(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 901 073 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.10.2021 Bulletin 2021/43

(51) Int Cl.:
B65H 29/40 *(2006.01)* ***B65H 29/12*** *(2006.01)*
B65H 31/36 *(2006.01)*

(21) Application number: **20170437.6**

(22) Date of filing: **20.04.2020**

(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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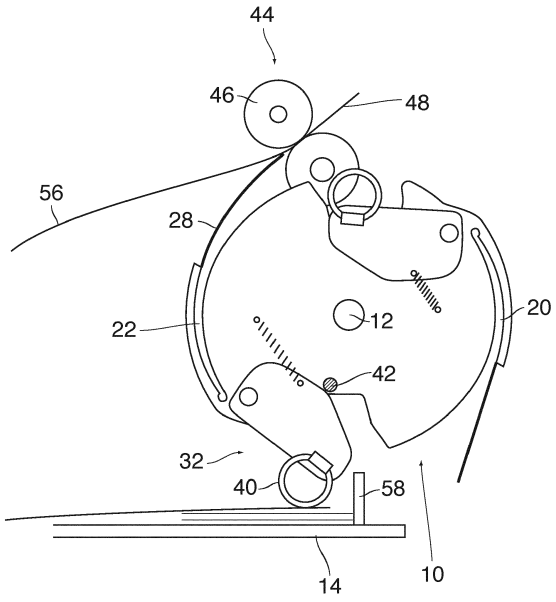
(54) A SHEET FLIPPING DEVICE

(57) A sheet flipping device comprising:
- a flipping element (10) rotatably disposed adjacent to a sheet receiving plane (14) and having, in its outer periphery, at least two insertion slots (20, 22) for insertion of a respective leading edge of a sheet (48) to be flipped;
- a sheet transport device (44) configured for feeding sheets with their respective leading edges into the insertion slots (20, 22); and
- a controller configured to control the sheet transport device (44) and a rotary drive (54) for the flipping element (10) such that each sheet the leading edge of which has been inserted into one of the insertion slots (20, 22) is temporarily restrained while the transport mechanism (44) continues to feed the sheet, so that the sheet flips over, and the sheet is then dropped onto the receiving plane (14),
characterized in that each insertion slot (20, 22) has a mouth (26) defined between a peripheral surface of the flipping element (10) and a flexible finger (28) that extends tangentially from said peripheral surface, the controller is configured to move one of the insertion slots (20, 22) into a sheet receiving position regardless of whether or not a trailing edge of a preceding sheet has left the sheet transport device, and the flexible finger (28) has sufficient flexibility to be deflected by a sheet which has its trailing edge still held in the sheet transport device (44).

Fig. 6



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Description

[0001] The invention relates to a sheet flipping device comprising:

- a flipping element rotatably disposed adjacent to a sheet receiving plane and having, in its outer periphery, at least two insertion slots for insertion of a respective leading edge of a sheet to be flipped;
- a sheet transport device configured for feeding sheets with their respective leading edges into the insertion slots; and
- a controller configured to control the sheet transport device and a rotary drive for the flipping element such that each sheet the leading edge of which has been inserted into one of the insertion slots is temporarily restrained while the transport mechanism continues to feed the sheet, so that the sheet flips over, and the sheet is then dropped onto the receiving plane.

[0002] An example of a sheet flipping device of this type has been disclosed in US 9 457 980 B2.

[0003] Such sheet flipping devices are employed for example in sheet stackers for stacking printed sheets that are successively discharged from a printing system. The flipping device is provided for flipping each sheet such that a side of the sheet which has been the top side in the sheet transport device will face downwards when the sheet is dropped onto the stack. In known sheet flipping devices, an empty insertion slot can only be brought into a receiving position for receiving a new sheet, when the trailing edge of the previous sheet has left the sheet transport device. Otherwise, a finger that delimits the insertion slot on the outer side would collide with the sheet that is still being fed from the sheet transport device, so that the sheet might be damaged. Consequently, a sufficient gap must be provided between the trailing edge of one sheet and the leading edge of the next sheet, in order for the insertion slot to have sufficient time to reach the sheet receiving position.

[0004] It is an object of the invention to provide a sheet flipping device that is capable of handling sheets that are supplied in close succession.

[0005] In order to achieve this object, according to the invention, the sheet flipping device is characterized in that each insertion slot has a mouth that is defined between a peripheral surface of the flipping element and a flexible finger that extends tangentially from said peripheral surface, the controller is configured to move one of the insertion slots into a sheet receiving position regardless of whether or not a trailing edge of a preceding sheet has left the sheet transport device, and the flexible finger has sufficient flexibility to be deflected by a sheet which has its trailing edge still held in the sheet transport device.

