine, or it may be a providing of a warning signal in the form of a visible or audible signal. When the operator of the machine notices such warning signal he or she may take appropriate action. Alternatively, a control system, such as a PLC-based control system, may keep track of the remaining amount of supply means on a given drum.

In order to make the apparatus or machine an independent unit, the apparatus or machine according to the first aspect of the present invention may further comprise means for moving the apparatus or machine across the soil. For example, the apparatus or machine may be moved across the soil using a combustion engine or an electrical motor. Even further, the apparatus or machine may comprise means for generating electricity at suitable voltage levels and pressurised air for activating pneumatic brakes. The generated electrical voltages may be used as supply voltages for other electronic equipment, such as electronic control units, sensors etc, on board the apparatus or machine.

The apparatus or machine may further comprise a central control unit which controls the overall operation of the apparatus or machine. The control unit also monitors that the apparatus or machine is fully functional. In order to comply with this, the control unit is in communication with the sensors monitoring whether one or more supply means are broken or whether one or more drums need to be replaced. In case a supply means breaks all drums may be immediately stopped by activating the brake associated with each of the drums. Alternatively, a warning signal may be generated in case a supply means breaks. As a consequence, the apparatus or machine is immediately stopped so that further damages can be avoided.

The apparatus or machine may be controlled or driven by having a driver positioned on the apparatus or machine itself. Alternatively, the apparatus or machine may be controlled or

driven from a portable control panel which is carried by the operator of the apparatus or machine while the operator is walking next to the apparatus or machine. The control panel may be communicating with the apparatus or machine via a wire or it may communicate with the apparatus or machine via a wireless connection. The portable control panel may offer full control over all functionalities of the apparatus or machine. Alternatively, the apparatus or machine may be pulled across the soil by another machine, for example a tractor. In this situation, the operator of the apparatus or machine may be the driver of that other machine pulling the apparatus or machine according to the present invention across the soil. In another scenario the sewing machine itself can be arranged on a motorised unit whereas drums holding the supply means are arranged on the separate wagon being pulled by the motorised unit.

In order to be able to move safely across the soil in all weather conditions the apparatus or machine may be equipped with tracks or big wheels, such as air-filled rubber wheels.

Even further, the apparatus or machine may be equipped with a digging tool for digging a trench in the soil. When the final bundle of supply means has been laid into the trench the trench may be closed or covered by a shovel-like arrangement mounted on the apparatus or machine.

In a second aspect, the present invention relates to a method for grouping a plurality of supply means for a household, the method comprising the steps of

- providing a plurality of replaceable drums, each drum being arranged to support a rolled up supply means, and

- forming a first bundle of supply means by grouping together supply means from at least two drums by wrapping or sewing at least one coloured ribbon around the grouped supply means.

The method according to the second aspect of the present invention may further comprise the step of

- forming a second bundle of supply means by grouping together supply means from at least two drums by wrapping or sewing at least one coloured ribbon around the second bundle.

The method may further comprise the step of grouping together the first and second bundles to form a final bundle of supply means, the final bundle being formed by wrapping or sewing at least one coloured ribbon around the first and second bundles.

5 Instead of grouping together the first and second bundles of supply means a third bundle of supply means may be formed by grouping together supply means from at least two drums by wrapping or sewing at least one coloured ribbon around the third bundle. Following this approach the first, second and third bundles may be grouped to form a final bundle of supply means, the final bundle being formed by wrapping or sewing at least one coloured ribbon around the first, second and third bundles.

- 10 The coloured ribbons wrapped or sewed around the first, second and third bundles may be different in colour so that the bundles are distinguishable from each other. The method according to the second aspect may further comprise the step of laying the final bundle of supply means into a trench in the soil.

15 The supply means may be selected from the group consisting from: optical fibres, electrical cables, telephone wires, antenna cables, water conduits, drain pipes and sewers.

The plurality of the supply means may be grouped into bundles of supply means on-the-fly, i.e. while the rolled up supply means are moved across the soil, or they may be grouped into bundles using a stationary arrangement, for example a sewing machine being positioned in a 20 or 40 feet standard shipping container.

- 20 In a third aspect, the present invention relates to a method for grouping a plurality of supply means for a household, the method comprising the steps of

- providing a plurality of supply means, and
  - forming a first bundle of supply means by grouping together a first and a second supply means by wrapping or sewing at least one coloured ribbon around the first and second supply means.
- 25

The method according to the third aspect may further comprise the step of

- forming a second bundle of supply means by grouping together a third and a fourth supply means by wrapping or sewing at least one coloured ribbon around the third and fourth supply means,

The method may further comprise the step of grouping together the first and second bundles to form a final bundle of supply means, the final bundle being formed by wrapping or sewing at least one coloured ribbon around the first and second bundles.

5 Instead of forming the final bundle of supply means from the first and second bundles of supply means, the method according to the third aspect may further comprising the steps of

- forming a second bundle of supply means by grouping together a third and a fourth supply means by wrapping or sewing at least one coloured ribbon around the third and fourth supply means, and

10 - forming a third bundle of supply means by grouping together a fifth and a sixth supply means by wrapping or sewing at least one coloured ribbon around the fifth and sixth supply means

The first, second and third bundles may be grouped together to form a final bundle of supply means, the final bundle being formed by wrapping or sewing at least one coloured ribbon around the first, second and third bundles. The coloured ribbons wrapped or sewed around  
15 the first, second and third bundles may be different in colour.

The method according to the third aspect of the present invention may further comprise the step of spooling the final bundle of supply means onto a drum.

The supply means may be selected from the group consisting from: optical fibres, electrical cables, telephone wires, antenna cables, water conduits, drain pipes and sewers.

20 In a fourth aspect, the present invention to an apparatus for grouping supply means for a household, the apparatus comprising

- a first sewing machine for forming a first bundle of supply means by sewing together first and second supply means,

25 - a second sewing machine for forming a second bundle of supply means by sewing together third and fourth supply means, and

- a final sewing machine for sewing together the first and second bundles of supply means.

The apparatus may further comprise a third sewing machine for forming a third bundle of supply means by sewing together fifth and sixth supply means. In this situation the final sewing machine may be arranged to sew together the first, second and third bundles of supply means.

- 5 Again, the supply means may be selected from the group consisting from: optical fibres, electrical cables, telephone wires, antenna cables, water conduits, drain pipes and sewers.

As previously mentioned, the bundles of supply means may be provided by sewing at least one coloured ribbon around the supply means constituting the bundle so that the bundles are distinguishable from each other.

- 10 The apparatus according to the fourth aspect of the present invention may be built into portable container comprising one or more movably or removably mounted sidewall portions so as to allow access to the apparatus. This portable container may be a 20 or 40 feet standard shipping container which may be moved around on a semitrailer by a truck.

#### BRIEF DESCRIPTION OF THE DRAWINGS

- 15 The present invention will now be explained in further details with reference to the accompanying figures, wherein

Fig. 1 illustrates the principle behind the present invention,

Fig. 2 shows an exploded view of a part of Fig. 1,

Fig. 3 depicts the apparatus or machine according to the present invention,

- 20 Fig. 4 illustrates a self moving machine according to the present invention,

Fig. 5 shows sewing machines capable of bundling 6 optical fibres,

Fig. 6 shows alternative implementations of a sewing machine,

Fig. 7 illustrates the position of a tachometer on a self moving machine according to the present invention,

- 25 Fig. 8 shows a container version of the machine according to the present invention, and

Fig. 9 shows a wagon capable of carrying 18 drums of supply means.

While the invention is susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and will be described in detail herein. It should be understood, however, that the invention is not intended to be limited to the particular forms disclosed. Rather, the invention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

#### DETAILED DESCRIPTION OF THE INVENTION

In its most general aspect the present invention relates to an apparatus or machine, in the following denoted a machine, capable of grouping a plurality of supply means, different or identical, in an effective and flexible manner. Supply means are here to be understood in its broadest possible sense – namely any supply means capable of bringing for example electricity, data signals, telephone signals, television signals, water etc. to or from a standard household. These supply means can be positioned on, and thereby carried by the machine, or they can be positioned in for example one or more separate containers. The supply means are preferably rolled up on drums prior to being grouped together.

One aspect of the present invention is depicted in Fig. 1 which schematically depicts a platform or support structure 100 of the machine according to the present invention. As seen the platform 100 carries 24 individual drums. Each drum supports a rolled up supply means, such as an optical fibre, an electrical cable, a telephone wire, an antenna cable, a water conduit, a drain pipe, a sewer or any other supply means relevant for a standard household. Different drums can also support different supply means. Thus, drum number 1 can support a rolled up optical fibre adapted for broadband communication, whereas drum number 2 can support a rolled up electrical cable, whereas drum number 3 can support a rolled up water conduit etc. It may also be that a drum supports a supply means which is constituted by a number of sub supply means. Thus, the situation may be that drum number 1 supports a cable containing for example 4 optical fibres.

In Fig. 1 the number of drums has for illustrative purposes been chosen to 24. However, this is just to be considered as an example. Thus, the number of drums which may be carried by the machine itself can be higher or lower than 24. As seen in Fig. 1 the supply means rolled up on drums 1-6 are fed into a first sewing machine denoted I. Sewing machine I sews the 6 supply means and an optional bundle carrier together to form a first bundle of supply means. Similarly, sewing machine II sews the 6 supply means from drums 7-12 and an optional bundle carrier together to form a second bundle of supply means, and sewing machine III

sews the 6 supply means from drums 13-18 and an optional bundle carrier together to form a third bundle of supply means, and sewing machine IV sews the 6 supply means from drums 19-24 and an optional bundle carrier together to form a fourth bundle of supply means. Each of the sewing machines I-IV may optionally be equipped with a velocity control mechanism.

