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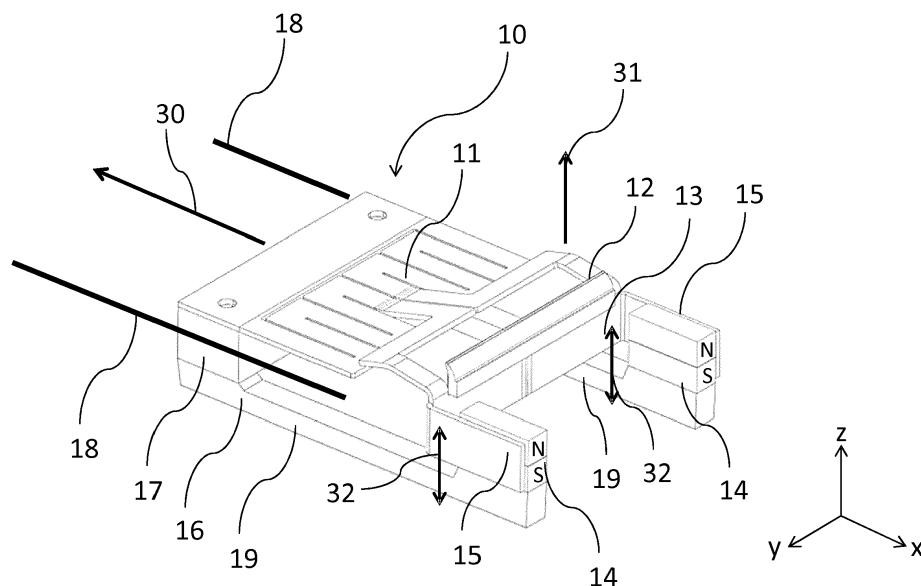
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(54) FRICTIONLESS DAMPED WIPER SUSPENSION

(57) A carriage (16) for a wiper assembly (10) for a print head of an inkjet printer, comprising: a wiper blade element (13) comprising a wiper blade (12) for wiping the print head of the inkjet printer; and a spring member (11); wherein the wiper blade element (13) is attached to the rest of the carriage (16) by means of the spring member (11); characterized in that the carriage (16) comprises at least one fin (15) attached to the wiper blade element (13) and at least one magnet (14); the at least one fin

(15) is made of an electrically conducting material; and the at least one fin (15) is positioned adjacent at a distance from the at least one magnet (14), such that oscillations (32) of the wiper blade element (13) at the spring member (11) with respect to the at least one magnet (14) cause the at least one magnet (14) to induce electrical currents in the at least one fin (15) in order to dampen said oscillations (32).

FIG 1



Description

FIELD OF THE INVENTION

[0001] The present invention relates to a carriage as well as to a wiper assembly and to an inkjet printer.

BACKGROUND ART

[0002] Inkjet printers work by expelling droplets of ink from nozzles in a nozzle plate of a print head onto a medium such as paper. To print a text or an image, either the print head moves back and forth across the paper, ejecting droplets of ink in a desired pattern as it moves, or the medium is moved relative to a stationary print head. The expelling of the droplets over time causes a wetting, or fouling, of the nozzle plate by ink droplets. During operation, sometimes also clogs in the print head are periodically cleared by firing a number of droplets of ink through each of the nozzles in a process known as spitting or purging. Droplets present on the nozzle plate can randomly detach and drip onto the medium or a medium transport belt.

[0003] As a consequence, the ink droplets from printing and from spitting have to be wiped to maintain a homogeneous printing quality. A wiper assembly is usually used for this purpose. Wiper assemblies work by pressing a wiper blade against the nozzle plate and moving the wiper blade in a wiping direction to remove ink residue, as well as paper dust or other debris that has accumulated on the print head.

[0004] One issue during the wiping process is that during the purging of the nozzle plate and printing, ink residue remains in the center of the nozzle plate in the area of the nozzles, whereas areas close to edges of the nozzle plate stay ink free. At the beginning of the wiping process the wiper blade is positioned on one edge of the nozzle plate. During the wiping process the ink is pushed forward by the wiper blade in a wiping direction, into the previously clean area in the vicinity of the edge behind the nozzles. If the wiper is in that position then removed from the nozzle plate, ink droplets and ink spatters can remain on the nozzle plate. In order to avoid the ink droplets and the ink spatters, the wiper blade has to wipe over the edge of the nozzle plate. By wiping over the edge of the nozzle plate a new issue occurs.

