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(71) Applicant:
**OLIVETTI-CANON INDUSTRIALE S.p.A.
10015 Ivrea (TO) (IT)**

(72) Inventor: **Forlani, Riccardo
10146 Torino (IT)**

(74) Representative:
**Casuccio, Carlo et al
Olivetti S.p.A.
Via G. Jervis 77
10015 Ivrea (Torino) (IT)**

(54) Device for feeding a sheet for duplex copying and associated method of operation

(57) The device for feeding a sheet in equipment for generating images on both faces of said sheet, is of the type in which a stack of sheets (P1), (P2) and (P), having a first image on one face, is first stored in an intermediate tray, wherein it is piled step-like staggering each sheet by a determined distance, and comprises a flexible plate (50) having a first, substantially flat part and a second part, the continuation of the first part,

inclined with respect to the first part by a determined angle, which is capable of assuming an idle position and a working position wherein it is raised by a loop formed by the bottom sheet (P1) of the stack, thus raising all the other sheets of the stack above the feeding rollers and permitting feeding of the bottom sheet (P1) only.

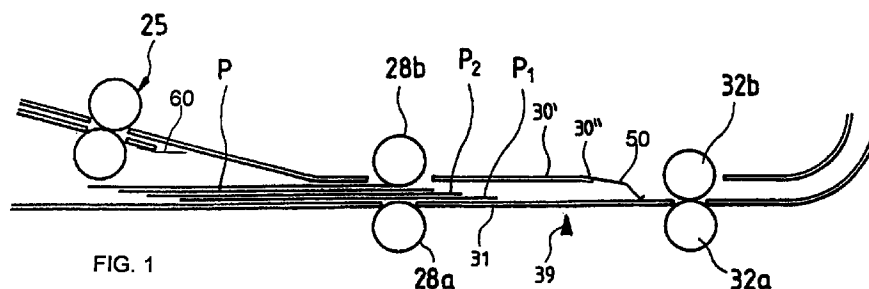


FIG. 1

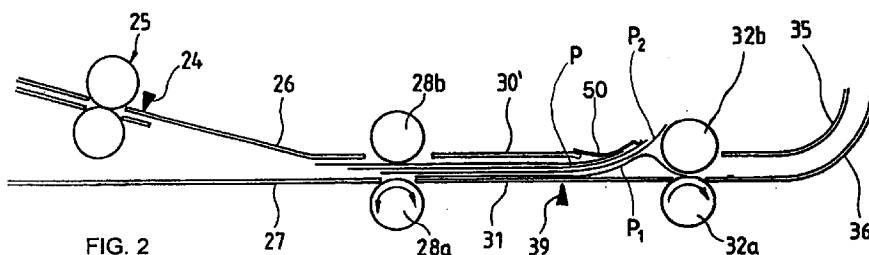


FIG. 2

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Description

Technological Field of the Invention

[0001] The device according to this invention may be used in equipment for generating images on a medium (for example, a photocopier or a printer), provided with the "duplex" or "recto/verso" function, i.e. capable of forming an image on both the faces of a medium, typically a sheet of paper, and/or with the "multiprint" feature, i.e. capable of forming two images overlaid on the same face of the medium, for instance in two different columns.

Background of the Invention

[0002] Equipment of the type described above is widely known, typically provided with an intermediate paper tray in which the sheets are collected and temporarily stored after passing for a first time through a zone of the equipment provided with a device for forming images (for instance, an electrophotographic printing or copying device or an ink jet printing device, all known type) by means of which a first image is formed on one face of the sheet; subsequently, the sheets are taken one by one from the intermediate tray and brought back to the same zone of the equipment in which the image forming device is located, in order to form a second image on the other face of the sheet or, alternatively, a second image on the same face of the sheet.

[0003] The operation of singly feeding the sheets, already having the first image on one face, from the intermediate tray to the image forming device is particularly critical, it being essential to avoid both the typical feeding problems (failure to take a sheet, two sheets taken, etc.) and causing damage to the image already present (blotches, offsets, stains, etc.).

