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- (71) **Applicant (for all designated States except US):** WINCOR NIXDORF INTERNATIONAL GMBH [DE/DE]; Heinz-Nixdorf-Ring 1, 33106 Paderborn (DE).
- (72) **Inventors; and**
- (75) **Inventors/Applicants (for US only):** LIOW, Ridwan [SG/SG]; 216 Bishan Street 23 # 08-327, Singapore 570216 (SG). MALKE, Wolfgang [DE/DE]; Hainbuchenstrasse 47, 13465 Berlin (DE).
- (74) **Agent:** SCHAUMBURG, THOENES, THURN, LANDSKRON, ECKERT; Postfach 86 07 48, 81634 München (DE).

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(54) **Title:** DOT MATRIX PRINTER FOR PASSBOOKS, RECEIPTS OR THE LIKE

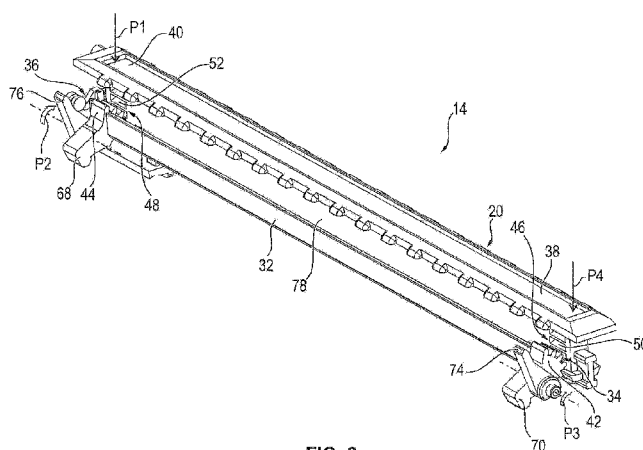


FIG. 2

(57) **Abstract:** A dot matrix printer (10) comprises a printing unit (14) including a print head (16) and an elongated counter-pressure element (20) between which a printing material can be guided along a transport plane, and at least one biasing element (18) on which the counter-pressure element (20) is mounted and biased against the print head (16). Both end regions (38, 40) of the elongated counter-pressure element (20) are each coupled via a conversion mechanism (34, 36) to a stationary, torsion-proof compensating bar (32) that is rotatably mounted about its longitudinal axis. A displacing movement of one of the two end regions (38, 40) of the counter-pressure element (20) directed transversely to the transport plane is converted via the associated conversion mechanism (34, 36) into a rotary motion of the compensating bar (32). This rotary motion of the compensating bar (32) is converted via the respective other conversion mechanism (36, 34) into a compensation movement of the other end region (40, 38) of the counter-pressure element (20), which compensation movement has the same direction as the mentioned displacing movement.



Dot matrix printer for passbooks, receipts or the like

The invention relates to a dot matrix printer comprising a printing unit including a print head and an elongated counter-pressure element between which a printing material can be guided along a transport plane, and at least one biasing element on which the counter-pressure element is mounted and biased against the print head.

A dot matrix printer of the afore-mentioned type is used, for example, in banks for printing passbooks and in forwarding agencies for printing receipts or the like, referred to in the following as printing material.

During printing, the printing material is arranged between the print head and the elongated counter-pressure element. The counter-pressure element is biased against the print head by one or several biasing elements, resulting that the printing material is pressed against the print head with a pressing force. It often happens that the pressing force varies along the counter-pressure element, for example in an arrangement in which one biasing element each is provided at both ends of the counter-pressure element. In this case, only one biasing element each is effective at both ends of the counter-pressure element, whereas in the central area of the counter-pressure element both biasing elements act proportionately. This results in that the pressing force reaches a maximum in the central area of the counter-pressure element and decreases toward the ends of the counter-pressure element.

The print contrast of the print image also depends on the pressing force. A high pressing force results in a good print contrast, whereas a lower pressing force results in a lower print contrast. Therefore, in the above-described arrangement the quality of the print image decreases in the marginal areas of the print area.

It is the object of the invention to specify a dot matrix printer in which a uniform quality of the print image is achieved over the entire print area.

This object is solved by a dot matrix printer in which both end regions of the elongated counter-pressure element are each coupled via a conversion mechanism to a stationary, torsion-proof compensating bar that is rotatably mounted about its longitudinal axis. A displacing movement of one of the two end regions of the counter-pressure element directed transversely to the transport plane results, via the associated conversion mechanism, in a rotary motion of the compensating bar. Via the respective other conversion mechanism, this rotary motion of the compensating bar produces a compensation movement of the other end region of the counter-pressure element, which compensation movement has the same direction as the above-mentioned displacing movement.

By providing a compensation mechanism which is substantially formed by the torsion-proof compensating bar and the conversion mechanisms it is achieved that the counter-pressure element exerts over its entire length a uniform pressing force onto the printing material and thus allows for a uniform quality of the

print image over the entire print area. Moreover, by means of this compensation mechanism the counter-pressure element always remains parallel to the transport plane of the printing material even in the case of one-sided loads which result, for example, when using a printing material having a thickness that varies over the print area.