[0005] A conventional wiper assembly comprises a spring member to press the wiper blade against the nozzle plate. By pressing the wiper blade against the nozzle plate, the spring member is tensioned. After wiping over the edge of the nozzle plate, the tension in the spring member is suddenly released, resulting in oscillations of the spring member and the ink stained wiper blade. The oscillations cause ink spatters and therefore a fouling of the surrounding inkjet printer components.

SUMMARY OF THE INVENTION

[0006] One objective of the present invention is therefore to provide a carriage comprising a spring member for a wiper assembly for a print head of an inkjet printer with reduced fouling of the interior of the inkjet printer by ink spatters, as well as a corresponding wiper assembly and an inkjet printer.

[0007] The above objectives are solved by the independent claims of the present invention.

[0008] In accordance with the present invention, there is provided a carriage for a wiper assembly, comprising: a carriage for a wiper assembly for a print head of an inkjet printer, comprising:

a wiper blade element comprising a wiper blade for wiping the print head of the inkjet printer; and a spring member; wherein the wiper blade element is attached to the rest of the carriage by means of the spring member; characterized in that the carriage comprises at least one fin attached to the wiper blade element and at least one magnet attached to the rest of the carriage; the at least one fin is made of an electrically conducting material; and the at least one fin is positioned adjacent at a distance from the at least one magnet, such that oscillations of the wiper blade element at the spring member with respect to the at least one magnet cause the at least one magnet to induce electrical currents in the at least one fin in order to dampen said oscillations.

[0009] The term carriage (or: wiper carriage) in the context of a wiper assembly for a print head of an inkjet printer is usually applied to a component of an inkjet printer configured to carry a wiper blade for cleaning a nozzle plate of a print head.

[0010] In such a carriage, oscillations of the wiper blade element cause the at least one magnet to induce electrical currents, in particular eddy currents, in the at least one fin such that said oscillations from the spring member of the wiper blade element are damped.

[0011] Advantageously, the damping of the oscillations of the carriage prevent ink spatters when the wiper blade wipes over the edge of the nozzle plate so as to avoid a fouling of the surrounding inkjet printer components. Preferably, the at least one magnet and the at least one fin are designed and configured such that oscillations are critically damped, i.e. the spring member and the wiper blade come to a standstill after leaving the edge of the nozzle plate without changing directions once.

[0012] In some advantageous embodiments, the at least one fin is made of a non-magnetizable material. This prevents the fins from becoming magnetized themselves over time.

[0013] In some advantageous embodiments, the at

least one magnet is a permanent magnet. In this way, a magnetic field between the magnetic north pole and the magnetic south pole of the at least one magnet is provided permanently and at low cost.

[0014] In some advantageous embodiments, the at least one magnet is an electromagnet. In this way, a magnetic field of the at least one magnet is controllably provided, to enable eddy currents to dampen said oscillations of the spring member of the wiper assembly. The electromagnet enables a tuning of the magnetic field strength by controlling the amount of electric current running through the electromagnet. The tuning of the magnetic strength enables an adjustment of the strength of the damping effect. Moreover, the magnetic field can be activated when it is needed (i.e. when the wiper blade is about to detach from the nozzle plate when wiping over its edge) and can be deactivated when it is no longer needed (i.e. when oscillations have been completely damped). This may prevent the magnetic field from needlessly interacting, or even interfering, with any other printer components.

[0015] In some advantageous embodiments, the carriage further comprises a friction resistance member or a fluidic resistance member. In this way, the oscillations from the spring member can further be dampened, to achieve a stronger and faster dampening effect.

[0016] In some advantageous embodiments, the wiper blade is configured for wiping the print head in a wiping direction, and a magnetic axis between the magnetic poles of each of the at least one magnet is arranged perpendicular to the wiping direction. In this way, eddy currents are induced especially effectively.