5 This mechanism monitors and controls the conveying speed of the bundles.

Thus, in the example depicted in Fig. 1 24 supply means, different or identical, are grouped into four bundles of supply means. Each of these bundles is constituted by 6 supply means, different or identical, and an optional bundle carrier position in the centre of the bundle. The bundle carrier adds to the mechanical stability and stiffness of the bundles. However, it  
10 should be noted that the bundle carrier is optional and it may thus be omitted.

The 4 bundles of supply means are fed into a fifth sewing machine, denoted V, where the 4 bundles are bundled, by sewing, to a final bundle of supply means which, in principle, is ready to be positioned in a bottom of a trench in the soil. Thus, the final bundle of supply means is constituted by 24 supply means, different or identical. With the final bundle of  
15 supply means positioned in a trench every household along that trench can be connected to at least one of the supply means 1-24. Similar to sewing machines I-IV, sewing machine V may be equipped with a velocity control mechanism in order to monitor and control the conveying speed of the final bundle of supply means.

It is important to stress that the number of supply means can in principle be arbitrary. Thus,  
20 instead of 24 drums with associated supply means the machine can also be arranged to host 18 drums with associated supply means. These 18 supply means can be grouped, for example by sewing, into 3 bundles each being constituted by 6 supply means and an optional bundle carrier. The 3 bundles are finally grouped into a final bundle containing all 18 supply means.

25 In order to distinguish the supply means from each other each bundle of supply means is colour coded. The colour coding is performed by varying the colour of a band or ribbon wrapped or sewed around each bundle. In addition to this, the supply means constituting a bundle of supply means are also individually coloured. Thus, if a bundle is constituted by 6 supply means these 6 supply means are coloured in 6 different colours. The bundle itself is  
30 also colour coded by having a coloured band or ribbon wrapped or sewed around it. Evidently, the bundles of supply means are coloured with different bands or ribbons.

Sensors 201, see Fig. 2, for constantly monitoring the status of supply means may be positioned between each of the drums and the associated sewing machine. Alternatively, these sensors can be positioned on the associated sewing machine. These sensors are

adapted for detecting breakage of the supply means or detecting if a drum needs to be replaced because it is empty. These sensors can be optically-based sensors where a light emitter and a light detector are positioned on opposite sides of the supply means. If the supply means breaks or the drum runs out of supply means a light beam from the light  
5 emitter can propagate freely to the light detector whereby an alarm signal is generated. This alarm signal is forwarded to an overall control system of the machine, and in case of an empty drum or a broken or damaged supply means, the control system can bring the machine to an immediate hold in order to avoid further damages, or the control system can launch a visible or audible alarm signal. The operator of the machine may then take  
10 appropriate actions in response to said alarm signal.

The sensor for detecting whether a given supply means is still available may alternatively be a non-optical based sensor. Suitable sensor types are for example commercially available capacitive sensors. Such capacitive sensor is mounted in the vicinity of the supply means in order to detect whether a given supply means is available for bundling or not. For example, if  
15 a total of 6 supply means are to be monitored at or near a given sewing machine 6 capacitive sensors are required. Preferably, these 6 capacitive sensors are arranged in a star-like formation in order for the sensing part of the sensors to be positioned in vicinity of the supply means.

Fig. 3a shows a more detailed illustration of the machine according to the present invention.  
20 In contrast to Fig. 1 where the machine was fed with 24 supply means the machine depicted in Fig. 3 is fed with only 18 supply means. Each of the 18 supply means is passed through a guider 301 which limits the possible sideways movements of each of the supply means. The supply means then passes a cutter 302 so that each of the supply means can be cut at a desired length. Thus, the 18 cutters 302 can be operated independently. Before entering the  
25 sewing machine 304 the 6 supply means that are to be sewed together in sewing machine 304 passes a guider 303 which is capable of keeping track of all 6 supply means prior to being sewed together, Marker 305 is used for marking the bundle 311. Such marking could be relevant if the bundle at a given point should perform for example a sharp bend. The bundle 311 is sewed together with bundles 312 and 313 in sewing machine 307. Before  
30 entering the sewing machine 307 the 3 bundles of supply means 311, 312, 313 pass a guider 306 which keeps track of all 3 bundles of supply means prior to being sewed together in sewing machine 307. Again, marker 308 is used for marking the final bundle 314. Such marking could be relevant if the final bundle at a given point should perform for example a sharp bend. The final bundle 314 is coiled on the drum 309. The supply means 310 has been  
35 separated from the bundles 311, 312, 313, 314 in that supply means 310 constitute a service supply means. By service supply means is meant that supply means 310 is the actual part that is separated from the final bundle 314 in order to physically reach a given household.

Points 316 are used for providing a weak or a strong attachment of a separated supply means 310 to the final bundle 314. The weak and the strong attachment can be provided by wrapping weak or strong tape around the final bundle 314 and the separated supply means 310.

5 Figs. 3b and 3c illustrate the machine of Fig. 3a from a different perspective, As seen in Fig. 3b the drums carrying the individual supply means is denoted 300, whereas in Fig. 3c an arrangement, typically an encoder wheel, for measuring the length of the final bundle is denoted 315.

10 Fig. 4 depicts a machine adapted to move across a surface of soil while grouping a plurality of supply means together. As seen the machine is adapted to move across the surface of soil 401 by means of for example tracks 402. Alternatively, the machine can also be equipped with wheels. The direction of movement is indicated by the arrow in the left hand side of Fig. 4. The tracks or wheels are driven by a combustion engine or an electrical motor (not shown). As seen the machine carries its own supply of supply means in that these supply  
15 means are rolled up on a number of drums 403. As an example the machine depicted in Fig. 4 contains 18 drums (only 6 drums are visible), but as already mentioned this number can be altered depending on the situation.

As an alternative to a self driven machine, the machine according to the present invention can also be configured without having a combustion engine or electrical motor on board. This  
20 embodiment of the invention needs to be pulled across the soil using for example a tractor. The control system applying to this embodiment of the present invention is discussed in further details below.

The drums 403 supply a sewing machine 404 with 6 supply means 406 which are sewed together to form a bundle of supply means 407. This bundle is formed by 6 supply means  
25 and an optional bundle carrier which can be a relatively stiff plastic rod in order to stabilise the bundle 407. It should be noted that the bundle carrier can be omitted. The bundle 407 is in sewing machine 405 sewed together with other bundles in order to form the final bundle of supply means 408. In Fig. 4, 3 bundles are sewed together in sewing machine 405. As  
30 already mentioned this number can be both higher and lower depending on the number of households to be supplied. The final bundle of supply means 408 is positioned below the surface of the soil 401 in the bottom of a trench 409.

An example of a sewing machine is depicted in Fig. 5a. The sewing machine generally consists of two parts – a non-rotating inner part 508 and a rotating outer part 509. The non-rotating part consists of a back plate 501 in which a number of tubes 507 are arranged. In

Fig. 5 the number of tubes is 6 whereby 6 supply means, such as 6 optical fibres, can be bundled using the sewing machine depicted in Fig. 5a. In Fig. 5a the fibres to be bundled enter the tubes from the backside of the paper and leave the sewing machine by travelling in a direction out of the paper. Around the non-rotating part a rotatably mounted ring or cylinder 502, having its longitudinal direction arranged perpendicular to the paper, is mounted. Two cups 503, 504 are attached to this rotatably mounted ring or cylinder. These cups house the band or ribbon 505, 506 to be wound around the optical fibres when these optical fibres leave their respective tubes 507 in the direction pointing out of the paper. Thus, when the ring or cylinder 502 is rotated relative to the non-rotating part of the sewing machine – including the fibres to be bundled – the bands or ribbon 505, 506 are wrapped around the fibres whereby a bundle of optical fibres is provided. As the optical fibres perform a movement out of the paper while the band or ribbon 505, 506 is wrapped around the fibres, the bands or ribbons are wrapped around the fibres along a helical-type pattern.

An alternative implementation of the back plate is depicted in Fig. 5b where the tubes of Fig. 5a have been replaced by 6 radially extending trenches 510 arranged in the back plate 511. Each of the radially extending trenches 510 is arranged to support a supply means, such as an optical fibre, During the sewing process the supply means are located in the centre part 512 of the radially extending trenches. The supply means are kept in the position by mechanically biasing the supply means towards the centre parts of the trenches. An arrangement for providing this mechanically biasing is depicted in Fig. 5c. As seen in Fig. 5c the arrangement has a support structure 513, a pivotably mounted arm 514, a rotatably mounted guiding wheel 515 and a spring element 516 for mechanically biasing the supply means towards the centre part of the trenches. Obviously, an arrangement as depicted in Fig. 5c is provided for each supply means.

Compared to the back place depicted in Fig. 5a supply means can be removed from the radially extending trenches 510 of Fig. 6b by simply displacing them to the edge of the back plate 601 whereby only the remaining supply means in the radially extending trenches are sewed together. Thus, supply means can be separated as depicted in Fig. 3a (supply means 310). Fig. 5d shows the assembled biasing arrangement with support structure 513, pivotably mounted arm 514, rotatably mounted guiding wheel 515 and spring element 516 for mechanically biasing the supply means towards the centre part of the trenches.