A movement of one end region of the counter-pressure element is transmitted via the conversion mechanism provided in this end region to the compensating bar and is converted into a rotary motion of this compensating bar. This rotary motion is transmitted via the torsion-proof compensating bar to the respective other conversion mechanism. This second conversion mechanism converts the rotary motion of the compensating bar into a linear motion of the counter-pressure element. Accordingly, the compensation mechanism is designed such that both end regions of the counter-pressure element perform movements that have the same direction.

In a preferred embodiment of the dot matrix printer, one biasing element each is arranged in each end region of the counter-pressure element. This embodiment is characterized in that the counter-pressure element is very solidly mounted.

Preferably, each biasing element comprises at least one coil spring. By using coil springs, a compact design of the biasing elements is achieved.

In a further advantageous embodiment of the dot matrix printer, each conversion mechanism comprises a gear rack

and a gear wheel element, the gear wheel element engaging with the gear rack. As a result thereof, the conversion mechanism is low-maintenance and robust. Moreover, by way of this design, the movements of the counter-pressure element and of the compensating bar can be transmitted to the respective other component part almost with high-precision fit.

In a preferred development of the dot matrix printer, the gear rack of the respective conversion mechanism is formed integrally with the counter-pressure element. This reduces the number of component parts of the dot matrix printer and thus simplifies the assembly.

It is particularly advantageous to form the gear wheel element of the respective conversion mechanism integrally with the compensating bar. Thus, the number of required component parts can be reduced further, and the assembly can be simplified.

For reasons of material savings, the gear wheel elements can be formed as sector gears (toothed sectors) in a further embodiment.

In a preferred embodiment, the compensating bar is an injection-molded piece made from plastic material. In this embodiment, the compensating bar has a low weight. Moreover, the compensating bar can be produced in a cost-efficient manner.

Preferably, the compensating bar is stationarily and rotatably mounted in a frame. Thus, a mounting of the

compensating bar with high-precision fit is easily made possible.

In a particularly preferred development of the dot matrix printer, a drive unit for moving the counter-pressure element is provided. In a print mode, the counter-pressure element is arranged in a printing position in which it has a first distance to the print head. In a feed mode, the counter-pressure element is arranged in a second position in which the counter-pressure element has a second distance to the print head. Here, the second distance is greater than the first distance. The afore-mentioned print mode is the mode in which the printing material is arranged between the counter-pressure element and the print head, and in which the counter-pressure element, as already described further above, presses the printing material against the print head. The afore-mentioned feed mode differs from the print mode in that the counter-pressure element exerts no pressing force on the printing material. This is in particular the case during feeding or changing of the printing material.

In a further advantageous embodiment of the drive unit, said drive unit comprises at least one of the two conversion mechanisms, a motor and a cam shaft mounted stationarily in a frame. On the cam shaft, at least one cam is formed which can be brought into contact with at least one pin formed on the compensating bar for rotation thereof. In a predetermined rotational position of the cam shaft, the counter-pressure element is located at a minimum distance to the print head by means of the at least one conversion mechanism. As, in this

embodiment, the compensation mechanism forms part of the drive unit, the number of movable component parts in the dot matrix printer is reduced, which in turn reduces the maintenance requirements. The cam shaft which can rotate the compensating bar via the at least one pin defines, by means of this rotation, the minimum distance between the counter-pressure element and the print head. As the pin of the compensating bar can be lifted from the cam of the cam shaft, the compensation mechanism can reliably fulfill its functions in the print mode independent of the drive unit.

In a further preferred development of the compensating bar, said bar comprises at least one further pin which, in the second position of the counter-pressure element, rests against the counter-pressure element and thus prevents a further rotation of the compensating bar by which the counter-pressure element moves further away from the print head. Thus, damage to the counter-pressure element, the biasing elements and/or the abutments can be reliably prevented.

An embodiment of the invention is described in the following with reference to the drawings.

Figure 1 shows a schematic illustration of parts of a dot matrix printer according to the invention.

Figure 2 shows a perspective view of a printing unit of the dot matrix printer according to Figure 1, the print head not being illustrated.

Figure 3 shows a further perspective view of the printing unit according to Figures 1 and 2, the print head not being illustrated.

Figure 4 shows a further perspective view of the printing unit according to Figures 1 to 3 in a direction in which, in addition, a drive unit can be seen.

In Figure 1, a schematic illustration of a detail of a dot matrix printer 10 is shown. The dot matrix printer 10 prints on a printing material, such as passbooks and/or receipts. For reasons of clarity, the printing material is not shown on any of the attached figures.

The dot matrix printer 10 comprises a feeding unit 12 and a printing unit 14. The printing unit 14 comprises a print head 16 and an elongated counter-pressure element 20 mounted on biasing elements 18 (shown in Figure 3). For printing, the printing material is guided between the counter-pressure element 20 and the print head 16.