[0017] In some advantageous embodiments, a magnetic axis between the magnetic poles of each of the at least one magnet is further arranged perpendicular to a longitudinal extent of the wiper blade. In this way, a stronger damping effect of oscillations of a spring member is enabled between the at least one fin and the at least one magnet. In some advantageous embodiments, the carriage comprises at least two fins and at least two magnets arranged symmetrically to the wiper blade. In this way, a more robust structural arrangement of the components is achieved. However, any other numbers of magnets and fins are suitable, although it is preferred that the numbers of fins and magnets are equal, and that the numbers are even (divisible by two), and that the magnets and fins are symmetrically arranged about the wiper blade.

[0018] In some advantageous embodiments, the at least two magnets are arranged between the at least two fins. In this way, a space-saving design of the wiper assembly is achieved, and the magnetic fields of the at least two magnets may strengthen one another.

[0019] In some advantageous embodiments, the at least two magnets are arranged in parallel to each other regarding their magnetic poles. In this way, a space saving design of the wiper assembly is achieved.

[0020] According to another aspect of the invention, a

wiper assembly for a print head of an inkjet printer is provided, comprising at least one carriage according to the present invention, wherein the at least one carriage is movable in a wiping direction for wiping the print head, in particular its nozzle plate.

[0021] In some advantageous embodiments of the wiper assembly the at least one carriage further comprises a rail system for guiding the at least one carriage along the wiping direction and an actuator, wherein the rail system is movable in a direction perpendicular to the wiping direction and the nozzle plate by the actuator. In this way, the wiper blade of the wiper assembly can be positioned on the surface area of the nozzle plate to clean the nozzle plate and can be moved away from the nozzle plate once the wiper blade has cleared the edge of the nozzle plate. Another actuator may be provided for moving the carriage along the wiping direction.

[0022] According to another aspect of the invention, an inkjet printer is provided, comprising at least one print head and at least one wiper assembly according to the present invention for the at least one print head.

[0023] In some advantageous embodiments, the inkjet printer comprises a plurality of print heads and a wiper assembly for each of the plurality of print heads. In this way, an independent wiping of the print heads is possible.

[0024] In some advantageous embodiments, the inkjet printer comprises a plurality of print heads and a wiper assembly for all of the plurality of print heads. In this way, an efficient wiping of the print heads is possible.

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:
In the drawings:

Fig. 1 shows a schematic perspective view of a carriage according to an embodiment of the present invention; and

Fig. 2 shows a plan cross-sectional operational view of a wiper assembly for an inkjet printer according to further embodiments of the invention.

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. The numbering of method steps is, if not explicitly or implicitly described otherwise, not intended to necessarily indicate a time ordering of steps. In particular, several steps may also be performed simultaneously.

[0027] With reference to Fig. 1 of the drawings, a carriage 16 for a wiper assembly 10 for a print head of an inkjet printer is illustrated in a schematic perspective view.

[0028] A left-handed orthogonal coordinate system, comprising an x-axis, a y-axis and a z-axis is defined in Fig. 1.

[0029] As illustrated in Fig. 1 a wiper blade 12 is mounted on a wiper blade element 13. In Fig. 1, the wiper blade 12 extends along the y direction. The wiper blade element 13 is connected to the rest of the carriage 16 by means of a spring member 11. In Fig. 1 the spring member comprises a wave spring and a flat spring. Fig. 1 is not restricting the invention to these specific spring types. The carriage 16 (more precisely: the rest of the carriage 16) further comprises a main carriage element 17 that is directly connected to the spring member 11 and two supporting carriage elements 19 protruding from the main carriage element 17. Each supporting carriage element 19 supports one magnet 14. In some variants, one supporting carriage element 19 may support, or suspend, more than one magnet 14 or even all of the magnets 14. One or more support carriage elements 19 may be connected by an optional bracing element for improved stability. Additionally a dripping pan is arranged below the wiper blade 12 to collect wiped ink residue and may be connected to at least one supporting carriage element 19.

[0030] The outer edges in y-direction of the wiper blade element 13 are symmetrically connected to two fins 15 which are movable, by the spring member 11, with respect to the magnets 14. The fins 15 are configured as thin, electrically conductive and preferably non-magnetizable plates extending in planes parallel to the x-z-plane. Preferably the thicknesses of the fins are in a range of between 0.5 and 3 mm, more preferably between 0.7 and 1.5 mm and typically about 1 mm.

