



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
25.12.2019 Bulletin 2019/52

(51) Int Cl.:
B41J 11/00 (2006.01)

(21) Application number: **18178717.7**

(22) Date of filing: **20.06.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(54) **PRINTER AND METHOD FOR REPLACING A BELT OF A PRINTER**

(57) The invention provides a printer and a method for removing a belt from a printer. The printer comprises: an endless belt (10) configured to transport sheets of a printable medium; a belt unit (20) comprising rollers for carrying, guiding and moving the belt (10), wherein the rollers (21-24) are arranged in parallel to each other; a first support structure (31) arranged at a first end of the rollers (21-24), wherein the belt unit (20) is supported in part by the first support structure (31); a removable second support structure (32) arranged at a second end of

the rollers (21-24); wherein the removable second support structure (32) is removable to allow extracting the belt (10) from the belt unit (20) and wherein the belt unit (20) is supported in part by the second support structure (32) when the second support structure (32) is not removed; and an electromagnetic supporting structure (41, 42) that is activatable to support the belt unit (20) using an electromagnetic field (50) at the second end of the rollers.

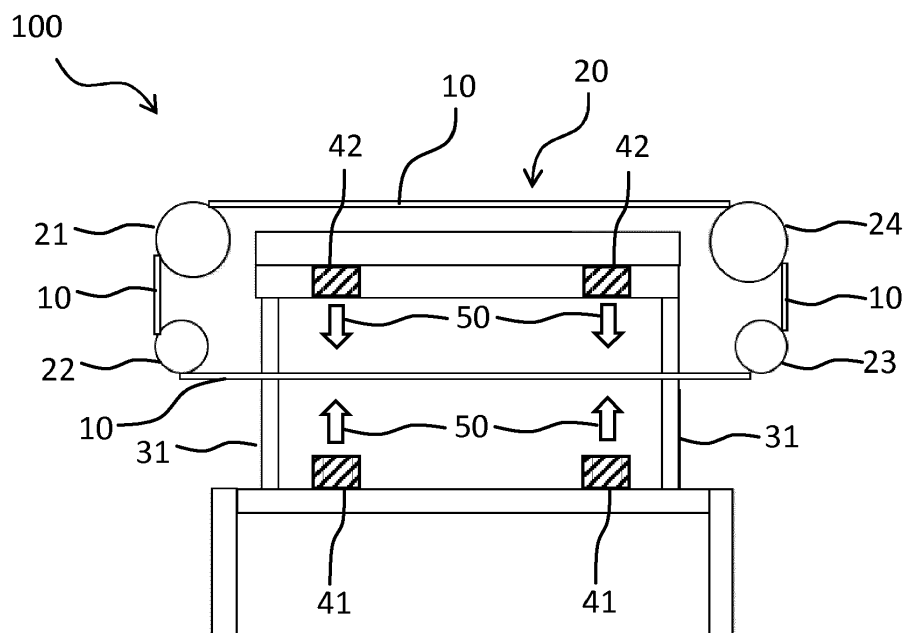


Fig. 1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a printer with a belt unit improved for easier replacement of the belt as well as to a method for replacing a belt of a printer.

BACKGROUND ART

[0002] Printers often comprise a continuous belt used for transporting sheets of paper, i.e. a belt made endless by being connected to a ring shape. Such belts are carried, guided and moved by a part of the printer that is sometimes called a belt unit, a belt conveyor, or a belt module. Belt units usually comprise a plurality of cylindric rollers that are arranged in parallel to each other, wherein the belt is in contact with the rollers and is moved tangentially along each roller.

[0003] The belt units are usually supported at both longitudinal ends of the rollers such that the weight of the belt unit is evenly distributed between two support structure, one at each end. However, after some usage, the belt always has to be replaced. In that situation, one of the support structures must be removed from the belt unit in order to be able to retrieve the belt.

[0004] This in turn means that, at the time when the belt is removed, a single support structure at one end of the belt unit must be able to support the belt unit alone. Since in that situation the weight of the belt unit applies a large angular torque to the free, unsupported end of the belt unit, the remaining support structure must be very sturdy. Such support structures add considerable to the weight of the printer and use up a lot of space within the printer, whereas it is desired to have printers that are as compact and as light-weight as possible.