The feeding unit 12 is manually fed with the printing material and feeds the printing material to the printing unit 14. The feeding unit 12 defines a transport plane in which the printing material is moved along a transport direction. The print head 16 is moved along an axis that is perpendicular to this transport direction and lies parallel to the transport plane. In Figure 1, the transport direction of the printing material lies horizontally in the drawing plane. The direction of movement of the print head 16 is perpendicular to the drawing plane.

The counter-pressure element 20 is guided transversely to the transport plane of the printing material by means of oblong hole guides 22, 24 provided in frame parts 26, 28 (shown in Figure 3) of the dot matrix printer 10. On its side facing the print head 16, the counter-pressure element 20 has a printing surface 30.

Parallel to the counter-pressure element 20, a compensating bar 32 is arranged which is stationarily and rotatably mounted in the frame parts 26, 28 and is connected to the counter-pressure element 20 at the end regions 38, 40 (shown in Figure 2) thereof by means of two conversion mechanisms 34, 36. In this embodiment, the compensating bar 32 is a torsion-proof injection-molded piece made from plastic material.

Figure 2 shows a perspective view of the printing unit 14 according to Figure 1. For reasons of clarity, the print head 16 is not shown in Figure 2 and the further Figures 3 and 4.

Each of the end regions 38, 40 of the counter-pressure element 20 comprises one of the two conversion mechanisms 34, 36. Each conversion mechanism 34, 36 comprises a sector gear 42, 44 integrally formed with the compensating bar 32 and a gear rack 46, 48 integrally formed with the counter-pressure element 20. Here, the sector gears 42, 44 and the gear racks 46, 48 are arranged such that each time one of the sector gears 42, 44 engages with one of the gear racks 46, 48. The respective sector gear 42, 44 forms a part of a gear wheel. The segment angle of the sector gear lies in a range between about 45° and 90°.

The counter-pressure element 20 is an elongated injection-molded piece made from plastic material. Its length is at least as long as the length of the print area of the counter-pressure element (20). The printing surface 30 of the counter-pressure element 20 facing the print head 16 is even and oriented in parallel to the transport plane of the printing material. The side of the counter-pressure element 20 facing the compensating bar 32 and identified with the reference sign 78 in Figure 2 lies perpendicular to the transport plane of the printing material and parallel to the axis of rotation of the compensating bar 32. In this embodiment, the side 78 of the counter-pressure element 20 shows oblonged holes 50, 52 which form the respective gear rack 46, 48 and which are engageable with the teeth of the sector gears 42, 44 of the conversion mechanisms 34, 36. The gear racks 46, 48 are formed perpendicular to the printing surface 30.

Two biasing elements 18, which in this embodiment are formed as coil springs, are allocated to the two end regions 38, 40 of the counter-pressure element 20 and generate the pressing force with which the counter-pressure element 20 presses the printing material against the print head 16.

In a dot matrix printer without the compensating bar 32, this pressing force is not constant over the length of the counter-pressure element 20, as in the center of the counter-pressure element 20 both biasing elements 18 act proportionately, whereas in the end regions 38, 40 of the counter-pressure element 20 only the biasing element

18 provided in this end region 38, 40 is effective. Thus, at each of the end regions 38, 40 a lower pressing force is exerted which results in a lower contrast of the print image thereat. In this embodiment, the non-uniform pressing forces further result in that the counter-pressure element 20 is tilted relative to the transport plane of the printing material when the printing material has a thickness that varies over the length of the counter-pressure element 20.

In the inventive embodiment of the dot matrix printer 10 a movement of, for example, the one end region 40 of the counter-pressure element 20 from the transport plane of the printing material in accordance with the arrow P1 shown in Figure 2 causes a respective movement of the gear rack 48. This enforces a rotation of the sector gear 44 in a direction indicated by the arrow P2. This rotation is transmitted via the torsion-proof compensating bar 32 to the other sector gear 42 which, as a result thereof, performs a rotary motion in a direction indicated by the arrow P3. By means of the gear rack 46 with which the sector gear 42 engages, this rotary motion is converted into a linear motion of the other end region 38 of the counter-pressure element 20 as indicated by the arrow P4.

The two conversion mechanisms 34, 36 have the same construction. Therefore, the two movements of the end regions 38, 40 indicated by the arrows P1 and P4 have the same direction and are equal in length. Hereby it is achieved that the printing surface 30 of the counter-pressure element 20 always remains oriented parallel to the print head 16. Thus, always a uniform pressing force

acts on the print head 16, which results in a uniform quality of the print image over the width of the printing material.