[0031] The two magnets 14 are arranged between the two fins 15 and in parallel to each other regarding their magnetic axes in North-South direction in z-direction. The two fins 15 are positioned adjacent at a constant distance in y-direction from the two magnets 14. Preferably, the distance between each fin 15 and its corresponding adjacent magnet 14 in y-direction is smaller than and extent of the magnet 14 in y-direction.

[0032] Preferably, the two magnets 14 attached to the carriage 16 are permanent magnets as illustrated in Fig. 1. Permanent magnets provide strong and cost-effective magnetic fields and simplify the construction of the carriage 16.

[0033] Alternatively, the two magnets 14 attached to the carriage 16 are electromagnets. In that case a magnetic field is produced by an electric current. The magnetic field disappears when the electric current is turned off. The magnetic field, thus the magnet field strength of the at least one magnet, is changeable by controlling the amount of electric current supplied to the electromagnets.

[0034] The magnetic axes of the two permanent mag-

nets 14 in the embodiment of Fig. 1 are oriented so that their north poles N point in an engaging direction 31, oriented by the z-axis, whereas their south poles S point in the opposite direction, thus, the magnetic N-Saxes are arranged perpendicular to a longitudinal extent of the wiper blade 12. The engaging direction 31 is a direction in which the carriage 16 is movable to engage with (or: touch) the nozzle plate to be wiped.

[0035] Alternatively, the magnetic axes of the magnets 14 are oriented such that their south poles S point in the engaging direction 31, oriented by the z-axis, wherein their north poles N point in the opposite direction.

[0036] It should be appreciated, that the embodiment illustrated and described in Fig. 1, comprising two fins and two magnets, is only one representative embodiment of the invention.

[0037] The two fins 15 connected to the wiper blade element 13, are made of an electrically conducting and non-magnetizable material. The conducting and non-magnetizable material may, for example, be Aluminum, RVS 316, copper and/or the like.

[0038] Fig. 1 also illustrates a wiper assembly 10 according to a further embodiment of the invention. The wiper assembly 10 according to Fig. 1 comprises the carriage 16, as described in the foregoing. The wiper assembly 10 further comprises a rail system 18 for guiding the carriage 16 along a wiping direction 30 and an actuator. The wiper assembly 10, according to Fig. 1 and Fig. 2, is movable in the wiping direction 30, along wiping positions oriented by the x-axis. The rail system 18 is movable in the engaging direction 31 perpendicular to the wiping direction 30 by the actuator. The rail system 18 may comprise a further actuator for moving the carriage 16 in the wiping direction 30. The exact functionality of the wiping positions 1-5, the rail system 18 and the actuator will be explained in more detail below in the description of Fig. 2.

[0039] Fig. 2 schematically illustrates an inkjet printer 100 according to another embodiment of the invention and is depicted with the same coordinate system as defined in Fig. 1.

[0040] The inkjet printer 100 according to Fig. 2 comprises a print head 22 including a nozzle plate 23, and the wiper assembly 10 as described in the foregoing comprising the carriage 16 and the rail system 18 to move the carriage 16 in the wiping direction 30. The wiping direction 30 is oriented by the x-axis, according to the defined coordinate system.

[0041] Alternatively, the inkjet printer 100 comprises a plurality of print heads 22 and a wiper assembly 10 for each of the print heads 22, each wiper assembly 10 comprising a carriage 16 wherein the carriage 16 is movable in a wiping direction 30.

[0042] The wiper blade element 13 is configured for wiping the print head 22 in the wiping direction 30, whereas the print head 22 is arranged parallel to a longitudinal extent of the wiper assembly 10 and to the wiping direction 30 such that the nozzle plate extends in a plane par-

allel to the x-y-plane.

[0043] As illustrated schematically in Fig. 2, a wiping process may begin at a wiping position 1. In the wiping position 1 the wiper assembly 10 is moved by the actuator in the engaging direction 31 and by the rail system 18 in the wiping direction 30.

[0044] In the wiping position 2 the actuator engages the wiper assembly 10 with the nozzle plate 23 to start wiping in wiping direction 30. While engaged, the spring member 11 biases the wiper blade 12 against the nozzle plate 23.