[0006] In the device according to the invention, an empty insertion slot can be moved already into the sheet receiving position before the previous sheet has left the nip of the sheet transport device. The high flexibility of the finger assures that the finger can be deflected by the sheet without causing damage to the sheet. Then, when the trailing edge of the sheet has left the nip, the finger can flex back into its natural position, and the slot is ready to receive the leading edge of the next sheet within an extremely short time. Consequently, the gaps between successive sheets that are being fed to the flipping device can be reduced significantly and, accordingly, the throughput of the flipping device can be increased.

[0007] Another advantage of the invention is that the time interval between the moment at which a sheet clears the insertion slot and is dropped onto the receiving plane and the moment when this slot reaches again the sheet receiving position is no longer dependent upon the length of the sheets. The gaps between successive sheets may fed even be zero

[0008] It is also possible to provide three or more insertion slots on the periphery of the flipping element, so that the throughput can be increased further.

[0009] More specific optional features of the invention are indicated in the dependent claims.

[0010] An embodiment example will now be described in conjunction with the drawings, wherein:

Fig. 1 is a schematic view of a sheet flipping device according to the invention; and

Figs. 2 to 6 shows the sheet flipping device of Fig. 1 in a sequence of operational states.

[0011] The sheet flipping device shown in Fig. 1 has a disc-like flipping element 10 that is rotatably mounted on an axis 12 and is disposed near an edge of a sheet receiving surface 14 on which a stack of sheets 16, 18 is to be formed.

[0012] Two sheet insertion slots 20, 22 are formed in the peripheral surface of the flipping element 10 at diametrically opposite positions. An inner portion of each receiving slot 20, 22 is defined between a part of the peripheral surface of the flipping element 10 and a rigid arm 24 that extends in circumferential direction of the flipping element. Further, each slot 20, 22 has a mouth 26 that is defined between another portion of the peripheral surface of the flipping element 10 and a flexible finger 28 that extends tangentially to the flipping element from a tip of the arm 24.

[0013] Two pushing mechanisms 30, 32 are mounted on the flipping element 10 in diametrically opposite positions, each pushing mechanism being disposed adjacent to an inner end of one of the insertion slots 20, 22. Each pushing mechanism 30, 32 has a cam follower 34 that is supported on the flipping element 10 so as to be rotatable about an axis 36.

[0014] In Fig. 1, the cam follower 34 of the pushing mechanism 32 is biased into a rest position by a spring 38. A friction member 40 in the form of an elastic ring 40 is mounted on the free end of the cam follower so as to project radially outwardly towards the periphery of the flipping member 10.

[0015] In the situation shown in Fig. 1, the cam follower of the other pushing mechanism 30 has run onto a stationary cam 42 and has thereby been tilted into a working position in which the friction member 40 projects further out from the periphery of the flipping element and engages the topmost sheet 18 of the stack formed on the receiving plane 14.

[0016] A sheet transport device 44 is provided at the periphery of the flipping element 10 in a position opposite to the sheet receiving surface 14. In the example shown, the sheet transport device comprises a pair of rollers 46 one of which is drivable for rotation and which form a nip in which a printed sheet 48 is held and conveyed towards the mouth 26 of the sheet insertion slot 20.

[0017] In the given example, the pair of rollers 46 constitutes the end of a sheet transport path along which printed sheets such as the sheet 48 are discharged one after another from a printer which has not been shown here.

[0018] An electronic controller 50 is provided for controlling rotary drives 52, 54 for the sheet transport device 40 and the flipping element 10.

[0019] In the situation shown in Fig. 1, the flipping element 10 is held stationary in a position in which the sheet insertion slot 20 assumes a sheet receiving position in which the mouth 26 is opened towards the nip of the pair of rollers 46, so that the leading edge of the sheet 48 may be received in the sheet insertion slot.

[0020] Fig. 2 shows the device in a later stage in which the flipping element 10 is still in the same position as in Fig. 1, but the sheet transport device 44 has conveyed the sheet 48 further, so that the leading edge of the sheet has entered into the sheet receiving slot 20. In the situation shown in Fig. 2, the leading edge of the sheet 48 has just reached the bottom of the sheet insertion slot. Optionally, the flipping element 10 may already be rotated anti-clockwise in this stage, but with a peripheral speed that is smaller than the transport speed of the sheet 48, so that the sheet will be pushed deeper into the slot 20.

[0021] In Fig. 3, the flipping element 10 is still in the same position as in Figs. 1 and 2, but the leading edge of the sheet 48 has reached the bottom of the slot 20, and, since the sheet transport device 44 continues to advance the sheet 48, a blouse 56 in the sheet has been formed in the entry part of the mouth 26. This blouse 56 engages the flexible finger 28 and has slightly flexed this finger into an outward direction.

[0022] In the above-mentioned alternative embodiment in which the flipping element 10 is rotated already in this stage, the speed of the flipping element may be controlled such that no blouse 56 is formed and the leading edge of the sheet 48 just smoothly approaches the bottom of the slot 20.