[0005] In US 2012 / 0090159 A1 a method is described wherein a belt is made endless on the belt unit itself, while being placed around the rollers. Such a method may have limited accuracy and be quite difficult to perform.

[0006] In US 8 196 737 B2, a method of replacing a continuous belt on a belt module is described, wherein a specialized frame construction is used for holding the belt module during replacement of the belt.

SUMMARY OF THE INVENTION

[0007] It is one of the objects of the present invention to provide a printer with an improved belt unit that makes it easier to replace the continuous belt at the end of its lifetime without adding a lot of weight or mechanical complexity to the printer and without using up a lot of space within the printer.

[0008] According to a first aspect, the invention provides a printer comprising:

an endless belt configured to transport sheets of a

printable medium;

a belt unit comprising rollers for carrying, guiding and moving the belt, wherein the rollers are arranged in parallel to each other;

a first support structure arranged at a first end of the rollers, wherein the belt unit is supported in part by the first support structure;

a removable second support structure arranged at a second end of the rollers ;wherein the removable second support structure is removable to allow extracting the belt from the belt unit and wherein the belt unit is supported in part by the second support structure when the second support structure is not removed; and

a electromagnetic supporting structure that is activatable to support the rollers belt unit using a electromagnetic field at the second end of the rollers.

[0009] The electromagnetic supporting structure provides a contactless force (e.g. an electrical force) on the belt unit, such that the second end of the rollers is repulsed by electromagnetic support structure in a direction opposite to the direction of gravity.

[0010] The first support structure is preferably a fixed support structure. For example, such a fixed support structure cannot be removed from the printer, or can only be removed with considerable effort, i.e. by destroying the printer or by taking it completely apart. Designing the first support structure as a fixed support structure has the advantage that said support structure may be made sturdier and may be fixed more robustly and more accurately to the printer, e.g. to the housing of the printer.

[0011] The first end of the rollers, where the first support structure is arranged, may also be termed as a distal end, and the second end of the rollers, where the removable support structure is arranged, may be termed as a proximal end, because usually the user will be closer to the removable support structure than to the other support structure when replacing the belt.

[0012] Supporting the belt unit by the electromagnetic field means that the belt unit is, at that end, support without contact such that the endless belt may be removed from the belt unit through the electromagnetic field, while the belt unit is at the other end of the rollers still supported by the fixed first support structure.

[0013] According to a second aspect, the invention provides a method for removing an endless belt from a printer, comprising steps of:

activating a electromagnetic supporting structure configured to support a belt unit which comprises rollers for carrying, guiding and moving the endless belt;

removing a removable support structure for supporting the belt unit;

replacing the endless belt while the removable support structure is removed and while the electromagnetic supporting structure is activated;

reattaching or replacing the removable support structure;
deactivating the electromagnetic supporting structure.

[0014] Further variants and additional modifications will be apparent from the subject-matter of the dependent claims as well as from the description and the corresponding figures.

[0015] In some advantageous embodiments, the electromagnetic supporting structure comprises at least one first electromagnetic unit arranged apart (i.e. distanced) from the belt unit and at least one second magnet unit arranged apart at or within the belt unit. In that way, a strong electromagnetic repulsion may be efficiently created between the first and the second electromagnetic units in order to support the belt unit when the removable second support structure is removed.

[0016] In some advantageous embodiments, the electromagnetic supporting structure comprises an activatable electromagnet arranged apart from the belt unit. Electromagnets can be accurately controlled, in particular activated when they are needed and deactivated when not. When both the first and the second support structure are present, the electromagnetic field from the first electromagnet may be deactivated such that it does not interfere with any of the functions of the printer. The electromagnet may be configured to repulse, when activated, a permanent magnet arranged within the belt unit and/or an electromagnet that is arranged within the belt unit and that is activated at the same time. In some preferred embodiments, the belt unit comprises only electromagnets and no permanent magnets. In some especially preferred embodiments, the electromagnetic supporting structure comprises only electromagnets and no permanent magnets.

[0017] In some advantageous embodiments, the electromagnetic supporting structure comprises a first permanent magnet arranged apart from the belt unit. Permanent magnets are comparatively cheap and do not require additional circuitry which adds further complexity to the printer. Activating the electromagnetic supporting structure in these embodiments may comprise activating an electromagnet arranged within the belt unit in order to produce an electromagnetic field that leads to a repulsion between the electromagnet and the permanent magnet.