Figs 6a and 6b show an alternative implementation of a sewing machine. Fig 6a shows a front view whereas Fig. 6b shows a side view. The sewing machine is mounted on a stand 601. A rotatably mounted drive wheel 602, which is driven by an electrical motor 603, causes the cans 604, 605 to perform a rotational movement around the centre 606 of the sewing machine. As seen in Fig. 6a the cans 604, 605 are fixedly arranged relative to the rotatably

mounted base element 607 via connection arms 608, 609. Upon rotation of the cans 604, 605 and the rotatably mounted base element 607, the base element 607 is guided by guiding wheels 610 which are operatively connected to frame 611 via arms 612. Thus, when the electrical motor 603 is activated the drive wheel 602 causes the base element 607 to rotate  
5 whereby the cans 604, 605, within which the ribbon to be sewed around the supply means is positioned, perform a rotational movement around the centre 606 of the sewing machine.

As already mentioned the support for each drum is equipped with a pneumatic or an electric brake so that each drum can be stopped immediately if a situation so demands. Such situation could be if a supply means for some reason breaks or if a drum is empty.

10 In case of a self moving machine as depicted in Fig. 4 the machine can be controlled by a person positioned on the machine itself. Alternatively, the machine can be controlled from a portable control panel which may be carried by the operator of the machine while the operator is walking next to the machine. The control panel may be communicating with the machine via a wire or it may communicate with the apparatus or machine via a wireless  
15 connection. A suitable wireless standard that may be applied is Bluetooth. The portable control panel offers full control over all functionalities of the machine.

In case the machine has its own motor in the form of a combustion engine or an electrical motor the control system is intended for controlling the full operation of the machine. Thus, if for example a supply means breaks the control system immediately brings the machine to a  
20 full stop.

In case the machine has to be pulled by another machine, such as for example a tractor, the control system is configured to provide a warning signal to the driver of the tractor in the situation where a supply means breaks or a drum is suddenly empty. The warning signal can be a visible signal or an audible signal or a combination thereof. In case of a tractor driven  
25 machine, the sewing machines are activated in response to a signal provided by a tachometer 701, see Fig. 7. This tachometer 701 generates a tacho signal when the machine is moved across the soil in that this tachometer 701 monitors if an additional piece of final bundled supply means 708 is required. Thus, a force provided to the final bundled supply means 708 in a direction away from the machine activates the tachometer which is  
30 operatively connected to the final bundled supply means 708 via for example a rotatably mounted wheel. The signal from the tachometer is provided to the control system which activates the sewing machines accordingly. A tractor driven machine will receive its electrical supply from the tractor, or will carry its own supply of electrical power.

It is important to stress that the number of drums, the number of sewing machines, the number of supply means in each bundle, the number of bundles etc. can be varied in accordance with the specific requirements. Thus, the shown embodiments are only to be considered as examples and are thus not limiting the scope of protection of the present invention.

Instead of being configured to be moved across the surface of the soil the machine according to the present invention may also be implemented in a more stationary configuration. Such stationary configuration could involve a number of containers, for example one container for housing the sewing machines and a number of containers for housing drums of supply means. Such an arrangement is depicted in Fig. 8 where the sewing machine itself is positioned in container 801 whereas drums with various supply means are positioned in containers 802, 803, 804. In Fig. 8 each of the containers 802, 803, 804 houses 6 supply means. Obviously, the number of supply means in each container can be different from 6. Also, the number of containers supplying the sewing machine with supply means can be different from the 3 containers depicted in Fig. 8. The final bundle of supply means 806 is coiled onto a drum 805. The drum on which the final bundle of supply means is coiled can be brought to the location where the final bundle is to be laid down in a trench. The scenario can also be that container 801 housing the sewing machine is positioned at the location of the manufacturer of the supply means, such as at the manufacturer of optical fibres/cables. In this scenario containers 802, 803, 804 can be omitted in that the manufacturer of the supply means provide the necessary amount of supply means directly to the sewing machine in container 801. The containers depicted in Fig. 8 are preferably standard shipping containers well-known from the shipping industry. Also, such standard containers fit on semitrailers which can be moved around by trucks.

In a final scenario the sewing machine itself can be arranged on a motorised unit whereas drums holding the supply means are arranged on the separate wagon being pulled by the motorised unit. An arrangement of 18 drums on such a wagon is depicted in Fig. 9, where Fig. 9a shows a side view of the wagon whereas Fig. 9b shows a top view of the wagon. As seen in Figs. 9a and 9b a wagon according to this aspect of the invention comprises a bottom frame structure 901, a set of wheels 902 and a suitable upper frame structure 903 for holding the 18 drums 904.

## CLAIMS

1. An apparatus for grouping supply means, the apparatus comprising a support structure arranged to be moved across a surface of soil, the apparatus further comprising

5 ~ means for holding a plurality of replaceable drums, said holding means being arranged on the support structure of the apparatus, each drum being arranged to support a rolled up supply means, and

~ means for forming a first bundle of supply means by grouping together supply means from at least two drums.

10 2. An apparatus according to claim 1, further comprising means for forming a second, a third and a fourth bundle of supply means, the second bundle being formed by grouping together supply means from drums other than the drums used for forming the first bundle, the third bundle being formed by grouping together supply means from drums other than the drums used for forming the first and second bundles, the fourth bundle being formed by grouping together supply means from drums other than the drums used for forming the first, second  
15 and third bundles.

3. An apparatus according to claim 2, further comprising means for grouping together the first, second, third and fourth bundles in a final bundle of supply means.

4. An apparatus according to any of the preceding claims, wherein the supply means are selected from the group consisting from: optical fibres, electrical cables, telephone wires,  
20 antenna cables, water conduits, drain pipes and sewers.

5. An apparatus according to any of the preceding claims, wherein the holding means comprises, for each drum, an arrangement allowing the speed of a rotating drum to be slowed down.

6. An apparatus according to claim 5, wherein the arrangement allowing the speed of a  
25 rotating drum to be slowed down comprises an electrical brake.

7. An apparatus according to any of the preceding claims, wherein the holding means comprises, for each drum, a sensor arrangement for detecting breakage of the supply means or detecting if a drum needs to be replaced.

8. An apparatus according to any of the preceding claims, wherein the bundles of supply means are provided by wrapping at least one coloured ribbon around the supply means constituting the bundle.

5 9. An apparatus according to any of the preceding claims, further comprising means for moving the apparatus across the soil.

10. An apparatus according to claim 9, wherein the means for moving the apparatus across the soil comprises a combustion engine.

11. An apparatus according to claim 9, wherein the means for moving the apparatus across the soil comprises an electrical motor.

10 12. An apparatus according to any of claims 9-11, wherein the means for moving the apparatus across the soil is operatively connected to a pair of tracks.

13. A method for grouping a plurality of supply means for a household, the method comprising the steps of

15 - providing a plurality of replaceable drums, each drum being arranged to support a rolled up supply means, and

- forming a first bundle of supply means by grouping together supply means from at least two drums by wrapping or sewing at least one coloured ribbon around the grouped supply means.

14. A method according to claim 13, further comprising the step of

20 - forming a second bundle of supply means by grouping together supply means from at least two drums by wrapping or sewing at least one coloured ribbon around the second bundle.

25 15. A method according to claim 14, further comprising the step of grouping together the first and second bundles to form a final bundle of supply means, the final bundle being formed by wrapping or sewing at least one coloured ribbon around the first and second bundles.

16. A method according to claim 14, further comprising the steps of

- forming a third bundle of supply means by grouping together supply means from at least two drums by wrapping or sewing at least one coloured ribbon around the third bundle.

17. A method according to claim 16, further comprising the step of grouping together the first, second and third bundles to form a final bundle of supply means, the final bundle being formed by wrapping or sewing at least one coloured ribbon around the first, second and third bundles.

18. A method according to claim 17, wherein the coloured ribbons wrapped or sewed around the first, second and third bundles are different in colour.

19. A method according to claim 15, 17 or 18, further comprising the step of laying the final bundle of supply means into a trench in the soil.

20. A method according to any of claims 13-19, wherein the supply means are selected from the group consisting from: optical fibres, electrical cables, telephone wires, antenna cables, water conduits, drain pipes and sewers.

21. A method for grouping a plurality of supply means for a household, the method comprising the steps of

- providing a plurality of supply means, and
- forming a first bundle of supply means by grouping together a first and a second supply means by wrapping or sewing at least one coloured ribbon around the first and second supply means.

22. A method according to claim 21, further comprising the step of

- forming a second bundle of supply means by grouping together a third and a fourth supply means by wrapping or sewing at least one coloured ribbon around the third and fourth supply means,

23. A method according to claim 22, further comprising the step of grouping together the first and second bundles to form a final bundle of supply means, the final bundle being

formed by wrapping or sewing at least one coloured ribbon around the first and second bundles.

24. A method according to claim 21, further comprising the steps of

5       - forming a second bundle of supply means by grouping together a third and a fourth supply means by wrapping or sewing at least one coloured ribbon around the third and fourth supply means, and

      - forming a third bundle of supply means by grouping together a fifth and a sixth supply means by wrapping or sewing at least one coloured ribbon around the fifth and sixth supply means

10   25. A method according to claim 24, further comprising the step of grouping together the first, second and third bundles to form a final bundle of supply means, the final bundle being formed by wrapping or sewing at least one coloured ribbon around the first, second and third bundles.