[0004] Devices are known in the sector art for feeding a sheet reliably and without damaging the image; for instance, in the United States patent application No. US 5,305,995, Nakajima et alii describe one of these devices, the characteristics and method of operation of which will be illustrated briefly below with reference to Figures 4, 5a, 5b, 5c and 5d, corresponding respectively to the original figures 2, 5, 6, 7 and 9, which represent a lateral, schematic diagram during different stages of operation.

[0005] In these figures the numeral 23 identifies a feeding path of a sheet P coming from the zone (not depicted in the figures) of the equipment in which the image forming device is located and having a first image on the lower face; the numeral 25 identifies a first pair of conveyor rollers selectively put in rotation in the clockwise direction by means of a motor 25m, for example of the known stepper type; the numeral 24 identifies a first position sensor, for example of the known photoelectric type; the numeral 26 identifies an upper guide of the feeding path 23 facing a lower horizontal guide 27.

[0006] The numeral 28a identifies a roller with a rubber outer coating in contact with a roller 28b having a resin surface with a coefficient of friction lower than that of the rubber, the second pair of rollers 28a and 28b being selectively put in rotation both in the clockwise direction and in the anticlockwise direction by means of a motor 28m; the roller 28b may move vertically and is kept in contact with the roller 28a by means of a leaf spring 29, the point of contact between the rollers 28a and 28b being substantially aligned with the upper face of the lower horizontal guide 27.

[0007] A pair of guides, upper guide 30 and lower guide 31, is arranged to the right of the second pair of rollers 28a and 28b, whereas a third pair of rollers 32a and 32b is arranged to the right of the pair of upper 30 and lower 31 guides so that the relative point of contact is substantially aligned with the upper surface of the lower guide 31; the roller 32b can move vertically and is kept in contact with the roller 32a by means of the pressure exerted by a leaf spring 34; the third pair of rollers 32a and 32b is selectively put in rotation in the clockwise direction by means of a motor 32m.

[0008] Arranged on the right of the third pair of rollers 32a and 32b, are an upper curving guide 35 and a lower curving guide 36, both curving upwards, the upper face of the lower curving guide 36 being aligned with the point of contact between the third pair of rollers 32a and 32b. The numeral 37 identifies an upwardly inclining branching guide, disposed downstream of the upper guide 30 and upstream of the third pair of rollers 32a and 32b, whereas the numeral 38 identifies a separating plate or deflector hinge-mounted on a small shaft 38a, placed at the terminal base of the branching guide 37, and having a pointed appendage the thickness of which is less than the thickness of the sheet P. The deflector 38, through the action of a solenoid 38s, may selectively assume a first, substantially horizontal idle position, depicted with unbroken lines in Fig. 4, and a second working position, depicted with dashed lines, wherein the pointed appendage is in contact with the lower guide 31.

[0009] A control device 33, for example a microprocessor-based electronic circuit known in the sector art, suitably controls the rotation of the motors 25m, 28m, 32m and the actuation of the solenoid 38s; finally, the numeral 39 identifies a second position sensor arranged along the lower guide 31, the numeral 40 identifies a keyboard for selecting the operating conditions of the equipment for generating images which comprises the device described, and the numeral 41 identifies a device for detecting dimensions, the dimensions of the sheet P for example.

[0010] The method of operation of the device of the known art described above is illustrated hereinbelow with specific reference to Figs. 5a, 5b and 5c, starting from the operation of storing the sheets P, having the first image on their lower face, in the intermediate tray, represented by the lower guide 27: a first sheet P is fed

by way of a rotation in the clockwise direction of the first pair of rollers 25 until it reaches the point of contact with the second pair of rollers 28a and 28b, where it stops for a determined length of time in such a way that a loop is created in order to correct any misalignment. Subsequently, the rotation in the clockwise direction of both the first pair of rollers 25 and of the second pair of rollers 28a and 28b causes the first sheet P to be fed further forward until the position sensor 24 is disengaged; at this point, the rotation of the second pair of rollers 28a and 28b is inverted and continues until the leading edge of the sheet comes to a point a predetermined distance l downstream of the point of contact with the second pair of rollers 28a and 28b, while the trailing edge slips backwards on the lower guide 27 below the first pair of rollers 25. With the arrival of each subsequent sheet P, the whole cycle described above is repeated, in such a way that the sheets P₁, P₂, P are disposed on the guide 27, which acts as an intermediate tray, piled step-like, partly overlapping and each one staggered with respect to the previous one by the distance l.