[0018] Alternatively, a magnetic supporting structure comprising at least one permanent magnet may be activated by, or at least by, removing a magnetic cover from the permanent magnet such that the magnetic field from the permanent magnet may unfold.

[0019] In some advantageous embodiments, the electromagnetic supporting structure comprises an activatable electromagnet arranged within the belt unit. The electromagnet may be configured to repulse, when activated, a permanent magnet arranged outside of the belt unit and/or an electromagnet that is arranged outside of the

belt unit and that is activated at the same time.

[0020] In some advantageous embodiments, the electromagnetic supporting structure is activatable manually by a switch. In this way, a user intending to remove the removable second support structure may activate the electromagnetic supporting structure in good time before doing so.

[0021] In some advantageous embodiments, the printer comprises a first detector element that is configured to detect when the removable second support structure is being removed, for example by detecting when a fastening element is unfastened, said unfastening of the fastening element being a necessary condition for removing the removable second support structure. The printer may also comprise a controller that is configured to automatically activate the electromagnetic supporting structure when the first detector element detects the removable second support structure being removed. In this way, it is ensured that the electromagnetic supporting structure is always activated in time before the support provided by the removable second support structure is removed.

[0022] In some advantageous embodiments, the printer comprises a cover element that has to be removed before the removable support structure can be removed by a user and a second detector element that is configured to detect when the cover element is being, or has been, removed. The second detector element may function by detecting when a fastening element is unfastened, said unfastening of the fastening element being a necessary condition for removing the cover element. The printer may also comprise a controller that is configured to automatically activate the electromagnetic supporting structure when the second detector element detects the cover element being removed.

[0023] In some advantageous embodiments, the printer comprises a locking element configured to prevent a removing of the removable second support structure as long as the electromagnetic supporting structure is not activated. In particular when the activating of the electromagnetic supporting structure has to be done by a manually activatable switch, this ensures that the switch is activated before the removable second support structure is removed.

[0024] In some advantageous embodiments, the activating of the electromagnetic supporting structure comprises:

- activating at least one electromagnet;
- manually activating a switch;
- detecting when the removable support structure is being removed and automatically activating the electromagnetic supporting structure when it is detected that the removable support structure is being removed;
- detecting when a cover element is being, or has been, removed, wherein the cover element has to be removed before the removable support structure can be removed;

and/or

- unlocking a locking element when the electromagnetic supporting structure is activated, wherein the locking element is configured to prevent a removing of the removable second support structure when locked.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying schematic drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

Fig. 1 shows a schematic depiction of the interior of a printer according to an embodiment of the first aspect of the present invention;

Fig. 2 shows a schematic side view of the interior of the printer of Fig. 1;

Fig. 3 schematically illustrates the replacing of the belt of the printer; and

Fig. 4 shows a schematic flow diagram illustrating a method according to the second aspect of the present invention for removing an endless belt from a printer.

DETAILED DESCRIPTION OF THE DRAWINGS

[0026] The present invention will now be described with reference to the accompanying drawings, wherein the same reference numerals have been used to identify the same or similar elements throughout the several views, and in some instances throughout the several embodiments.

[0027] Fig. 1 shows a schematic depiction of the interior of a printer 100 according to an embodiment of the first aspect of the present invention.

[0028] The printer 100 comprises an endless (or: continuous) belt 10 configured to transport sheets of a printable medium, e.g. from a paper tray of the printer 100 to a print head of the printer 100 and/or from the print head to an output tray of the printer 100.

[0029] The printer 100 further comprises a belt unit 20 that comprises rollers 21, 22, 23, 24 that are arranged in parallel for carrying, guiding and moving the belt 10. At least one roller of the rollers 21, 22, 23, 24 of the belt unit 20 is preferably an active roller 21 configured to actively move the belt 10. Other rollers may be passive rollers 22-24 that are only moved by the belt 10 setting them in motion.

[0030] The printer 100 further comprises a first support structure 31 arranged at a first end of the rollers 21-24. The first support structure 31 is configured to support the

belt unit 20 in part, e.g. to support half of its weight. The rollers 21-24 may, at their first end, be rotatably fixed to and/or by the first support structure 31.