15   26. A method according to claim 24 or 25, wherein the coloured ribbons wrapped or sewed around the first, second and third bundles are different in colour.

27. A method according to claim 23 or 25, further comprising the step of spooling the final bundle of supply means onto a drum.

20   28. A method according to any of claims 21-27, wherein the supply means are selected from the group consisting from: optical fibres, electrical cables, telephone wires, antenna cables, water conduits, drain pipes and sewers.

29. An apparatus for grouping supply means for a household, the apparatus comprising

      - a first sewing machine for forming a first bundle of supply means by sewing together first and second supply means,

25       - a second sewing machine for forming a second bundle of supply means by sewing together third and fourth supply means, and

      - a final sewing machine for sewing together the first and second bundles of supply means.

30. An apparatus according to claim 29, further comprising a third sewing machine for forming a third bundle of supply means by sewing together fifth and sixth supply means.

31. An apparatus according to claim 30, wherein the final sewing machine is arranged to sew together the first, second and third bundles of supply means.

5 32. An apparatus according to any of claims 29-31, wherein the supply means are selected from the group consisting from: optical fibres, electrical cables, telephone wires, antenna cables, water conduits, drain pipes and sewers.

10 33. An apparatus according to any of claims 29-32, wherein the bundles of supply means are provided by sewing at least one coloured ribbon around the supply means constituting the bundle.

34. A portable container having an apparatus according to any of claims 29-33 arranged therein, the container comprising one or more movably or removably mounted sidewall portions so as to allow access to the apparatus.