[0023] In the situation shown in Fig. 4, the flipping element 10 has been rotated by a small angle, but the peripheral speed is still smaller than the transport speed of the sheet 48, so that the blouse 56 has grown.

[0024] The friction element 40 of the pushing mechanism 30 has moved relative to the sheet receiving surface 14 while pressing onto the topmost sheet 18. Due to the rotation of the flipping element 10, the friction element 40 has also moved downward, so that the elastic, annular friction element has been slightly compressed because the cam 42 prevents the cam follower 34 from yielding. At least the outer peripheral surface of the annular friction element 40 has a relatively high frictional coefficient, so that the topmost sheet 18 on the stack has been pushed rightwards in Fig. 4 until its leading edge abuts at a registration wall 58. It is noted that, in the view shown in Fig. 4, the registration wall 58 (as well as the rollers 46) are disposed in a different plane than the flipping element 10, so that the friction element 40 can move past the registration wall 58 as the rotation of the flipping element continues.

[0025] In Fig. 5, the rotation of the flipping element 10 has accelerated and the flipping element has been turned by about 45°. The cam follower 34 of the pushing device 30 has cleared the cam 42, so that the spring 38 has drawn the cam follower back into the rest position. Meanwhile, the insertion slot 22 approaches the sheet receiving position where a new sheet can be inserted. It is noted however that the sheet 48 has not yet cleared the sheet transport device 44.

[0026] The blouse 56 in the sheet has grown further, and due to the increased rotary speed of the flipping element 10 and the increased weight of the blouse 56 the leading edge of the sheet 48 is being drawn out of the slot 20.

[0027] In Fig. 6, the flipping element 10 has been rotated by an angle of 180° relative to the position shown in Fig. 1, and the rotation has been stopped, so that the insertion slot 22 is now held stationary in the sheet receiving position. The cam follower of the pushing device 32 has run onto the cam 42 and has been tilted downwards onto the leading edge of the sheet 48 which has meanwhile dropped out of the insertion slot 20. The blouse 56 has become so large that it cannot be entirely shown in Fig. 6. Still, the trailing edge of the sheet 48 is held in the nip of the rollers 46. For this reason, the flexible finger 28 forming the mouth of the sheet insertion slot 22 cannot yet assume its straight configuration but is flexed radially inwardly by the portion of the sheet 48 that leaves the sheet transport device 44. The friction between the sheet and the finger 28 is low, so that no damage will be caused to the sheet 48. As soon as the trailing edge of the sheet 48 has left the nip of the rollers 46, the sheet 48 will flip over so that it will then lie flat on the receiving surface 14. However, the leading edge of the sheet 48 is still spaced apart from the registration wall 58.

[0028] As soon as the trailing edge of the sheet 48 has cleared the nip of the rollers 46, the flexible finger 48 will instantly flex back into the straight configuration and will form the mouth 26 that is open towards the sheet transport device, so that the leading edge of a new sheet can be inserted. Consequently, no large gap is required be-

tween the trailing edge of the sheet 48 and the leading edge of the next sheet.

[0029] As soon as the new sheet has been inserted into the slot 22 and has reached the condition shown in Fig. 3, the rotation of the flipping element 10 will be resumed and the friction element 40 of the pushing device 32 will push the leading edge of the sheet 48 against the registration wall 58.

[0030] Due to the flexibility of the fingers 28, the flipping element 10 can be rotated into a sheet receiving position already at a relatively early stage and then wait until the leading edge of the next sheet arrives. Consequently, the timing control for the intermittent rotation of the flipping element 10 is less critical than in conventional devices.

Claims

1. A sheet flipping device comprising:

- a flipping element (10) rotatably disposed adjacent to a sheet receiving plane (14) and having, in its outer periphery, at least two insertion slots (20, 22) for insertion of a respective leading edge of a sheet (48) to be flipped;
- a sheet transport device (44) configured for feeding sheets with their respective leading edges into the insertion slots (20, 22); and
- a controller (50) configured to control the sheet transport device (44) and a rotary drive (54) for the flipping element (10) such that each sheet the leading edge of which has been inserted into one of the insertion slots (20, 22) is temporarily restrained while the transport mechanism (44) continues to feed the sheet, so that the sheet flips over, and the sheet is then dropped onto the receiving plane (14),

characterized in that each insertion slot (20, 22) has a mouth (26) defined between a peripheral surface of the flipping element (10) and a flexible finger (28) that extends tangentially from said peripheral surface, the controller (50) is configured to move one of the insertion slots (20, 22) into a sheet receiving position regardless of whether or not a trailing edge of a preceding sheet has left the sheet transport device, and the flexible finger (28) has sufficient flexibility to be deflected by a sheet which has its trailing edge still held in the sheet transport device (44).

2. The sheet flipping device according to claim 1, wherein the flipping element (10) has two insertion slots (20, 22) with a mutual angular spacing of 180°.