Figure 4 is a further perspective view of the printing unit 14 from another direction and shows a drive unit 56. The rear frame part 28 has been omitted in Figure 4. The drive unit 56 comprises a motor 58, for example a stepper motor, a toothed belt drive 60 and a cam shaft 62 with cams 64, 66 that is stationarily and rotatably mounted in the frame. Two pins 68, 70 are arranged on the compensating bar 32 such that one pin 68, 70 and one cam 64, 66 each can be brought into contact with one another. In this embodiment, the pins 68, 70 are formed integrally with the sector gears 42, 44 of the conversion mechanisms 34, 36.

Each of the cams 64, 66 form a spiral-shaped projection when viewed in the direction of the axis of rotation of the cam shaft 62 and thus offers a working surface 80 whose distance to the axis of rotation of the cam shaft 62 varies in circumferential direction. In addition, the respective cam 64, 66 has a step 72 which causes a jump between the maximum distance and the minimum distance to the axis of rotation of the cam shaft 62. The cam shaft 62 is designed for a rotary motion that is less than a complete revolution of the cam shaft 62.

Two different operating modes are provided for the printing unit 14. In a print mode, where the printing material, which is arranged between the counter-pressure element 20 and the print head 16, is printed on, the counter-pressure element 20 is biased against the print

head 16 and exerts a pressing force on the print head 16. In a feed mode in which the printing material is fed to the printing unit 14 without printing, the counter-pressure element 20 is spaced from the print head 16 and does not exert any pressing force on the print head 16.

For setting the feed mode, the cam shaft 62 of the drive unit 56 is rotated such that the portion of the working surface 80 of the cam 64, 66 that has the largest-possible distance to the axis of rotation of the cam shaft 62 rests against the associated pin 68, 70. As a result thereof, the pins 68, 70 are deflected in the direction of the arrow P5. This deflection of the pins 68, 70 by the cams 64, 66 causes a rotation of the compensating bar 32 integrally formed with the pins 68, 70. The rotation of the compensating bar 32 is converted via the two conversion mechanisms 34, 36 provided at the ends of the compensating bar 32 into a linear motion of the counter-pressure element 20 in the direction of the arrow P6 away from the print head 16 against the biasing force exerted by the biasing elements 18. In this state, the printing material is no longer clamped between the print head 16 and the counter-pressure element 20 and thus can easily be moved in the transport plane.

In the print mode, the cam shaft 62 is rotated such that the portion of the working surface 80 of the respective cam 64, 66 that has the shortest distance to the axis of rotation of the cam shaft 62 faces the respective pin 68, 70. In this mode, the distance between the print head 16 and the counter-pressure element 20 corresponds to the thickness of the printing material. The spacing between the counter-pressure element 20 and the print

head 16 is converted into a rotary motion of the compensating bar 32 by the conversion mechanisms 34, 36, which causes that the pins 68, 70 do not rest against the cams 64, 66 but are held above these.

With the aid of at least one further pin 74, 76 provided on the compensating bar 32 a maximum distance is set between the print head 16 and the counter-pressure element 20. A movement of the counter-pressure element 20 in the direction of the arrow P6 shown in Figure 4 is converted into a rotary motion of the compensating bar 32 in the direction of the arrow P5 via the conversion mechanisms 34, 36. As a result thereof, the pins 74, 76 move toward the counter-pressure element 20, against which they rest when the counter-pressure element 20 reaches its maximum possible distance to the print head 16.

The above-described embodiment is merely exemplarily. A number of variations are conceivable.

For example, only one biasing element 18 or more than two biasing elements 18 can be provided for the counter-pressure element 20. Further, the biasing elements can also be designed differently, for example in the form of leaf springs.

In alternative embodiments of the printing unit 14, more than one pin 68, 70 can be allocated to each cam 64, 66 or more than one cam 64, 66 can be allocated to each pin 68, 70. Both the cam shaft 62 and the compensating bar 32 can also be made from another material than plastic, such as metal.

In the described embodiment, the compensating bar 32 as well as the sector gears 42, 44 and the pins 68, 70, 74, 76 provided on the compensating bar 32 are formed in one piece. In an alternative embodiment the sector gears 42, 44 and the pins 68, 70, 74, 76 can also be designed as separate attachment parts which are mounted to the compensating bar 32.

List of reference signs

10	dot matrix printer
12	feeding unit
14	printing unit
16	print head
18	biasing element
20	counter-pressure element
22, 24	oblong hole guide
26	front frame part
28	rear frame part
30	printing surface of the counter-pressure element 20
32	compensating bar
34, 36	conversion mechanism
38, 40	end region of the counter-pressure element 20
42, 44	sector gear
46, 48	gear rack
50, 52	oblonged holes
54	abutment
56	drive unit
58	motor
60	toothed belt drive
62	cam shaft
64, 66	cam
68, 70, 74, 76	pin
72	step of the cam 64
78	side of the counter-pressure element 20
80	working surface of the cam 64
P1, P2, P3, P4, P5, P6	arrows