[0031] The printer 100 further comprises a second support structure 32 arranged at a second end of the rollers 21-24, wherein the second end of the rollers 21-24 is opposite of the first end of the rollers 21-24. The second support structure 32 is a removable support structure, i.e. it may be removed from its intended position during use of the printer 100, in order to allow extracting, or removing, the belt 10 from the belt unit 20. The removable support structure 32 may be removable completely from the printer 100, or may be designed such that it may only be removed from its intended position during use while still being attached to the printer 100 in some way.

[0032] The second support structure 32 is configured to support the belt unit 20 in part when it is not removed, i.e. when it is in its intended position during use of the printer 100. For example, the second support structure may be configured to support half of the weight of the belt unit 20. The rollers 21-24 may, at their second end, be rotatably fixed to and/or by the first support structure 32.

[0033] The first and/or the second support structure 31, 32 may comprise at least one bearing for bearing at least one of the rollers 21-24 at at least one end thereof.

[0034] The removable second support structure 32 is further configured such that it does not support the belt unit 20 when it is removed. Fig. 2 shows a schematic side view of the interior of the printer 100 with the removable second support structure 32 still attached (i.e. place for supporting the belt unit 220).

[0035] The printer 100 therefore comprises a electromagnetic supporting structure comprising a first electromagnetic unit 41 arranged apart, or distanced, from the belt unit 20 and a second electromagnetic unit 42 arranged at or within the belt unit 20. The electromagnetic supporting structure 41, 42 is activatable to support the belt unit 20 using an electromagnetic field 50 at the second end of the rollers 21-24. In a preferred embodiment, the electromagnetic supporting structure is a magnetic supporting structure configured to generate a magnetic field which repels the second end of the rollers.

[0036] Preferably, the electromagnetic field 50 is configured to, when activated, create a repulsion (i.e. repulsive force) between the belt unit 20 and another part of the printer 100 that is able to counteract the weight force and angular torque acting on the end of the belt unit 20 that will become unsupported when the removable second support structure 32 is removed.

[0037] Since objects can generally pass through the electromagnetic field 50 without critically interrupting it, the belt 10 may, when the second support structure 32 is removed while the electromagnetic supporting structure 41, 42 is activated such that it generates a repulsive electromagnetic field 50, be simply removed from the belt unit 20 as shown schematically in Fig. 3.

[0038] In preferred embodiments, both the first elec-

tromagnetic unit 41 and the second electromagnetic unit 42 are implemented as comprising, more preferably consisting of, at least one activatable electromagnet. However, as has been described in the foregoing, each of the first and second electromagnetic units 41, 42 may also

comprise, or consist of, at least one permanent magnet. **[0039]** In the embodiment shown in Fig. 1 to Fig. 3, two first electromagnetic units 41 and two second electromagnetic units 42 are provided, wherein each of the two first electromagnetic units 41 is arranged to electromagnetically oppose, when activated, a respective one of the two second electromagnetic units 42, when activated, and vice versa. Since the support provided by the electromagnetic supporting structure is arranged to bear the weight of the belt unit 20, preferably each of the two first electromagnetic units 41 is arranged directly under a respective one of the second electromagnetic units 42.

[0040] It should be understood that only a single first electromagnetic unit 41 and/or only a single second electromagnetic unit 42 may be provided, or that more than two first electromagnetic units and/or more than two second electromagnetic units 42 may be provided. The number of electromagnetic units 41, 42 to be provided may depend on, for example, a weight and/or an horizontal width (parallel to the ground and perpendicular to a direction in which the belt 10 is removed from the belt unit 10) of the belt unit 20. The number of first electromagnetic units 41 may be the same as the number of second electromagnetic units 42, but the two numbers may also be different. Preferably, the electromagnetic units 41, 42 are magnetic units, such that the electromagnetic support structure is a magnetic support structure.

[0041] The first electromagnetic units 41 may be configured to create a electromagnetic field that is somewhat weaker towards the middle of the horizontal width W of the belt unit 20 than towards the horizontal ends of the belt unit 20 so as to create a stable minimum around, or exactly at, the middle of the horizontal width of the belt unit 20.