[0011] The operation of feeding the sheets P (Fig. 5d), in order that an image may also be formed on the upper face of each one, starts with the rotation in the clockwise direction of the second pair of rollers 28a and 28b, so as to feed together all the sheets P₁, P₂, P stored towards the third pair of rollers 32a and 32b; after a determined length of time has elapsed from the time that the leading edge of the first sheet P₁, in contact with the guide 31 is detected by the position sensor 39, the activation of the solenoid 38s results in the deflector 38 assuming the second working position wherein the pointed appendage comes into contact with the first sheet P₁ placed on the guide 31 in a position between the leading edge of the said first sheet P₁ and the leading edge of the following sheet P₂, in such a way that the sheet P₂ and the following sheets P are upwardly deflected by the branching guide 37, whereas the first sheet P₁ continues along the guide 31 towards the third pair of rollers 32a and 32b.

[0012] The third pair of rollers 32a and 32b is put in rotation in the clockwise direction by the motor 32m and feeds the first sheet P₁ towards the upper 35 and lower 36 curving guides and hence towards the image forming device; after the trailing edge of the first sheet P₁ has left the second pair of rollers 28a and 28b, the motor 28m inverts its rotation to bring backwards all the stored sheets P₂, P, with the exception of the first sheet P₁, following which the feeding cycle just described is repeated for all the sheets P₂, P present in the intermediate tray, starting from the configuration illustrated in Fig. 5c.

[0013] The device according to the known art has, however, the drawback of requiring a dedicated actuator (the solenoid 38s), which furthermore must be driven on the basis of a very precise timing to be able to operate correctly, thus giving rise to problems of cost and reliability, to overcome which it is necessary to define a dif-

ferent solution.

Disclosure of the Invention

[0014] The object of this invention is to define a device that solves the above-mentioned problems, guaranteeing the maximum operating reliability at a very low cost price. The above object is obtained by dispensing with the deflector/timed solenoid system of the known art, substituted by a simple plate of an elastic material with determined geometrical and physical characteristics, capable of separating the first sheet from all the others in an automatic and reliable way.

[0015] Another object of this invention is to define equipment for generating images on both faces of a medium, comprising a device that resolves the problems stated above.

[0016] A further object of this invention is to define a method of feeding a sheet in equipment for generating images on both faces of a medium, that resolves the problems stated above.

[0017] These objects are achieved by means of a device for feeding a medium in equipment for generating images on both faces of said medium, and of the associated method of operation, characterized as defined in the main claims.

[0018] These and other objects, characteristics and advantages of the invention will become apparent upon consideration of the following description of a preferred embodiment, provided by way of a non-exhaustive example, in conjunction with the accompanying drawings.

Brief Description of Drawings

[0019]

Fig. 1 - is a partial, lateral schematized view of the device for feeding a sheet for duplex copying according to the invention.

Fig. 2 - is a lateral, schematized view of the device of Fig. 1, during an operating step.

Fig. 3a - is a simplified, section view of the separating plate comprised in the device of Fig. 1.

Fig. 3b - is a simplified, plan view of the separating plate comprised in the device of Fig. 1.

Fig. 4 - is a general, lateral schematized view of the device for feeding a sheet according to the known art.

Figs. 5a, 5b, 5c e 5d - are partial, lateral schematized views of the device of Fig. 4 during four different operating steps.

Best mode for Carrying Out the Invention

[0020] Fig. 1 is a simplified, partial, lateral view of a first embodiment of the device for feeding a sheet for duplex copying according to the invention; in this figure,

parts that are the same as those used in the device according to the known art of Fig. 4 are indicated with the same numerals.