Patent claims

1. A dot matrix printer (10), comprising

a printing unit (14) including a print head (16) and an elongated counter-pressure element (20) between which a printing material can be guided along a transport plane, and

at least one biasing element (18) on which the counter-pressure element (20) is mounted and biased against the print head (16),

characterized in that

both end regions (38, 40) of the elongated counter-pressure element (20) are each coupled via a conversion mechanism (34, 36) to a stationary, torsion-proof compensating bar (32) that is rotatably mounted about its longitudinal axis, and

a displacing movement of one of the two end regions (38, 40) of the counter-pressure element (20) directed transversely to the transport plane is converted via the associated conversion mechanism (34, 36) into a rotary motion of the compensating bar (32), and this rotary motion of the compensating bar (32) is converted via the respective other conversion mechanism (36, 34) into a compensation movement of the other end region (40, 38) of the counter-pressure element (20), which compensation

movement has the same direction as the mentioned displacing movement.

2. The dot matrix printer (10) according to claim 1, characterized in that one biasing element (18) each is arranged in each end region of the counter-pressure element (20).
3. The dot matrix printer (10) according to claim 1 or 2, characterized in that the respective biasing element (18) comprises at least one coil spring.
4. The dot matrix printer (10) according to one of the preceding claims, characterized in that the respective conversion mechanism (34, 36) comprises a gear rack (46, 48) and a gear wheel element (42, 44) engaging with the gear rack (46, 48).
5. The dot matrix printer (10) according to claim 4, characterized in that the gear rack (46, 48) of the respective conversion mechanism (34, 36) is formed integrally with the counter-pressure element (20).
6. The dot matrix printer (10) according to claim 4 or 5, characterized in that the gear wheel element (42, 44) of the respective conversion mechanism (34, 36) is formed integrally with the compensating bar (32).
7. The dot matrix printer (10) according to one of the claims 4 to 6, characterized in that the gear wheel element (42, 44) is formed as a sector gear.

8. The dot matrix printer (10) according to one of the preceding claims, characterized in that the compensating bar (32) is an injection-molded piece made from plastic material.
9. The dot matrix printer (10) according to one of the preceding claims, characterized in that the compensating bar (32) is stationarily mounted in a frame (26, 28).
10. The dot matrix printer (10) according to one of the preceding claims, characterized in that

a drive unit (56) is provided for moving the counter-pressure element (20),

in a print mode, where the counter-pressure element (20) is arranged in a printing position in which the counter-pressure element (20) has a first distance to the print head (16), and

in a feed mode, where the counter-pressure element (20) is arranged in a second position in which the counter-pressure element (20) has a second distance to the print head (16), the second distance being greater than the first distance.
11. The dot matrix printer (10) according to claim 10, characterized in that the drive unit (56) comprises at least one of the two conversion mechanisms, a motor (58) and a cam shaft (62) that is stationarily mounted in a frame (26, 28) and can be rotated by the motor (58), at least one cam (64, 66) being

formed on the cam shaft (62), which cam can be brought into contact with at least one pin (68, 70) formed on the compensating bar (32) for rotation of the compensating bar (32),

in a predetermined rotational position of the cam shaft (62), the counter-pressure element (20) is arranged at a minimum distance to the print head (16) via the at least one conversion mechanism (34, 36).

12. The dot matrix printer (10) according to claim 11, characterized in that the compensating bar (32) comprises at least one further pin which, in the second position of the counter-pressure element (20), rests against the counter-pressure element (20) and thus prevents a further rotation of the compensating bar (32) by which the counter-pressure element (20) moves further away from the print head (16).