[0042] As has been described in the foregoing, the activating of the electromagnetic supporting structure 41, 42 may be effected by a number of different mechanisms: The printer 100 may comprise a detector element that is configured to detect when the removable second support structure 32 is being removed, and a controller that is configured to automatically activate the electromagnets 41, 42 of the electromagnetic supporting structure when the detector element detects the removable second support structure 32 being removed.

[0043] The printer 100 may, in addition or alternatively, comprise a cover element that has to be removed before the removable support structure 32 can be removed by a user, and a detector element that is configured to detect when the cover element is being, or has been, removed. The printer 100 may also comprise a controller that is configured to automatically activate the electromagnets of the electromagnetic supporting structure when the

second detector element detects the cover element being removed.

[0044] The printer 100 may also comprise a manually activatable switch for activating the electromagnets 41, 42 of the electromagnetic supporting structure, for example a switch arranged at a housing of the printer 100. Additionally or alternatively, the printer 100 may also be provided with an interface configured to receive a command signal for activating and/or deactivating the electromagnets 41, 42, for example from a mobile device of a maintenance worker or the like.

[0045] The printer 100 may, in addition or alternatively, comprise a locking element configured to prevent a removing of the removable second support structure 32 as long as the electromagnetic supporting structure is not activated.

[0046] Fig. 4 shows a schematic flow diagram illustrating a method for removing an endless belt 10 from a printer. The method according to Fig. 4 may be performed on the printer according to the first aspect of the present invention, in particular on the printer 100 of Fig. 1 to Fig. 3, and may be adapted according to all modifications and variation as discussed with respect to the printer according to the first aspect and vice versa. Although for the description of the method partially reference signs of Fig. 1 to Fig. 3 will be used, it should be understood that the method is not limited to the embodiment described with respect to Fig. 1 to Fig. 3.

[0047] In a step S10, a electromagnetic supporting structure 41, 42 configured to support a belt unit 20 which comprises rollers 21-24 for carrying, guiding and moving the endless belt 10 is activated. The activating S10 may occur according to any of the variants as has been described in the foregoing, e.g. manually, by a control signal from a mobile device and/or based on a signal from one of the described detector elements. Accordingly, the step S10 may comprise sub-steps of detecting when the removable support structure 32 is being removed and/or detecting when a cover element is being, or has been, removed, in particular when the printer 100 is configured such that the cover element has to be removed before the removable support structure 32 can be removed.

[0048] In some advantageous embodiments, the method may be designed such that activating the electromagnetic supporting structure 41, 42 also causes a locking element that is configured to prevent a removing of the removable second support structure 32 when it is locked, to be unlocked.

[0049] The electromagnetic supporting structure may be provided such as has been described in the foregoing with respect to Fig. 1 to Fig. 3, in particular as comprising, preferably consisting of, electromagnets 41, 42. In that case, activating the electromagnetic supporting structure 41, 42 may comprise, or consist of, activating said electromagnets 41, 42.

[0050] In a step S20, the removable support structure 32 for supporting the belt unit 20 is removed, e.g. completely from the printer or simply from a position in which

it interferes with the removing of the belt 10, to a position where the removable support structure 32 can no longer fully, or no longer at all, support the belt unit 20. The removing of the removable support structure 32 may be performed by a user (e.g. a maintenance worker) and/or by a robot or the like. A robot configured and programmed to remove the removable support structure 32 may be configured to also emit a control signal for activating the electromagnetic supporting structure 41, 42.

[0051] In a step S30, the endless belt 10 is removed while the removable support structure is removed 32 and while the electromagnetic supporting structure 41, 42 is activated. Step S30 is illustrated schematically in Fig. 3. Since the electromagnetic supporting structure 41, 42 supports the belt unit 20 by use of a electromagnetic field 50 generated by the activated electromagnetic supporting structure 41, 42, removing the belt 10 preferably comprises moving the belt 10 through the electromagnetic field 50, moving a replacement belt through the electromagnetic field 50 and mounting the replacement belt onto the belt unit 20. Also the removing S30 of the endless belt 10 may be performed by a user and/or by a robot.

[0052] In a step S40, the removable support structure 32 is reattached, or replaced, e.g. in the same way as described with respect to step S20.