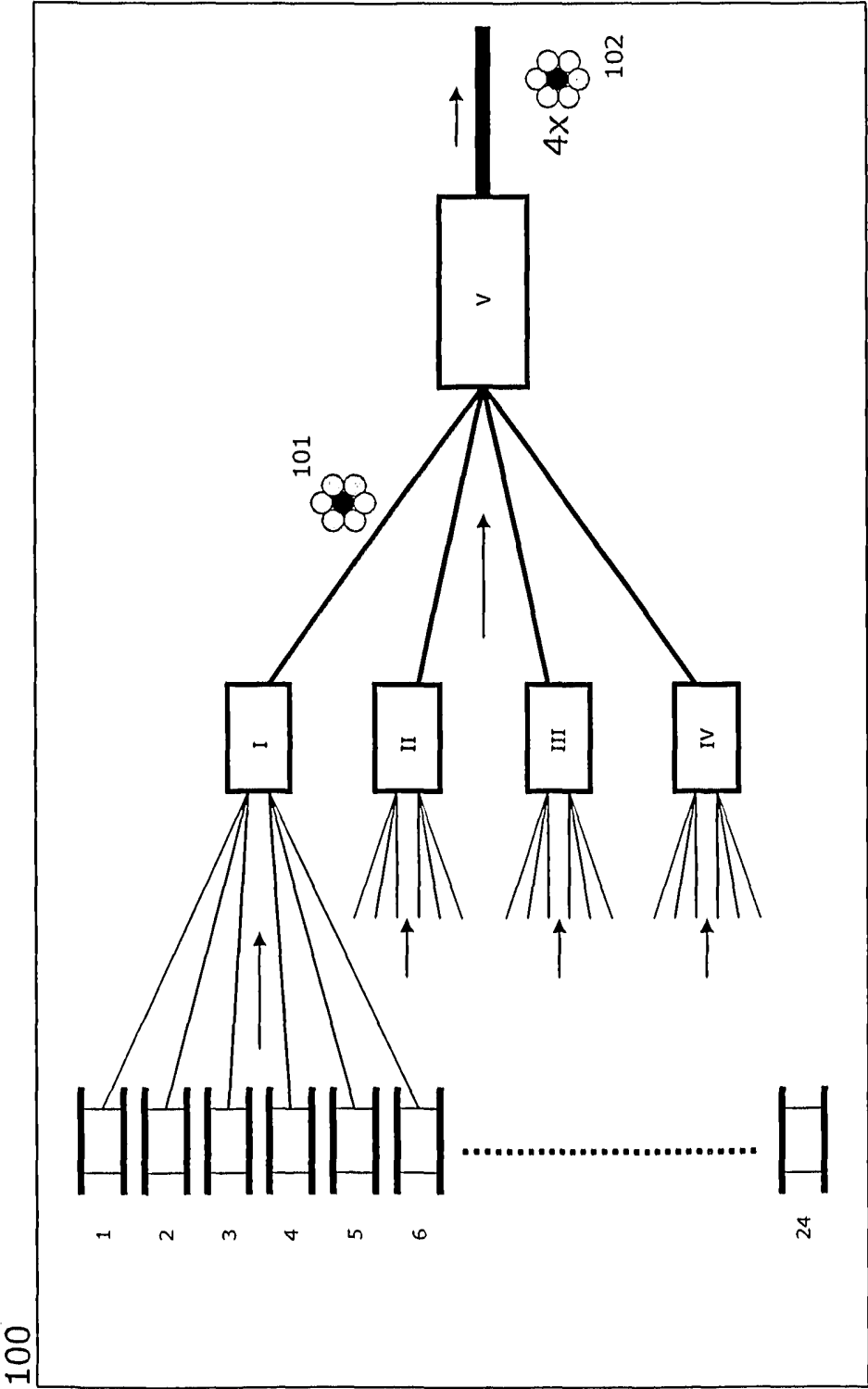


Fig. 1

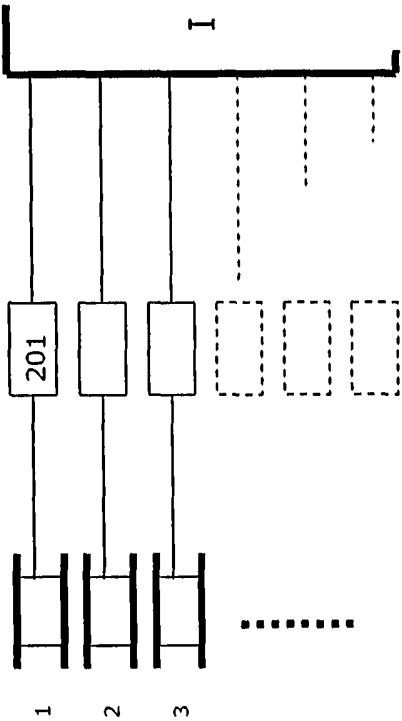


Fig. 2

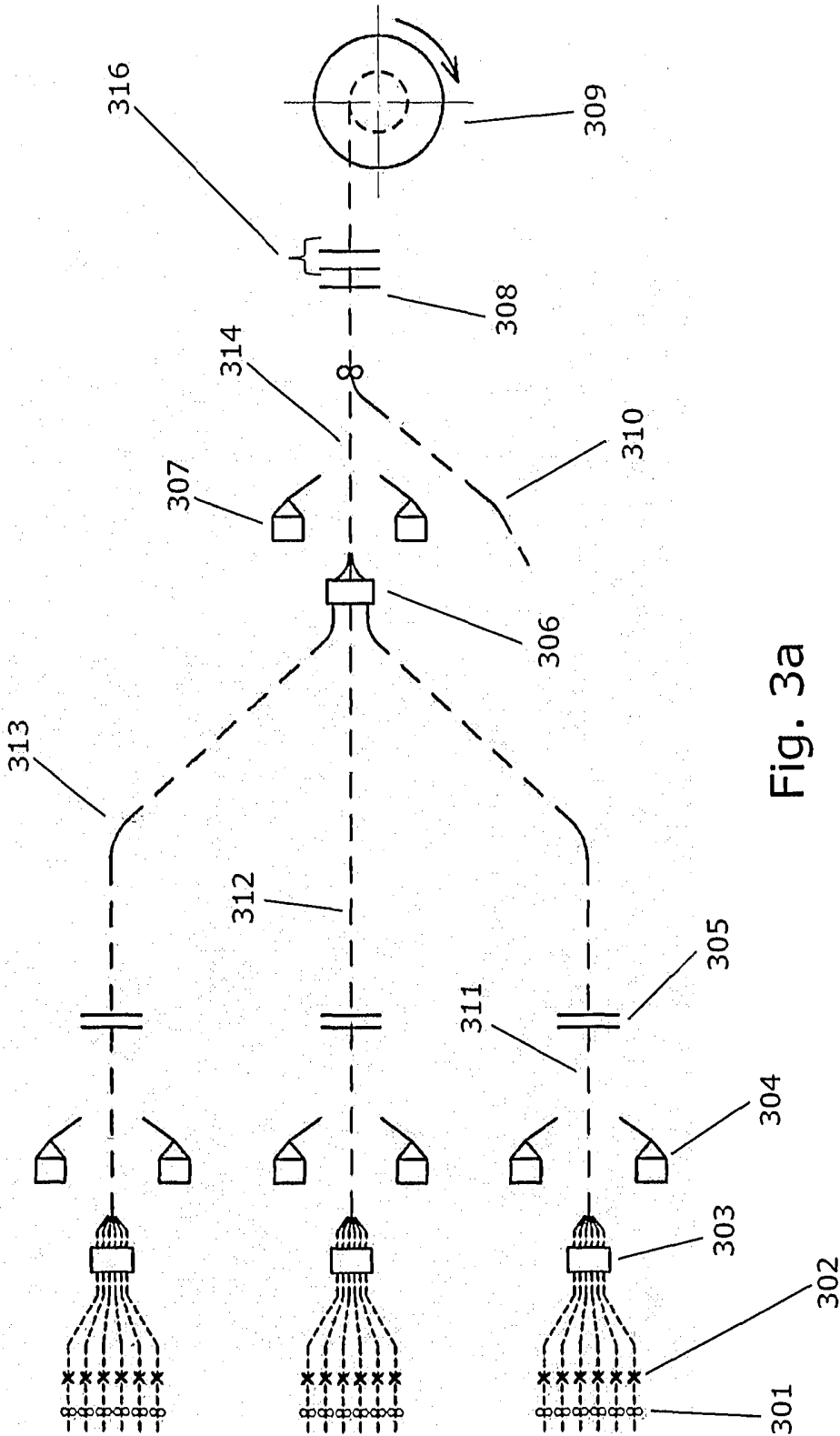


Fig. 3a

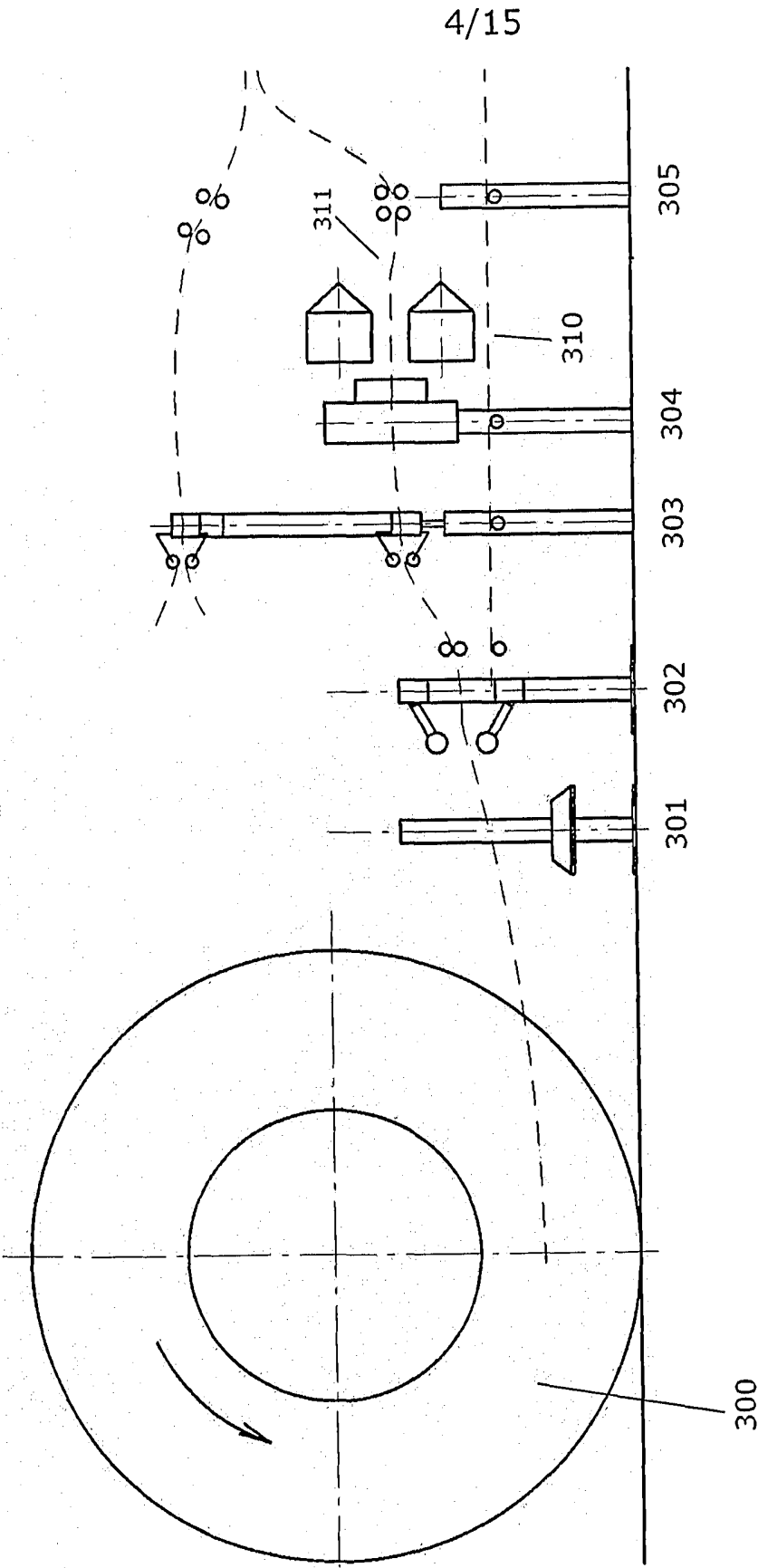