3. The sheet flipping device according to claim 1 or 2, wherein each insertion slot (20, 22) has an inner portion that is outwardly delimited by a rigid arm (24) of the flipping element (10), and the flexible finger (18) projects from a free end of said arm (24).

4. The sheet flipping device according to any of the preceding claims, wherein the flipping element (10) has, for each insertion slot (22), a pushing mechanism (30, 32) arranged to engage a sheet (18) that has been dropped onto the receiving surface (14) and then to push this sheet against a registration wall (58) as the flipping element (10) rotates.

5. A software product comprising computer-readable program code that, when loaded into a controller (50) of a sheet flipping device according to any of the preceding claims, causes the controller to operate as specified in claim 1.

Fig. 1

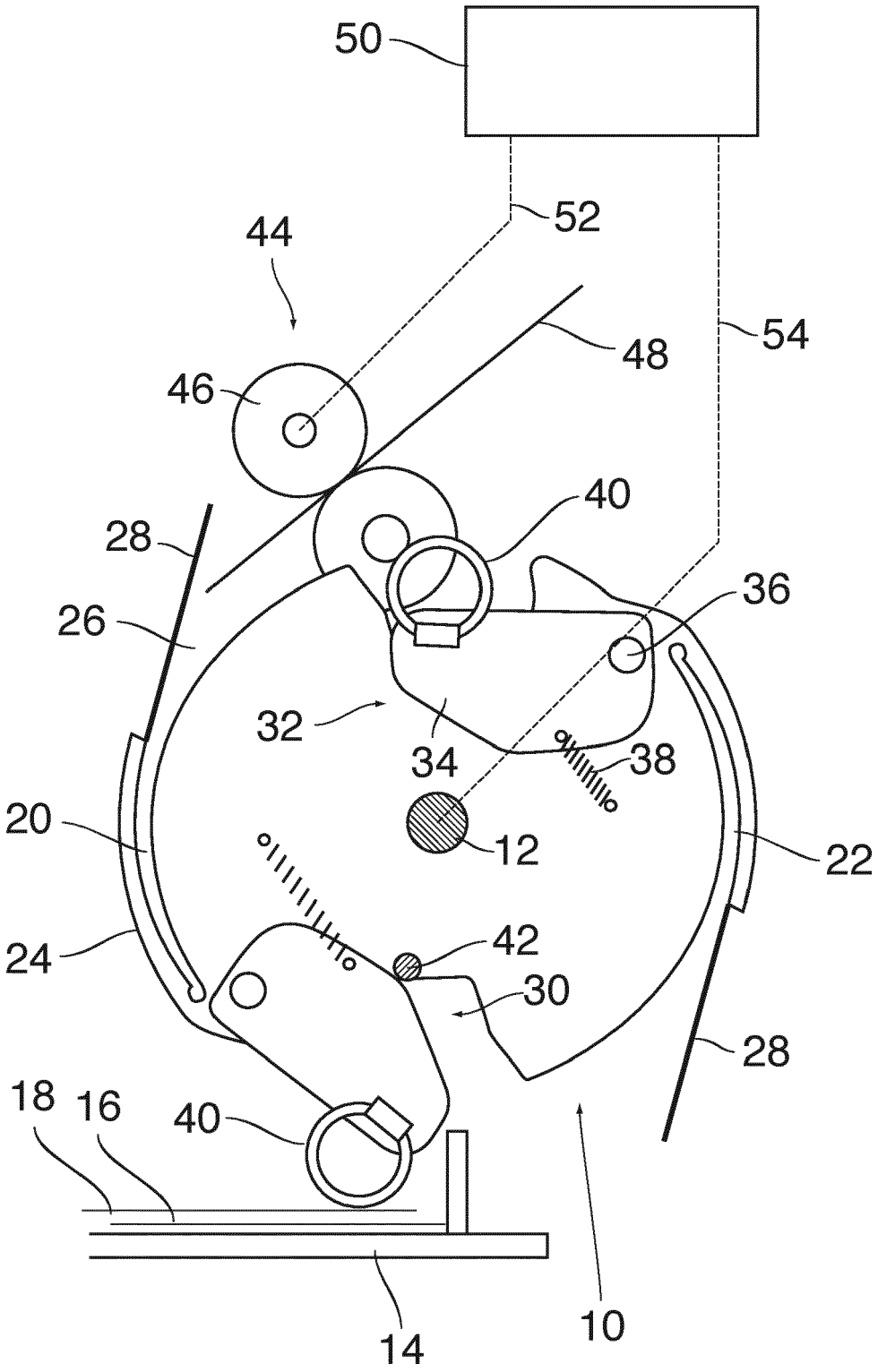
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Fig. 2