[0053] In a step S50, the electromagnetic supporting structure 41, 42 is deactivated, for example by stopping to submit a control signal for activating the electromagnetic supporting structure, by actuating a manual switch, by sending a control signal for deactivating the electromagnetic supporting structure and/or the like. When a locking element as described in the foregoing is present, as part or as a result of step S50, also the locking element may be locked again.

[0054] It will be evident that the described embodiments may be varied in many ways. All such modifications as would be evident to one skilled in the art starting from what is explicitly described are intended to be included.

Claims

1. A printer (100) comprising:

an endless belt (10) configured to transport sheets of a printable medium; a belt unit (20) comprising rollers for carrying, guiding and moving the belt (10), wherein the rollers (21-24) are arranged in parallel to each other;
a first support structure (31) arranged at a first end of the rollers (21-24), wherein the belt unit (20) is supported in part by the first support structure (31);
a removable second support structure (32) arranged at a second end of the rollers (21-24);
wherein the removable second support struc-

ture (32) is removable to allow extracting the belt (10) from the belt unit (20) and wherein the belt unit (20) is supported in part by the second support structure (32) when the second support structure (32) is not removed; and
an electromagnetic supporting structure (41, 42) that is activatable to support the belt unit (20) using an electromagnetic field (50) at the second end of the rollers.

2. The printer (100) of claim 1, wherein the electromagnetic supporting structure (41, 42) comprises at least one first electromagnetic unit (41) arranged apart from the belt unit (20) and at least one second magnet unit (42) at or within the belt unit (20).
3. The printer (100) of claim 2, wherein the at least one first electromagnetic unit (41) comprises an activatable electromagnet.
4. The printer (100) of claim 2 or 3, wherein the at least one first electromagnetic unit (41) comprises a permanent magnet.
5. The printer (100) of any one of claims 2 to 4, wherein the at least one second electromagnetic unit (42) comprises an activatable electromagnet.
6. The printer (100) of any one of claims 2 to 5, wherein the at least one second electromagnetic unit (42) comprises a permanent magnet.
7. The printer (100) of any one of claims 1 to 6, wherein the electromagnetic supporting structure (41, 42) is manually activatable by a switch.
8. The printer (100) of any one of claims 1 to 7, comprising a first detector element that is configured to detect when the removable second support structure (32) is being removed; and
a controller that is configured to automatically activate the electromagnetic supporting structure (41, 42) when the first detector element detects the removable second support structure (32) being removed.
9. The printer (100) of any one of claims 1 to 8, comprising a cover element that has to be removed before the removable support structure (32) can be removed;
a second detector element that is configured to detect when the cover element is being, or has been, removed; and
a controller that is configured to automatically activate the electromagnetic supporting structure (41, 42) when the second detector element detects the cover element being removed.

10. The printer according to any of claims 1 to 9,
comprising a locking element configured to prevent
a removing of the removable second support struc-
ture (32) as long as the electromagnetic supporting
structure (41, 42) is not activated. 5
11. A method for removing an endless belt (10) from a
printer, comprising steps of:
- activating (S10) a electromagnetic supporting 10
structure configured to support a belt unit (20)
which comprises rollers for carrying, guiding and
moving the endless belt (10);
removing (S20) a removable support structure
for supporting the belt unit (20); 15
replacing (S30) the endless belt (10) while the
removable support structure (32) is removed
and while the electromagnetic supporting struc-
ture (41, 42) is activated;
reattaching (S40) or replacing the removable 20
support structure (32);
deactivating (S50) the electromagnetic support-
ing structure (41, 42).
12. The method of claim 11, 25
wherein the activating (S10) of the electromagnetic
supporting structure (41, 42) comprises activating at
least one electromagnet (41, 42).
13. The method of claim 11 or 12, 30
wherein the activating (S10) of the electromagnetic
supporting structure (41, 42) comprises manually ac-
tuating a switch.
14. The method of any of claims 10 to 12, 35
wherein the activating (S10) of the electromagnetic
supporting structure (41, 42) comprises detecting
when the removable support structure (32) is being,
or has been, removed and automatically activating
the electromagnetic supporting structure (41, 42) 40
when it is detected that the removable support struc-
ture (32) is being, or has been, removed.
15. The method of any of claims 10 to 13, 45
wherein the activating (S10) of the electromagnetic
supporting structure (41, 42) comprises detecting
when a cover element is being, or has been, re-
moved, wherein the cover element has to be re-
moved before the removable support structure can
be removed. 50