Fig. 3b

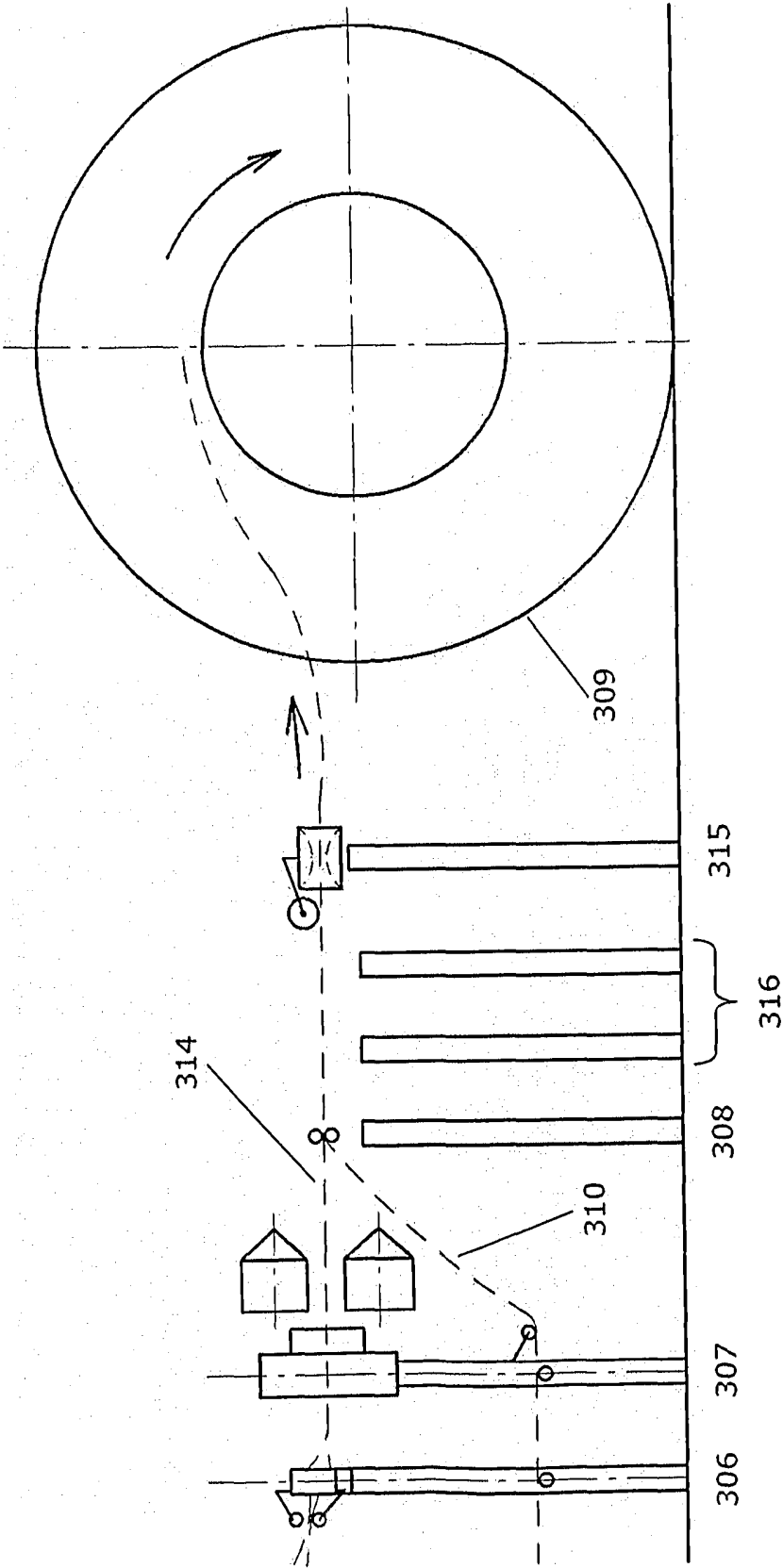


Fig. 3c

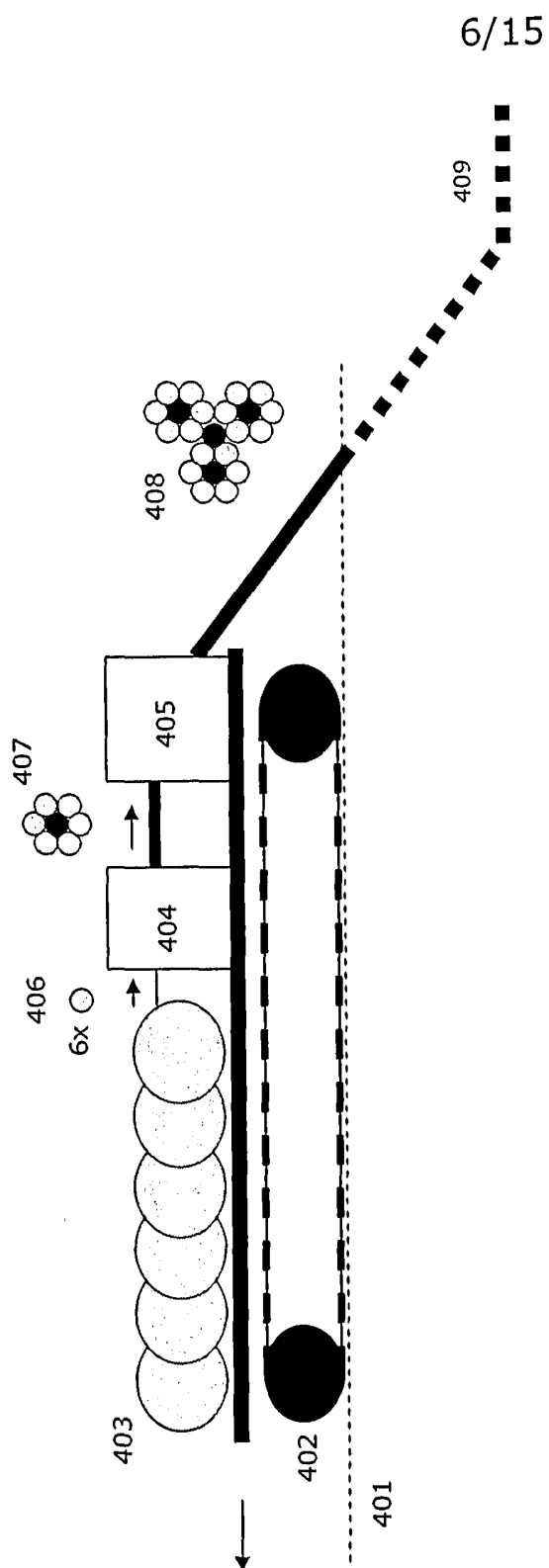


Fig. 4

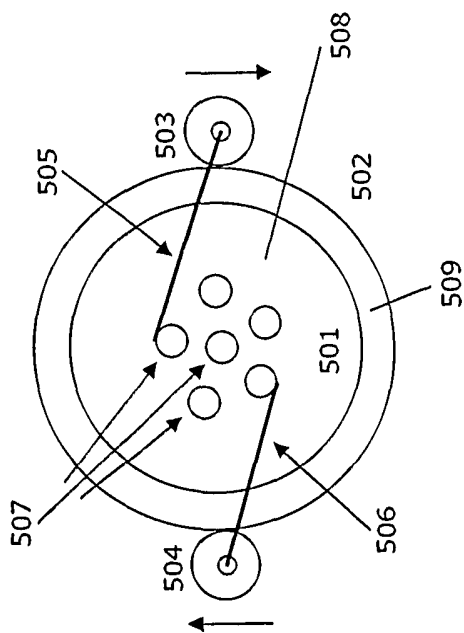


Fig. 5a

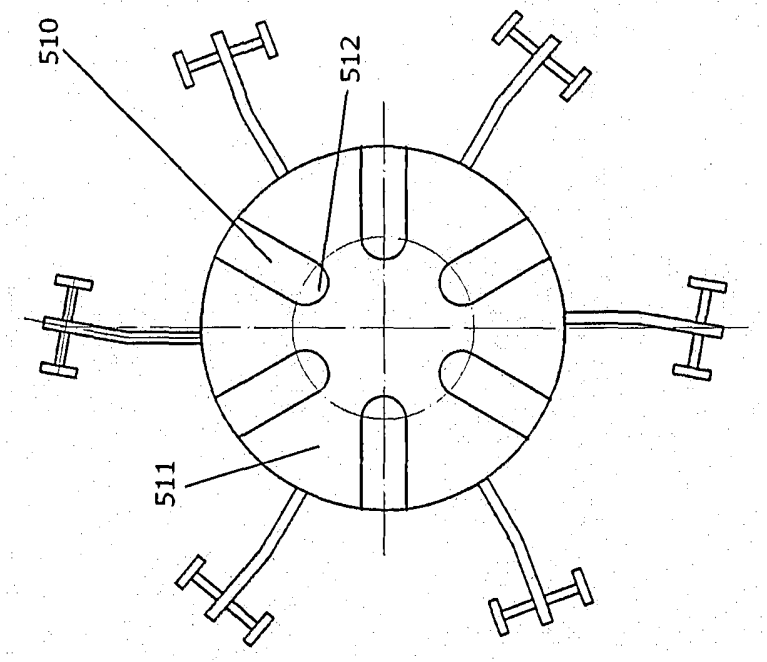