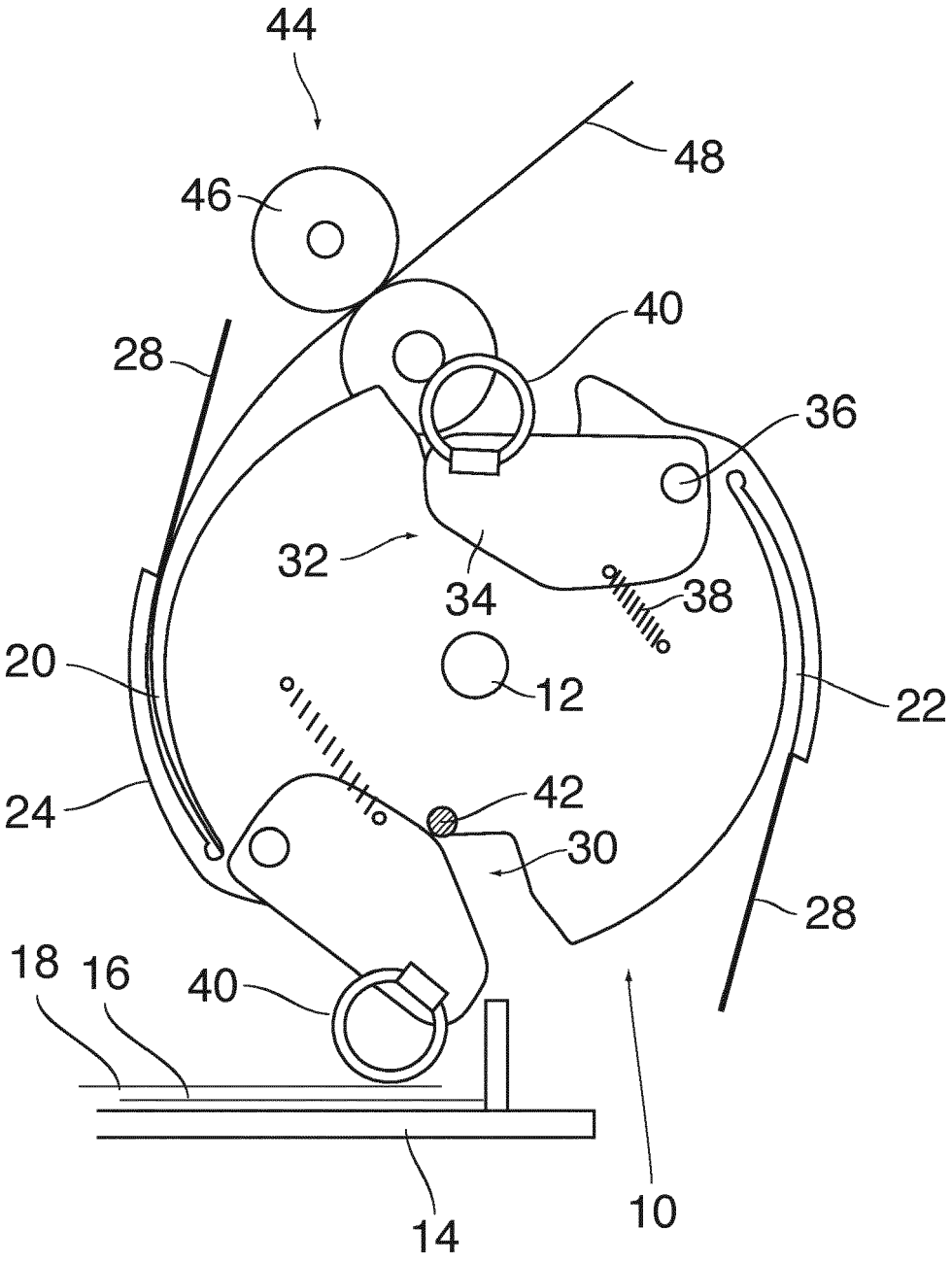


Fig. 3

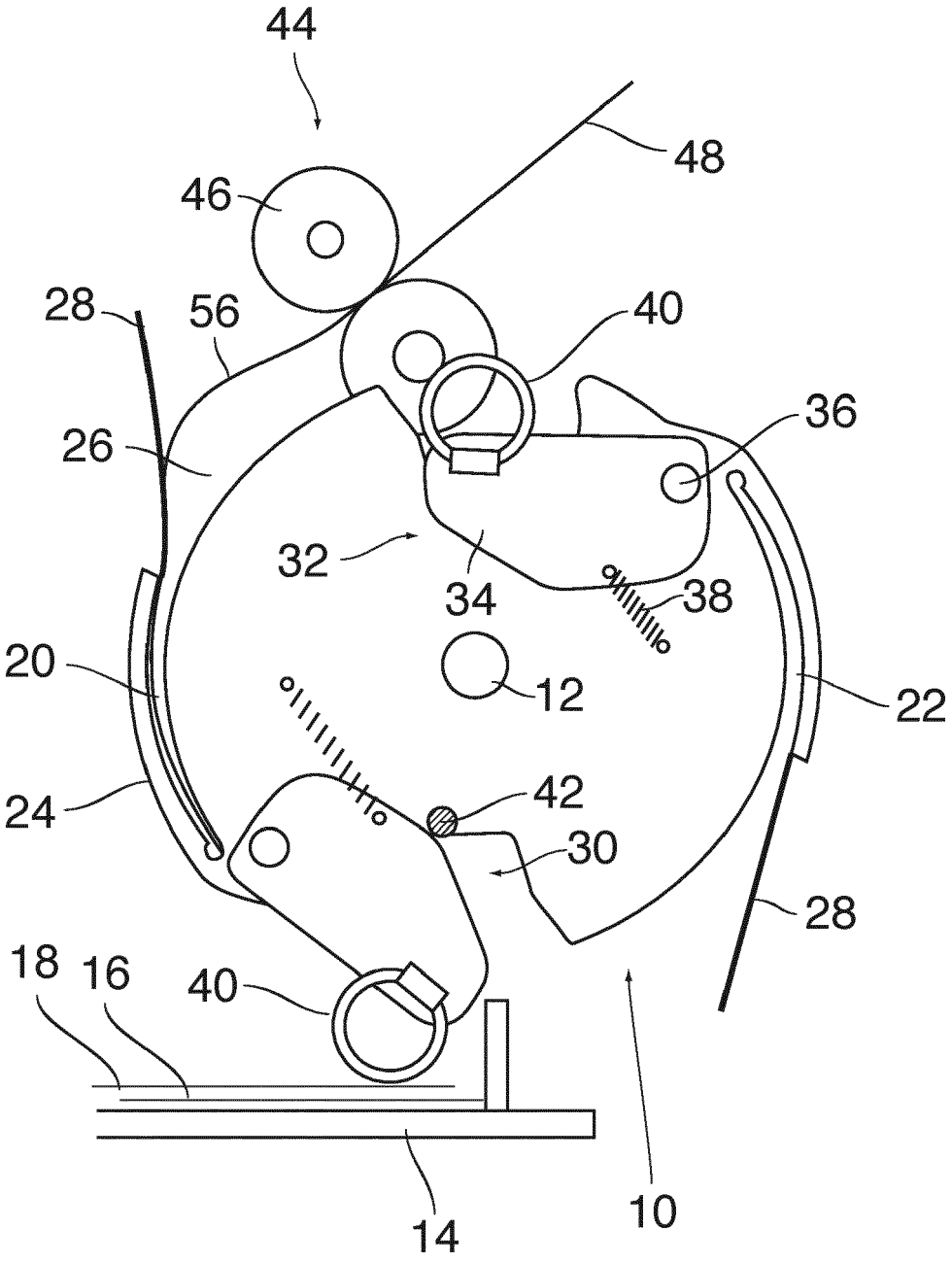


Fig. 4

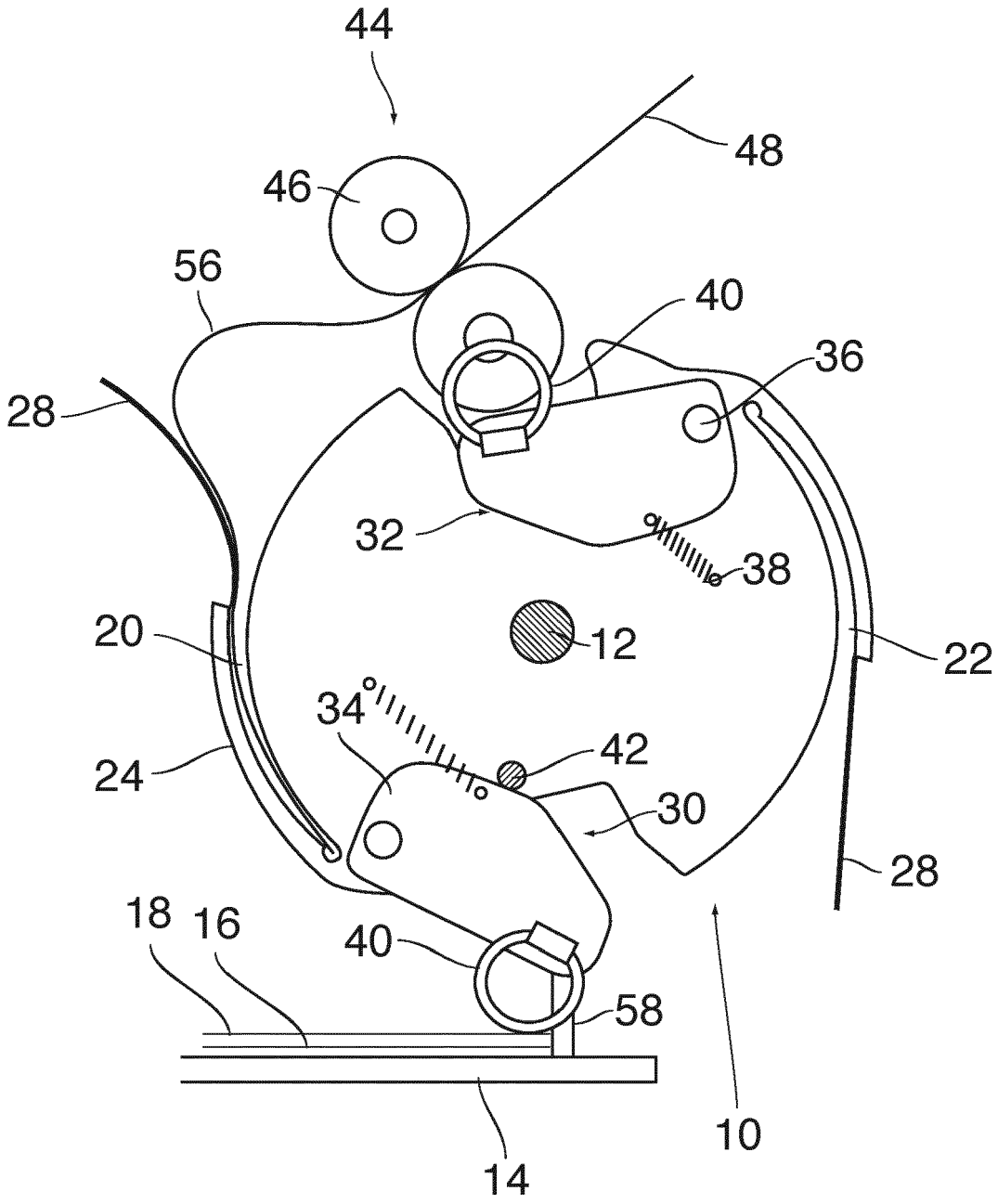