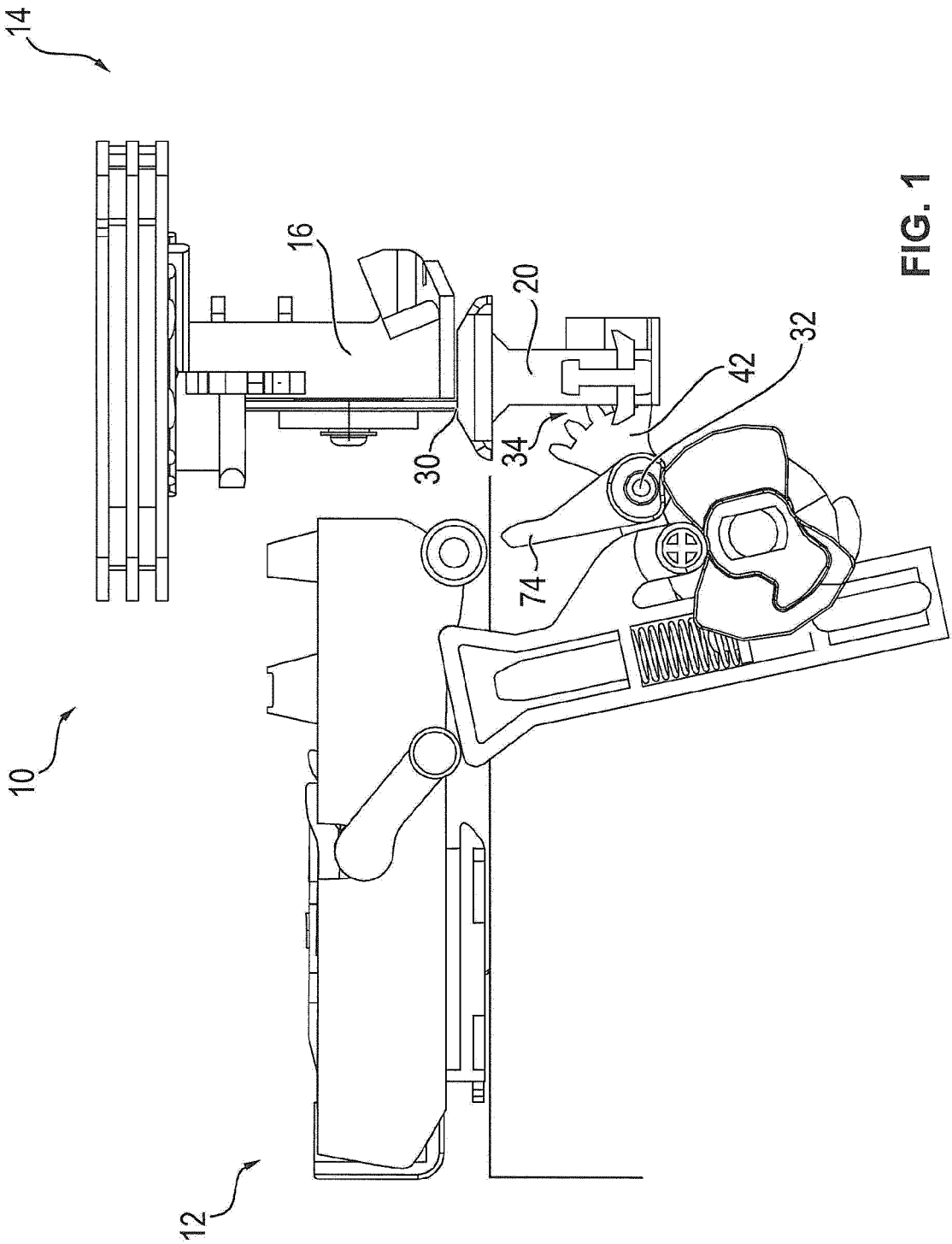


FIG. 1

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