Fig. 5b

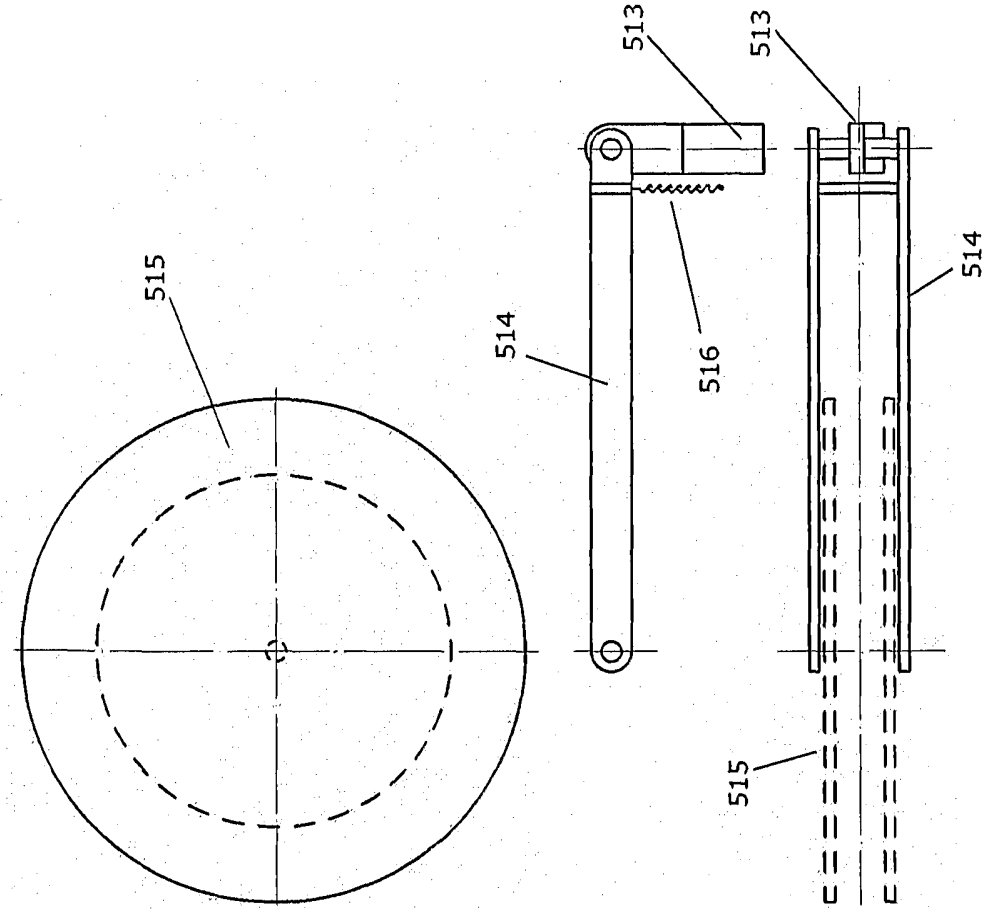


Fig. 5c

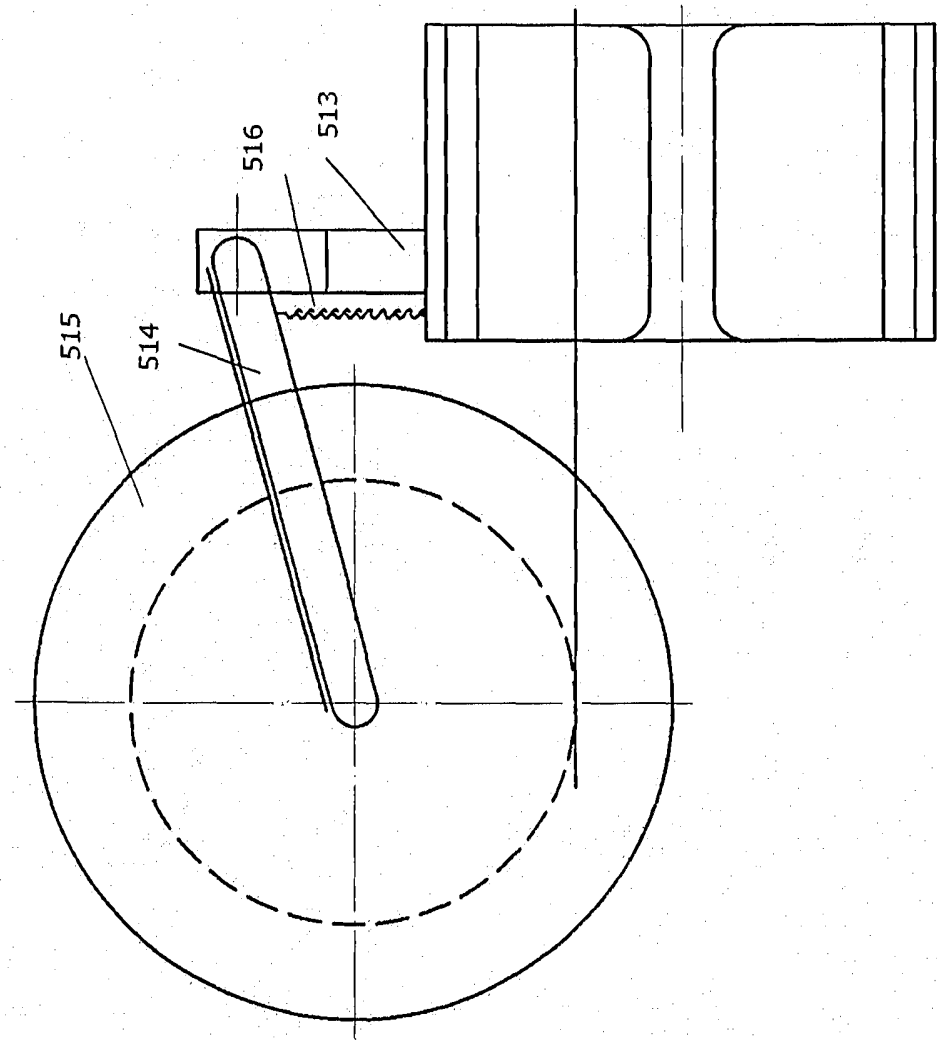


Fig. 5d

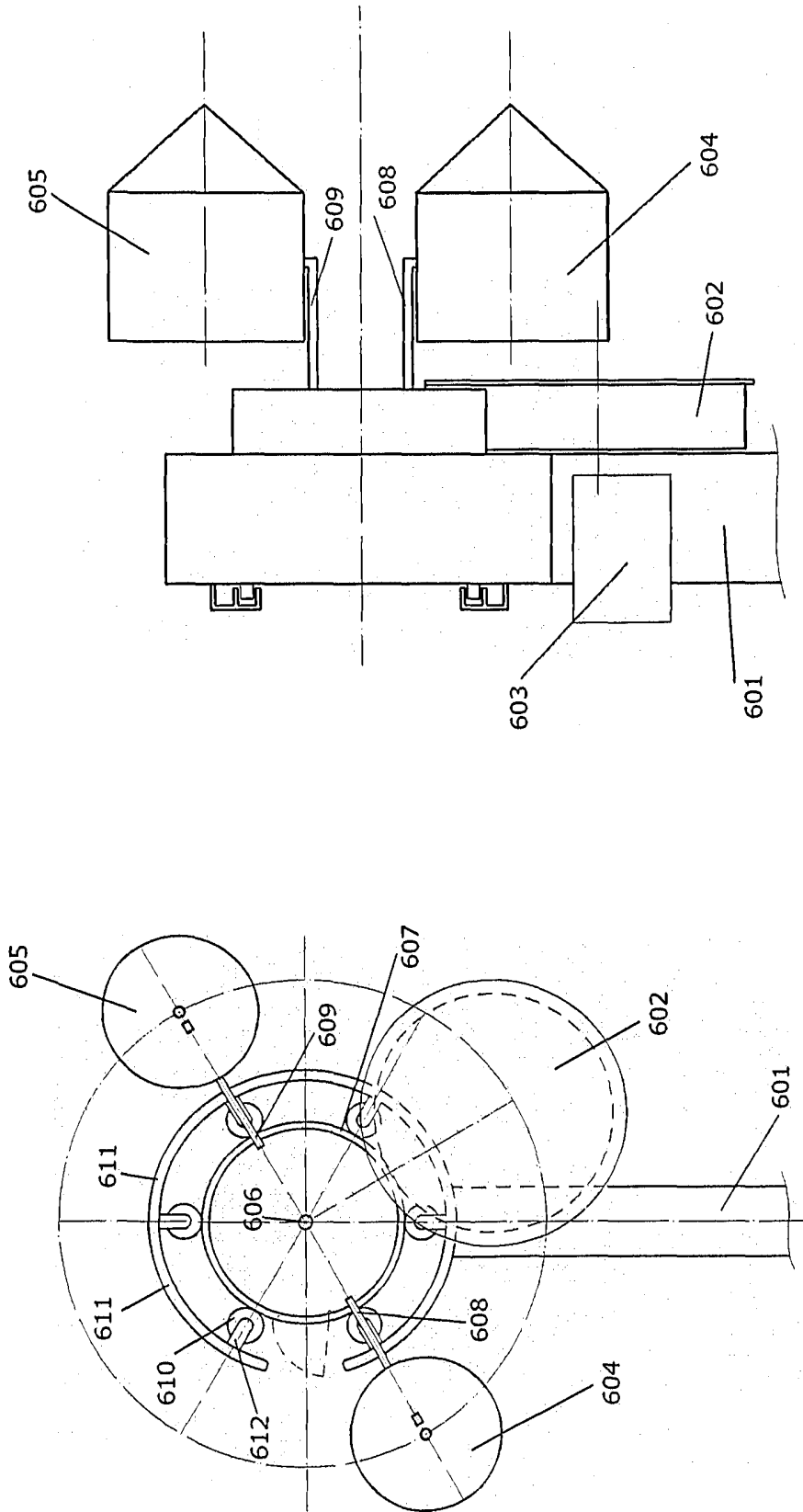


Fig. 6b

Fig. 6a