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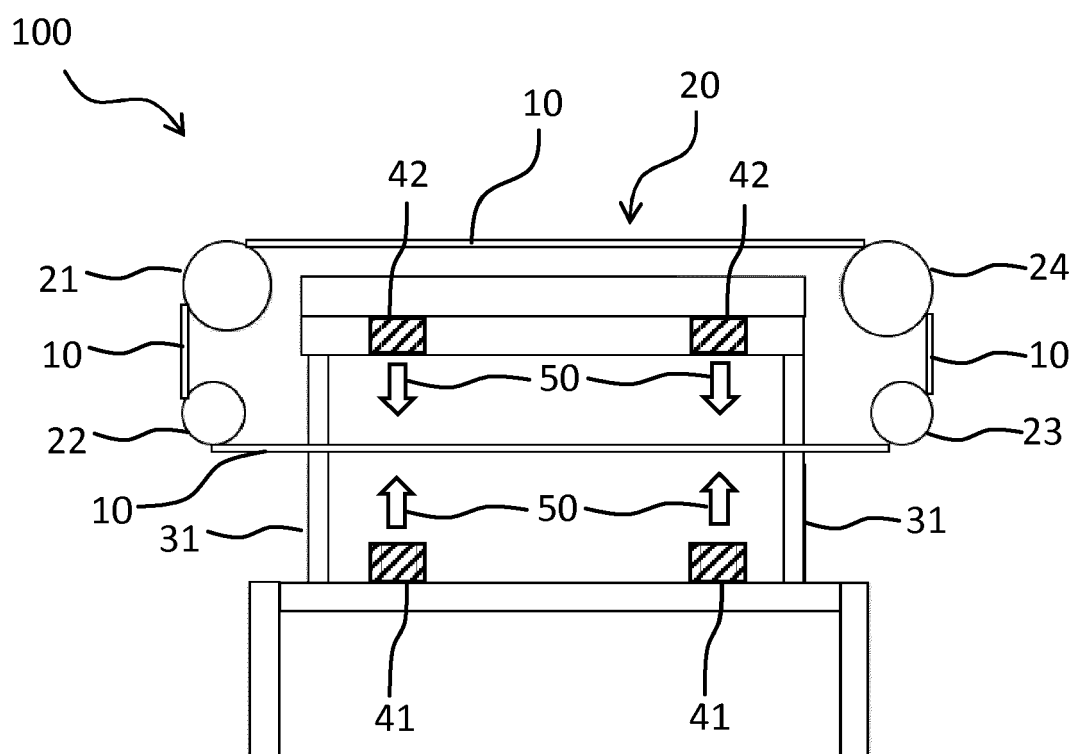