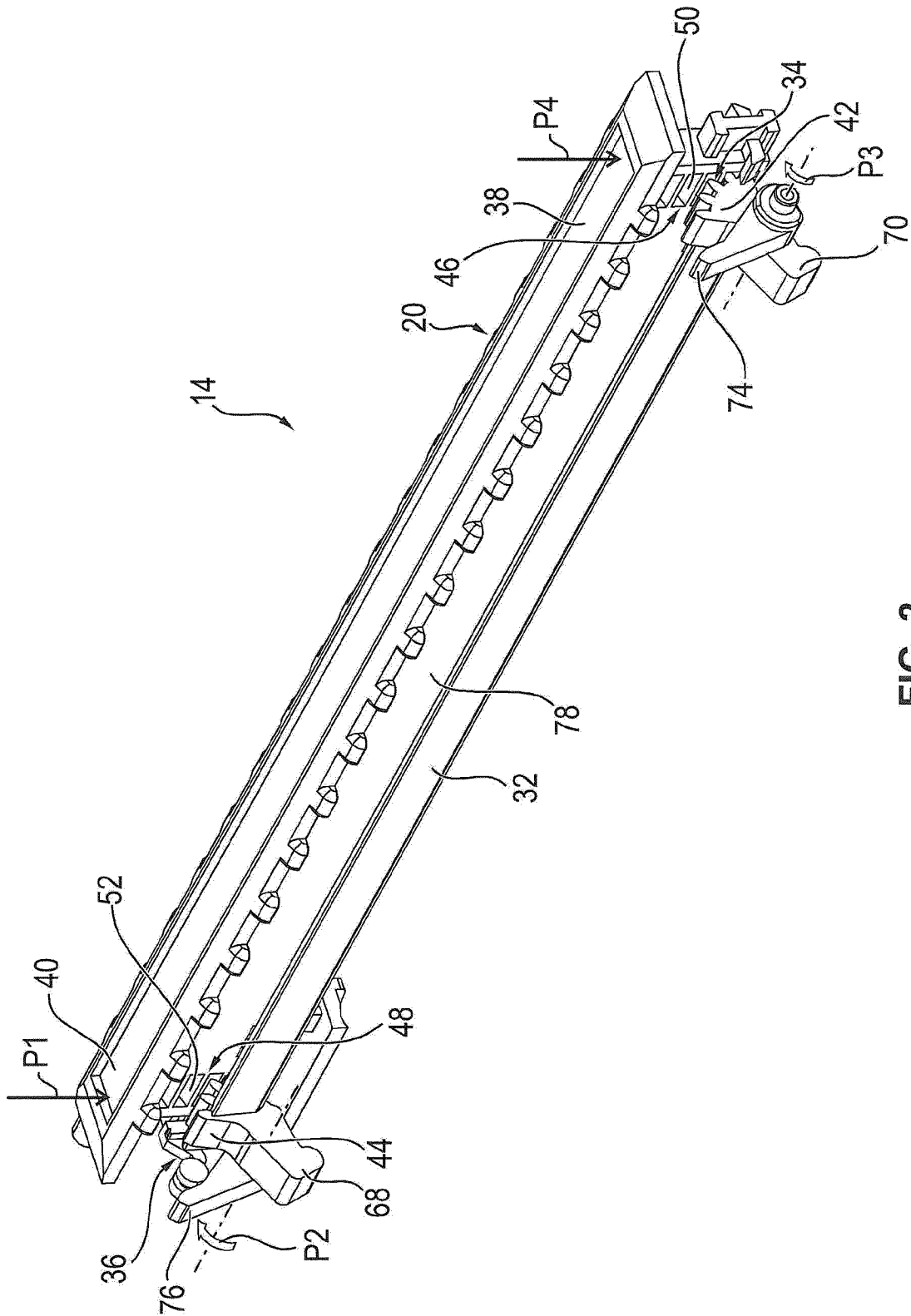
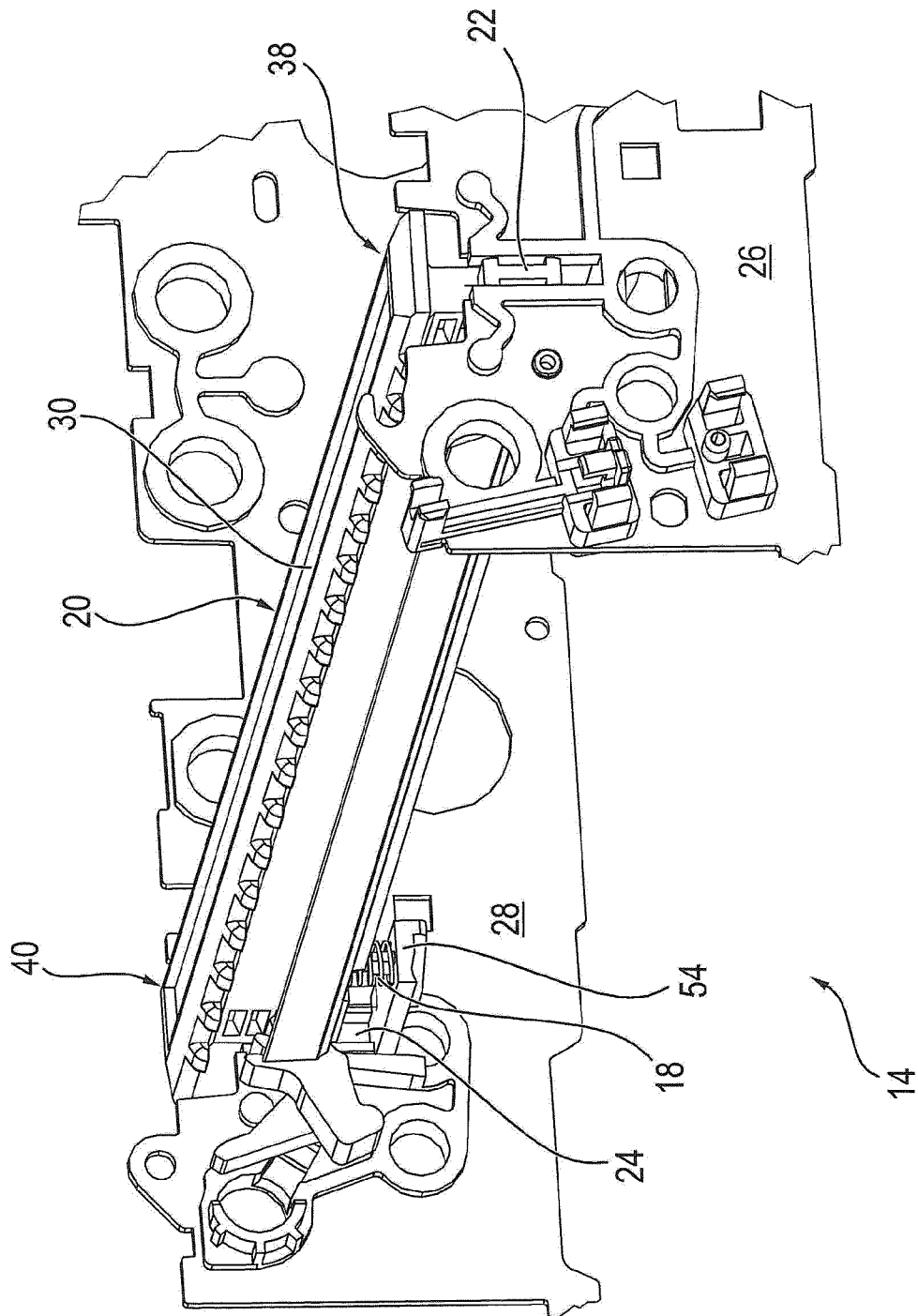