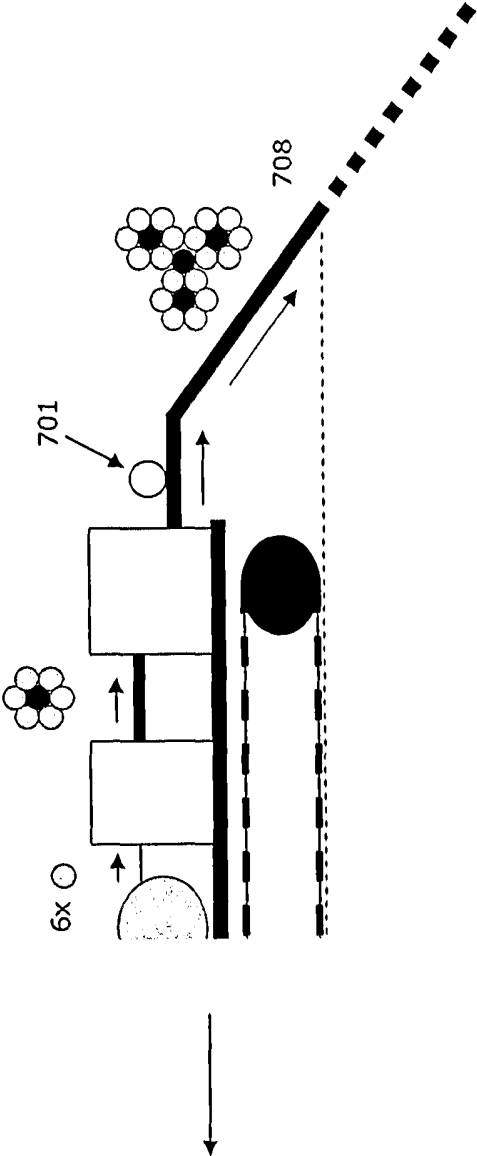


Fig. 7

13/15

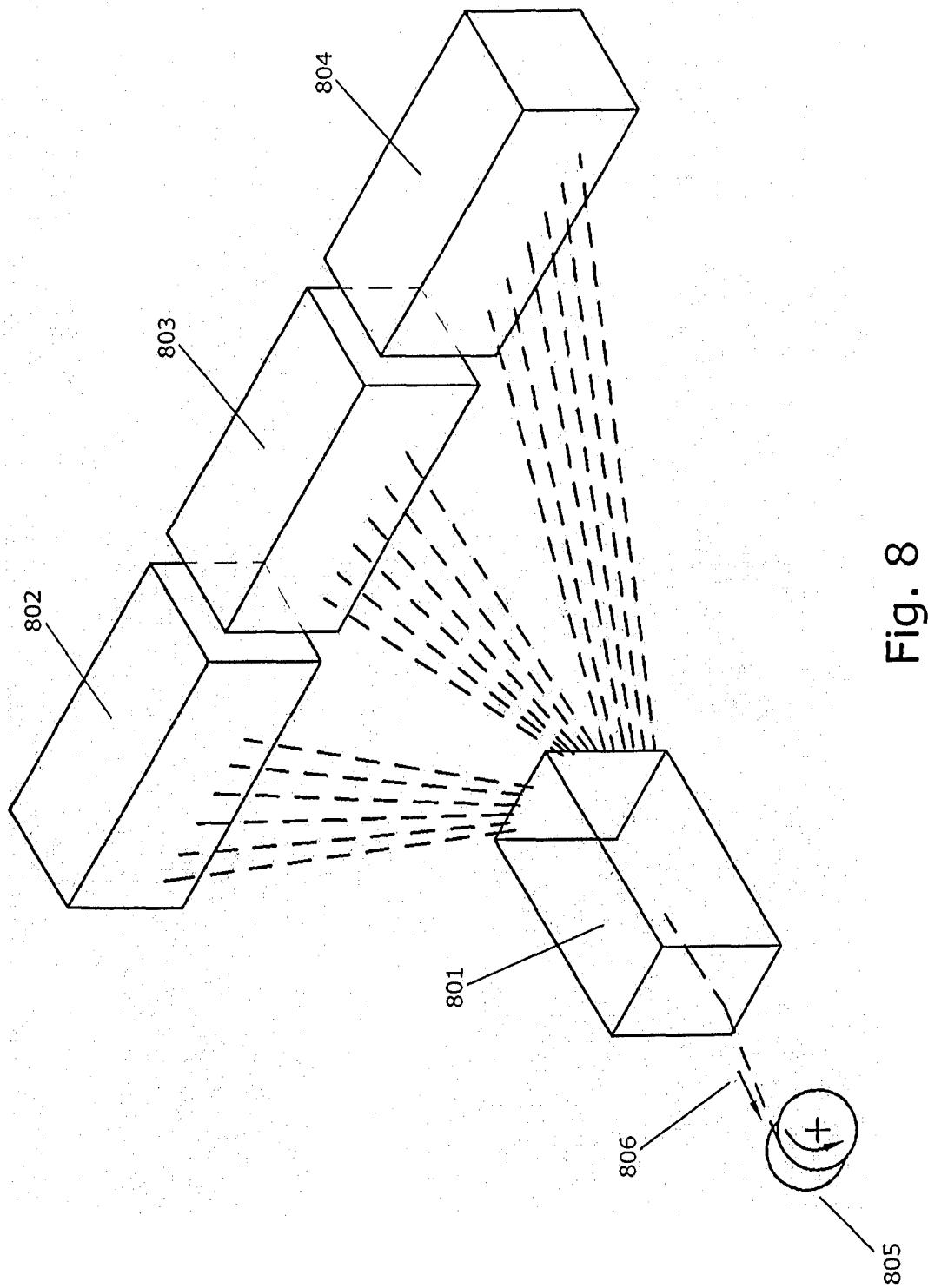


Fig. 8

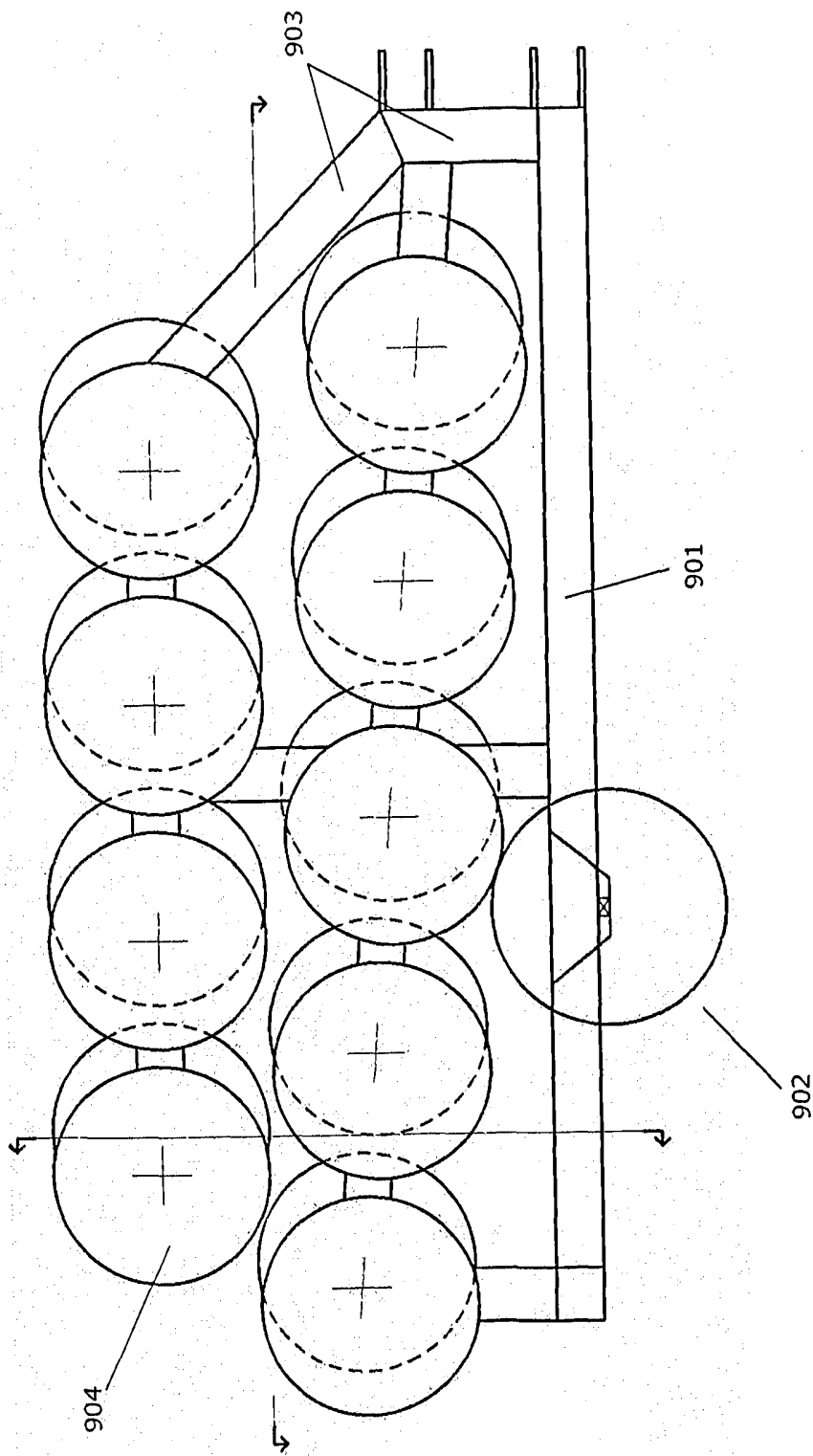


Fig. 9a

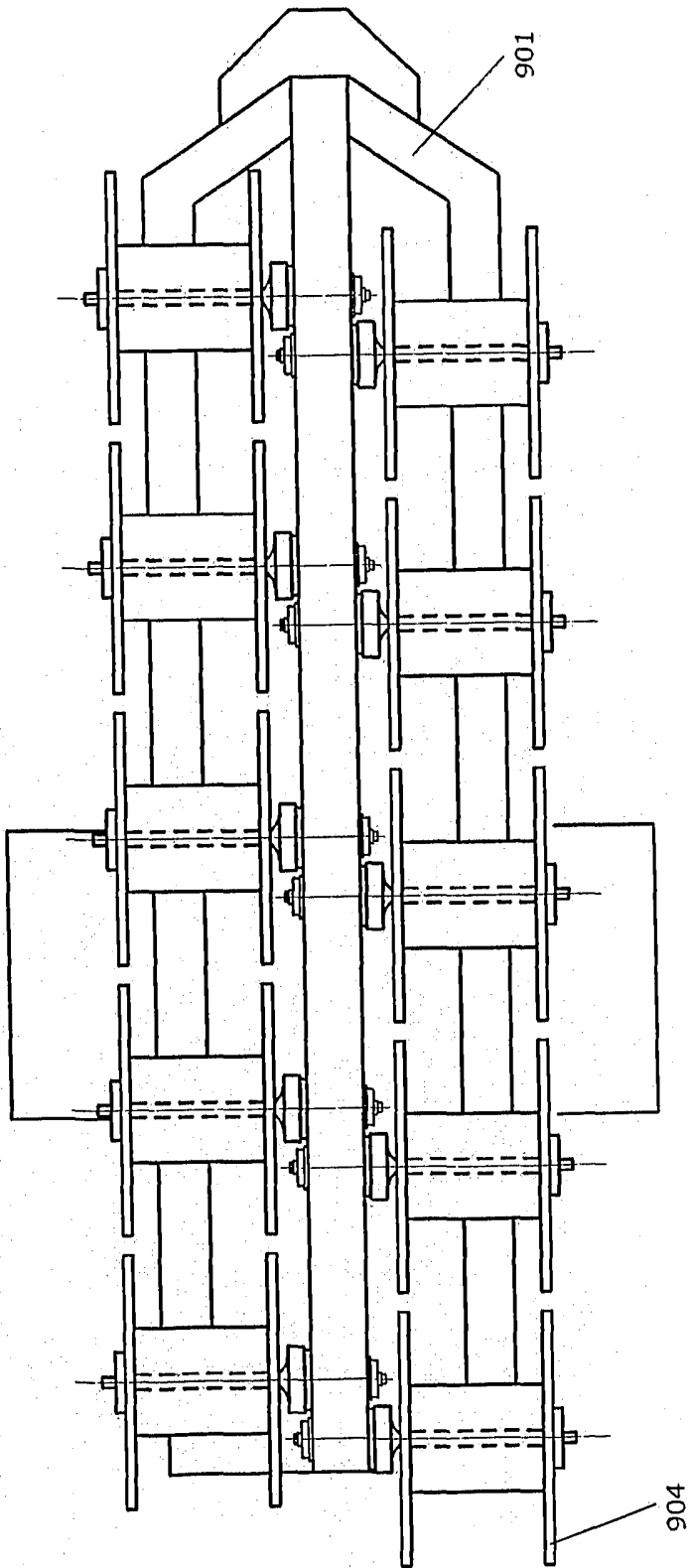


Fig. 9b