Fig. 1

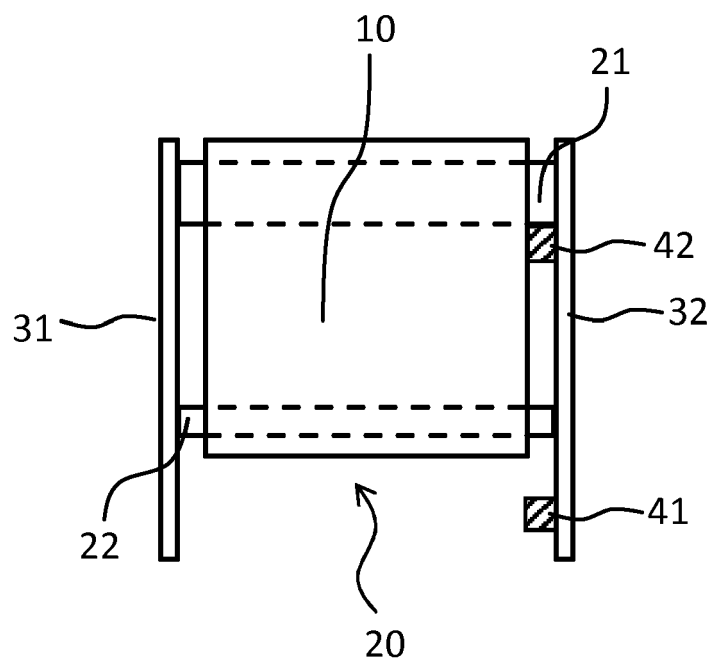


Fig. 2

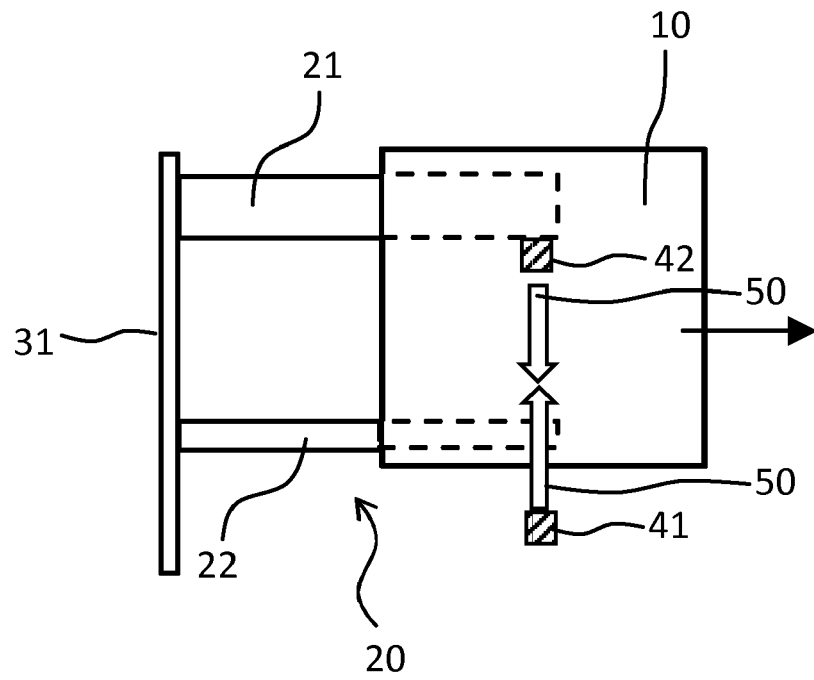


Fig. 3

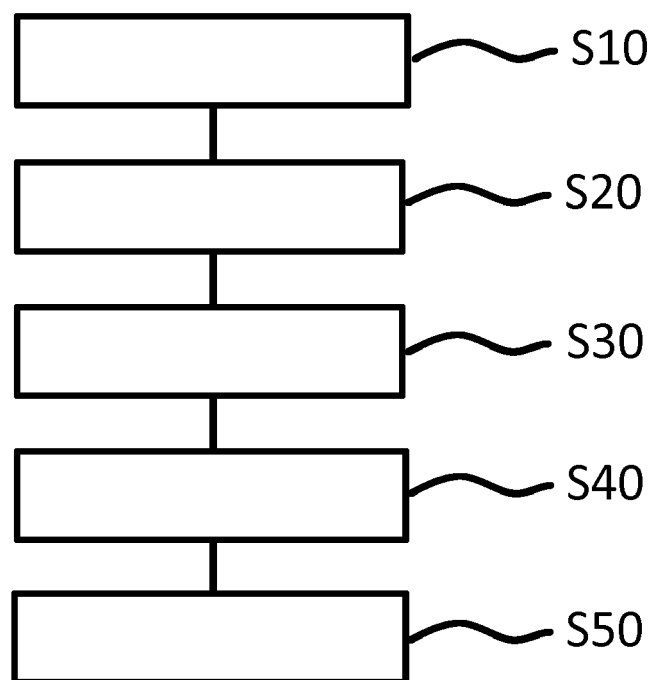


Fig. 4



EUROPEAN SEARCH REPORT

Application Number
EP 18 17 8717

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2009/244245 A1 (MITSUHASHI MASATO [JP] ET AL) 1 October 2009 (2009-10-01) * abstract; figure 1 * * paragraph [0067]; figures 5,9 * -----	1-15	INV. B41J11/00
			TECHNICAL FIELDS SEARCHED (IPC)
			B41J
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 3 December 2018	Examiner Wehr, Wolfhard
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ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 18 17 8717

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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