FIG. 2

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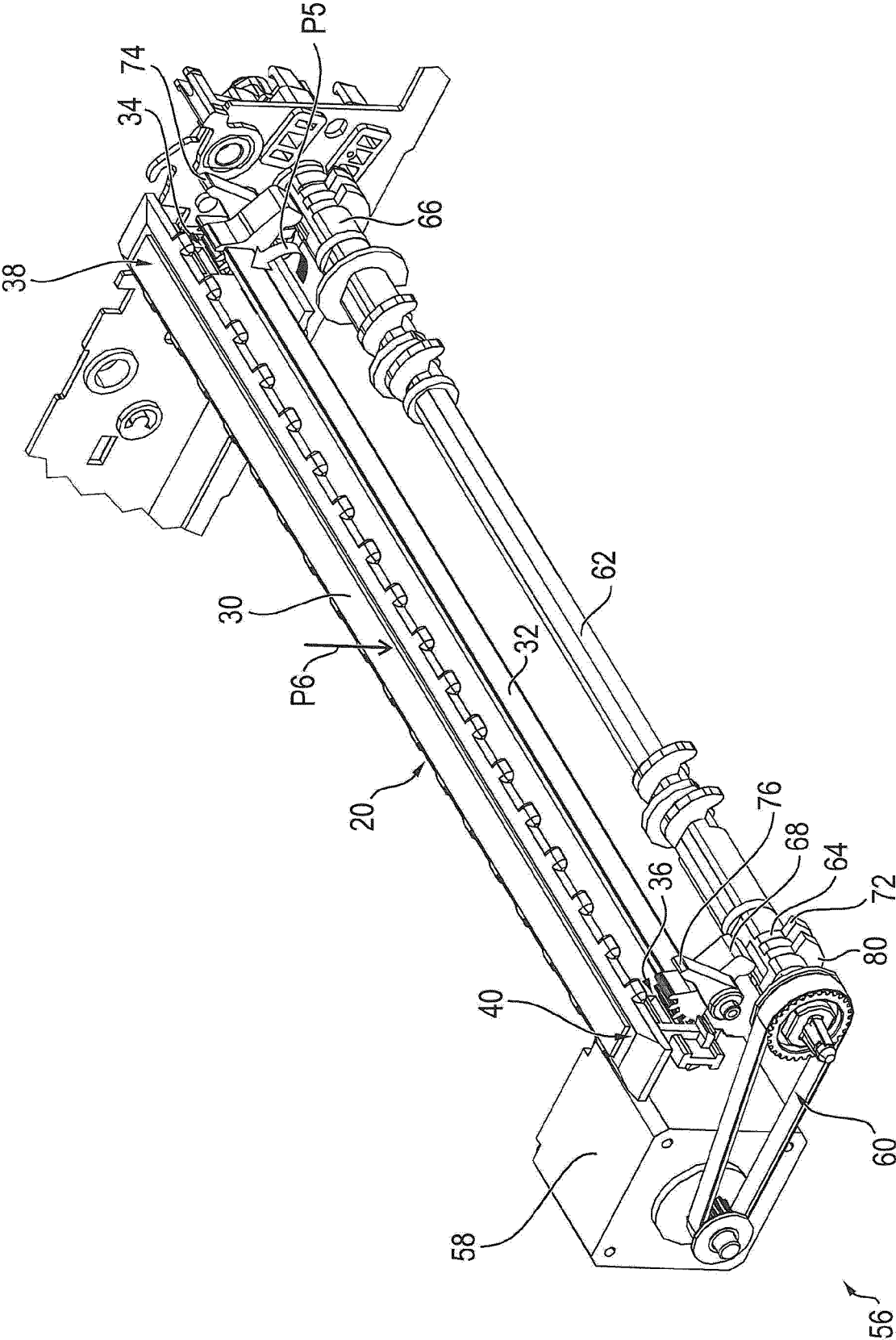


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2012/057194

A. CLASSIFICATION OF SUBJECT MATTER

INV. B41J11/20

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	DE 299 16 847 U1 (SIEMENS NIXDORF BANKING SYST [DE]) 2 March 2000 (2000-03-02) figure 1	1,12
A	DE 198 40 997 A1 (SIEMENS NIXDORF INF SYST [DE] WINCOR NIXDORF GMBH & CO KG [DE]) 9 March 2000 (2000-03-09) figure 2	1-12
A	US 2007/195154 A1 (NISHITANI HITOSHI [JP]) 23 August 2007 (2007-08-23) figure 1	1-12
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Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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Tel. (+31-70) 340-2040,
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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2012/057194

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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