[0045] In the wiping position 3 the wiper assembly 10 is moved by the rail system 18 in the wiping direction 30. While moving from the wiping position 3 to the wiping position 4 the engaged and biased wiper assembly 10 moves the wiper blade 12 over the edge 24 of the nozzle plate 23. After wiping over the edge 24 of the nozzle plate 23, the tension in the spring member 11 is suddenly released, resulting in initial oscillations 32 of the spring member 11 and the wiper blade element 13 and therefore of the fins 15 relative to the magnets 14. The oscillations 32 cause eddy currents in the two oscillating fins 15 induced by the two permanent magnets 14. Once the two electrically conducting fins 15 move through the magnetic field of the two permanent magnets 14, the two permanent magnets 14 exert a drag force on the two fins 15 which opposes the motion of the two fins 15. This drag force creates a quick and effective damping effect on the oscillations 32 and thus prevents a contamination of the surrounding components. Possible contaminated components may be the carriage 16 or the print head 22.

[0046] The wiping position 5 is a disengaging position, from where the wiper assembly 10 can be moved back to the wiping position 1 in a lowered position.

[0047] Optionally, the carriage 16 may comprise an additional friction resistance member or an additional fluidic resistance member to the magnetic induced damping to further dampen the oscillations 32 of the spring member 11.

[0048] While detailed embodiments of the present invention are disclosed herein, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure. In particular, features presented and described in separate dependent claims may be applied in combination and any advantageous combination of such claims are herewith disclosed.

[0049] Further, the terms and phrases used herein are not intended to be limiting; but rather, to provide an understandable description of the invention. The terms "a" or "an", as used herein, are defined as one or more than one. The term plurality, as used herein, is defined as two or more than two. The term another, as used herein, is

defined as at least a second or more. The terms including and/or having, as used herein, are defined as comprising (i.e., open language).

[0050] 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 carriage (16) for a wiper assembly (10) for a print head (22) of an inkjet printer (100), comprising: a wiper blade element (13) comprising a wiper blade (12) for wiping the print head (22) of the inkjet printer (100); and a spring member (11); wherein the wiper blade element (13) is attached to the rest of the carriage (16) by means of the spring member (11); **characterized in that** the carriage (16) comprises at least one fin (15) attached to the wiper blade element (13) and at least one magnet (14); the at least one fin (15) is made of an electrically conducting material; and the at least one fin (15) is positioned adjacent at a distance from the at least one magnet (14) such that oscillations (32) of the wiper blade element (13) at the spring member (11) with respect to the at least one magnet (14) cause the at least one magnet (14) to induce electrical currents in the at least one fin (15) in order to dampen said oscillations (32).
2. The carriage (16) according to claim 1, wherein the at least one fin (15) is made of a non-magnetizable material.
3. The carriage (16) according to any of claims 1 or 2, wherein the at least one magnet (14) is a permanent magnet.
4. The carriage (16) according to any of claims 1 or 2, wherein the at least one magnet (14) is an electro-magnet.
5. The carriage (16) according to any of claims 1 to 4, further comprising a friction resistance member or a fluidic resistance member to further dampen the oscillations (32) of the wiper blade element (13).
6. The carriage (16) according to any of claims 1 to 5, wherein the wiper blade (12) is configured for wiping the print head (22) in a wiping direction (30); and wherein a magnetic axis between the magnetic poles (N, S) of each of the at least one magnet (14) is arranged perpendicular to the wiping direction (30).
7. The carriage (16) according to claim 6, wherein the magnetic axis between the magnetic poles (N, S) of each of the at least one magnet (14)

is further arranged perpendicular to a longitudinal extent of the wiper blade (12).

8. The carriage (16) according to claim 1 to 7,
comprising at least two fins (15) and at least two
magnets (14) arranged symmetrically to the wiper
blade (12). 5
9. The carriage (16) according to claim 8,
wherein the at least two magnets (14) are arranged
between the at least two fins (15). 10
10. The carriage (16) according to claim 8 or 9,
wherein the at least two magnets (14) are arranged
in parallel to each other regarding their magnetic
poles (N, S). 15
11. A wiper assembly (10) for a print head (22) of an
inkjet printer (100), comprising:
a carriage (16) according to any of claims 1 to 10, 20
wherein the carriage (16) is movable in a wiping di-
rection (30).
12. The wiper assembly (10) according to claim 11,
further comprising an actuator and a rail system (18) 25
for guiding the carriage (16) along the wiping direc-
tion (30); wherein the rail system (18) is movable in
a direction (31) perpendicular to the wiping direction
(30) by the actuator. 30
13. An inkjet printer (100) comprising at least one print
head (22) and at least one wiper assembly (10) ac-
cording to claim 11 or 12 for the at least one print
head (22). 35
14. The inkjet printer (100) of claim 13,
comprising a plurality of print heads (22) and a wiper
assembly (10) according to claim 11 or claim 12 for
each of the plurality of print heads (22). 40