Fig. 5

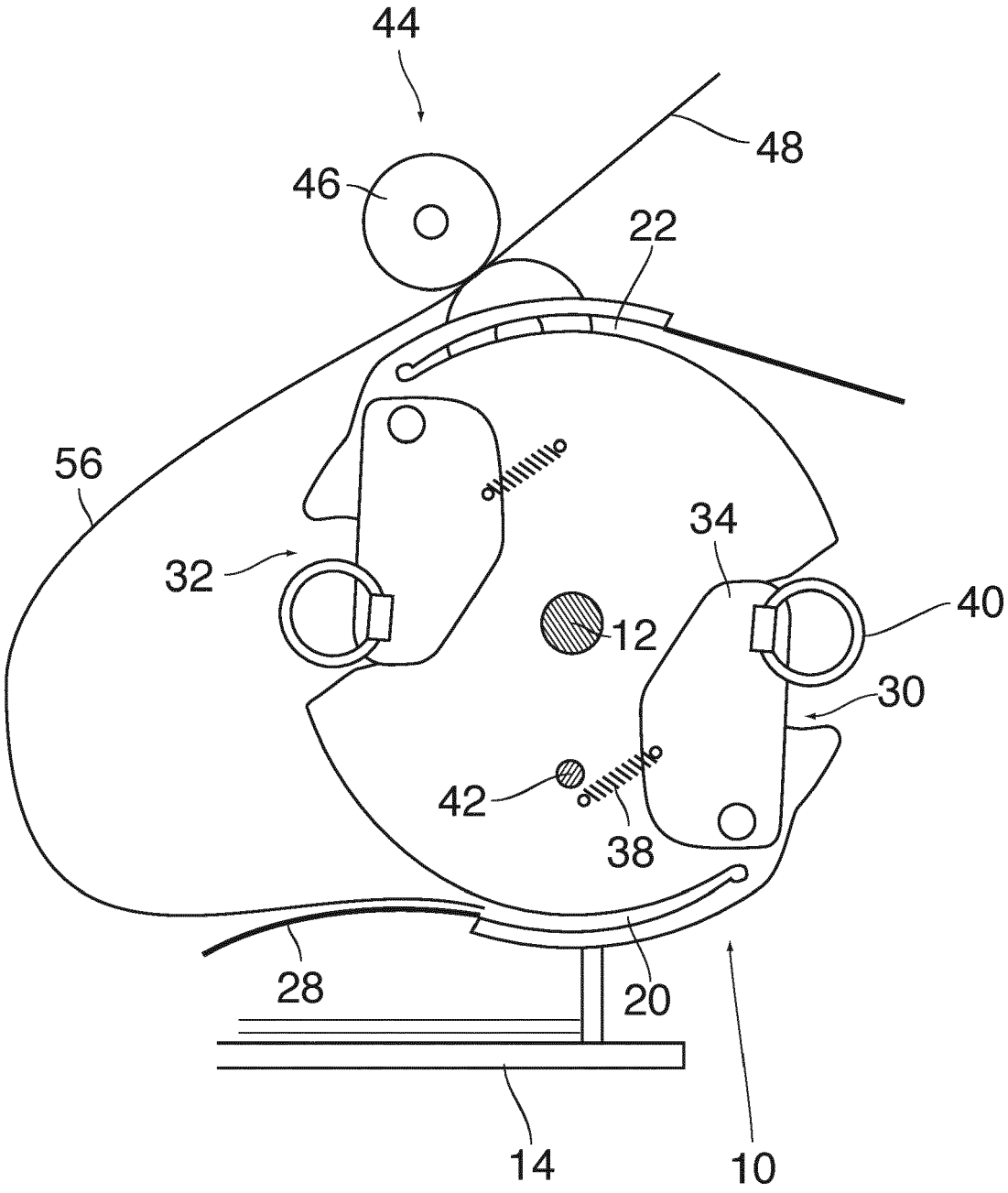
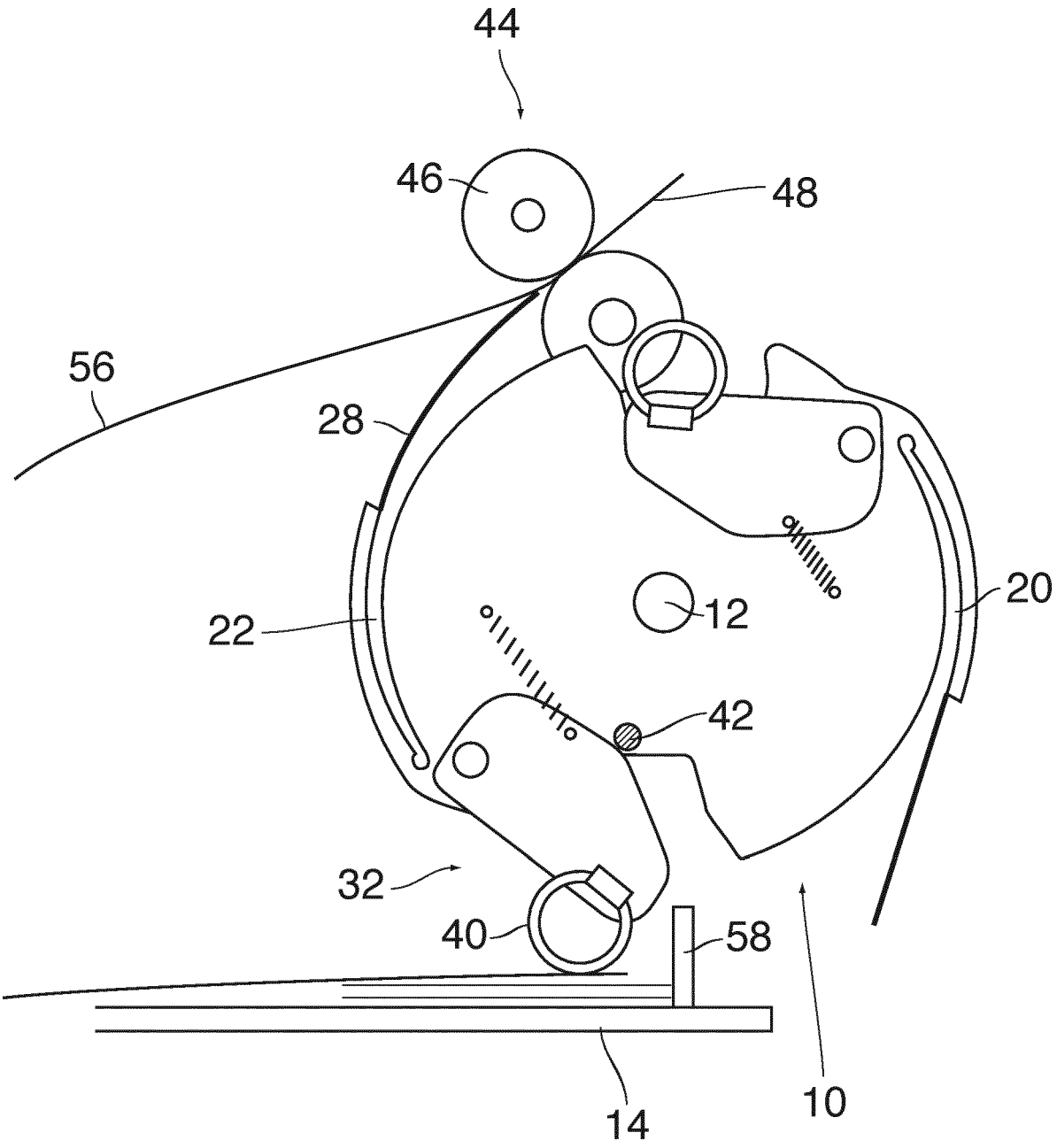


Fig. 6



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EUROPEAN SEARCH REPORT

Application Number
EP 20 17 0437

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	12 October 2020	Athanasiadis, A

CATEGORY OF CITED DOCUMENTS

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12-10-2020

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