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FIG 1

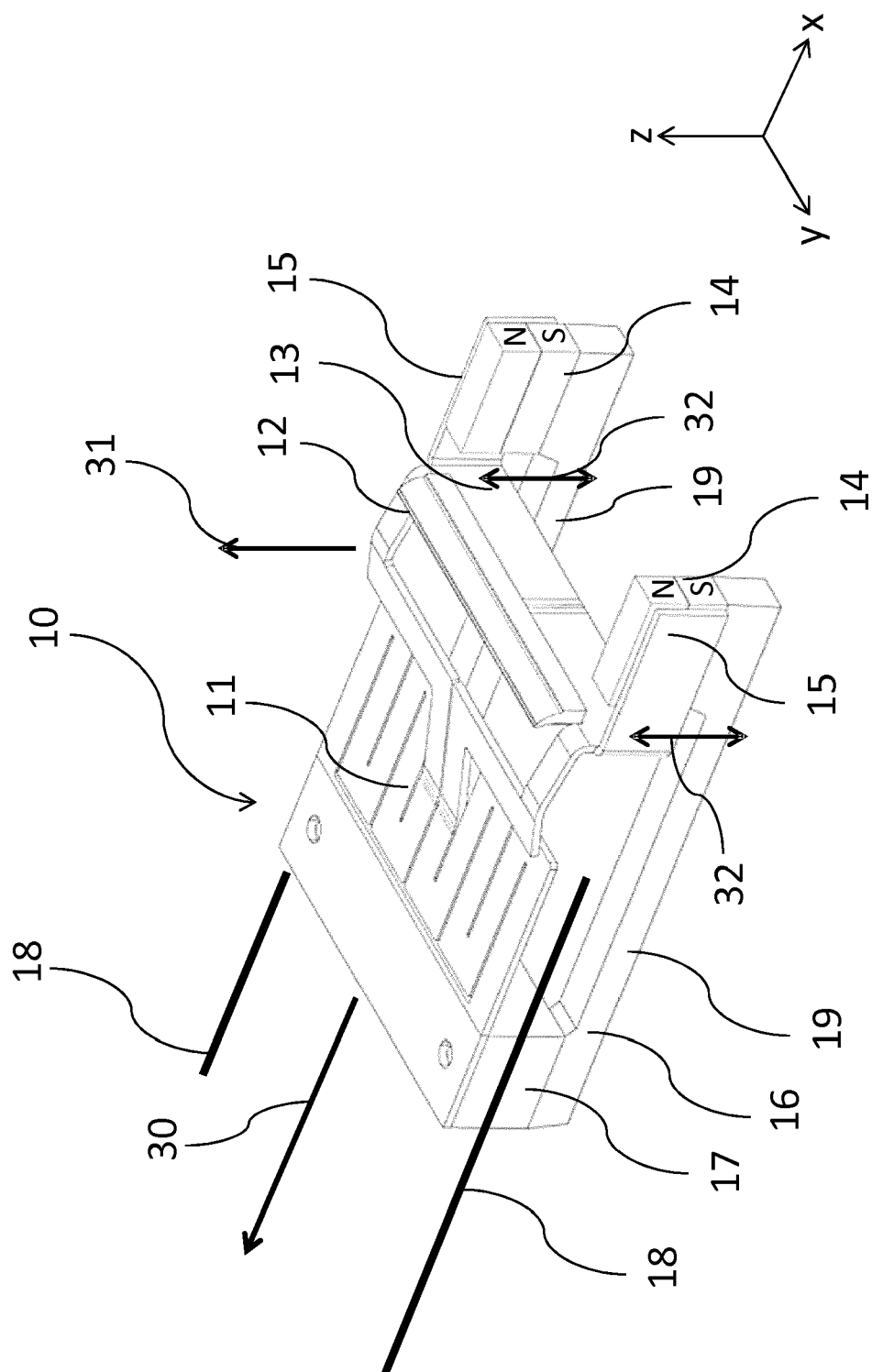
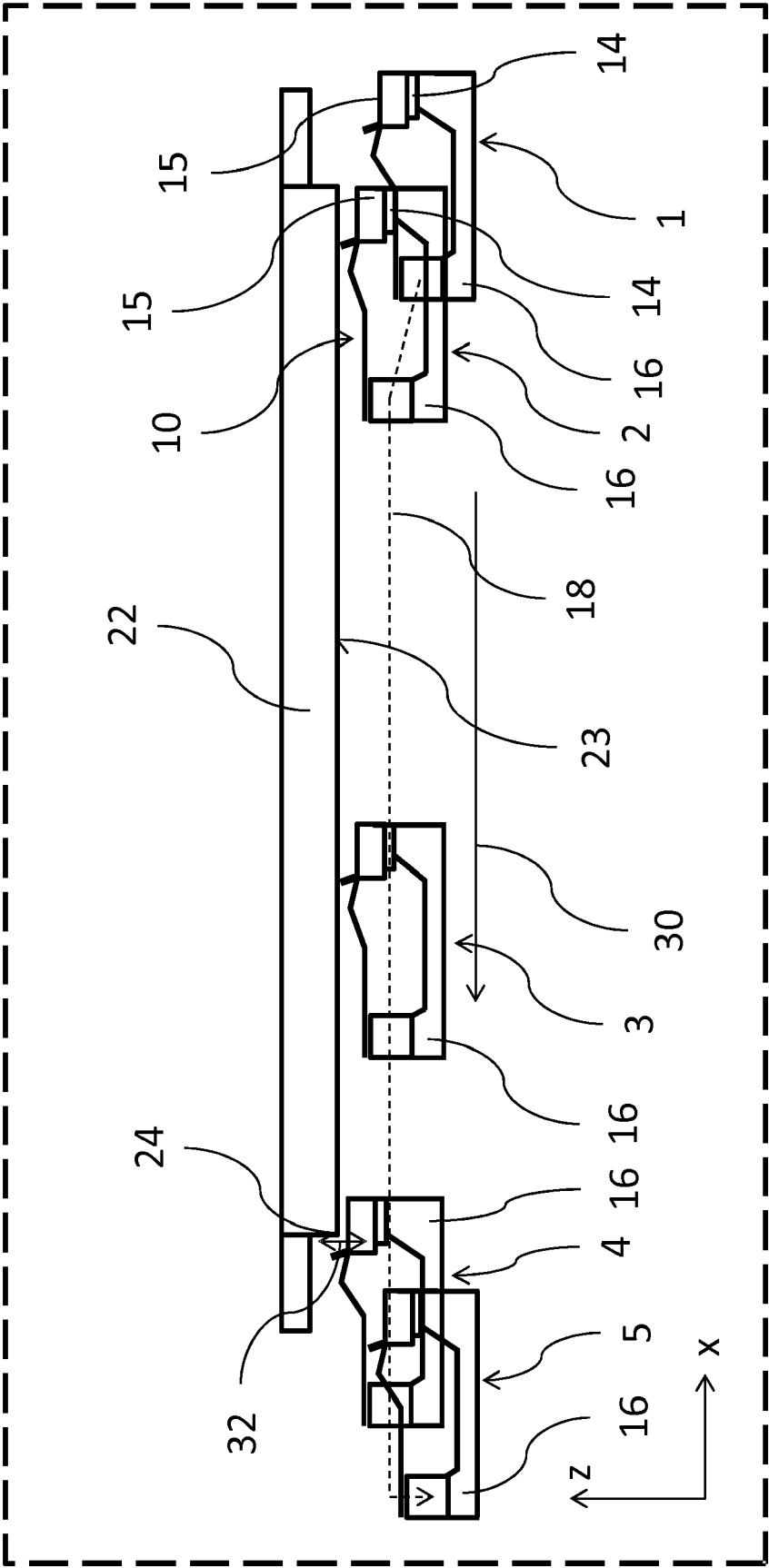


FIG 2

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EUROPEAN SEARCH REPORT

Application Number
EP 19 20 3014

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 1 April 2020	Examiner Hartmann, Mathias
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 19 20 3014

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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