[0021] The upper guide 30' presents a terminal part 30" inclined by an angle β towards the corresponding lower guide 31. Attached to the terminal part 30", by bonding for example, is a plate 50 (Figs. 3a and 3b) of a resilient, synthetic resin material, preferably polyester, known under the commercial name of Mylar™, substantially rectangular in shape, of longitudinal dimensions l_1 and transversal dimensions l_2 ; the plate 50 comprises a substantially flat first part 51 and an inclining second part 52, the continuation of the first part 51, forming an angle α with the latter and finishing with a bearing surface 53 in the shape of an open eyelet, which in the idle position is in contact with the upper face of the lower guide 31. The extremity of the flat part 51 opposite the inclining part 52 bears preferably on its lower face a layer 54 of adhesive or bi-adhesive tape, for the bonding of the upper guide 30' to the upper face of the terminal part 30".

[0022] The plate 50 is between 0.1 and 0.3 mm thick, preferably between 0.15 and 0.25 mm, and best between 0.19 and 0.21 mm; the angle β is between 5° and 20°, preferably between 5 and 15°, and best between 8 and 12°; the angle α is between 120° and 160°, preferably between 130° and 150°, and best between 139° and 141°; the longitudinal dimension l_1 is preferably between 100 and 200 mm, and best of about 130 mm; the transversal dimension l_2 is preferably between 40 and 80 mm, and best of about 60 mm.

[0023] Operation will now be described of the device for feeding a sheet for duplex copying according to the invention.

[0024] The operation of storing the sheets P, having the first image on their lower face, in the intermediate tray, represented by the lower guide 27, is substantially the same as that illustrated earlier in the description of the known art, the predetermined distance 1 being equal to 8÷15 mm, preferably equal to about 10 mm.

[0025] The operation of feeding the sheets P in order to form an image on the upper face of each one as well, likewise starts at a first determined instant in time with the rotation in the clockwise direction of the second pair of rollers 28a and 28b, so as to feed the whole stack of stored sheets P₁, P₂, P together towards the third pair of rollers 32a and 32b; the first sheet P₁, after reaching the point of contact with the third pair of rollers 32a and 32b, still motionless, forms a loop with upwardly facing convexity, contrasted in doing so by the plate 50. The loop lifts the sheets P₂, P following the first sheet P₁ above the third pair of rollers 32a and 32b, so that the third pair of rollers 32a and 32b, put subsequently in rotation in the clockwise direction by the motor 32m, feeds only the first sheet P₁ towards the image forming device. When the trailing edge of the first sheet P₁ has definitely left the point of contact with the second pair of rollers 28a and 28b, a second determined length of time having

expired from when the third pair of rollers 32a and 32b was put in rotation (the time varies depending on the distance between the pairs of rollers 28a, 28b and 32a, 32b), the second pair of rollers 28a and 28b stops and then inverts its rotation to bring the whole stack of sheets P₂, P, now without the first sheet P₁, upstream of the position sensor 39 and place it correctly in position with the leading edge of the last sheet P inserted in the intermediate tray at the predetermined distance 1 from the point of contact with the second pair of rollers 28a and 28b. At this point, the previously described cycle is repeated until there are no more sheets in the intermediate tray.

[0026] Reliability of the device for feeding a sheet for duplex copying according to the invention has been checked by the inventor, using as the media sheets of "plain" paper (i.e. paper intended prevalently for use in photocopiers and in laser and ink jet printers) produced by various vendors, weighing between 60÷80 g/m², of size ranging from A3 to A5, and under ambient conditions varying between 20 and 30°C in temperature, and between 5 and 80 % in relative humidity, with excellent results.

[0027] Naturally changes may be made to the invention described above, without departing from the scope of the invention itself.

[0028] For example, it is possible to use a plate 50 that has the shape of a "comb", with a number of "teeth" varying, for example, between 2 and 10, preferably four as illustrated in Fig. 3b; similarly, the material that the plate 50 is made of may be selected from among all the resins that are suitable for producing plates of limited thickness and high resilience and resistance, such as for example polyethylene or polyethylene terephthalate (PET).

[0029] It is also possible to insert a second resilient plate with a "non-return valve" function at the outlet of the first pair of rollers 25, as indicated with the numeral 60 in Fig. 1, to prevent the sheets P from entering the first pair of rollers 25 in reverse when the second pair of rollers 28a and 28b causes them to move backwards.

[0030] In short, without prejudice to the principle of this invention, the construction details and forms of embodiment may be significantly altered with respect to what has been described and illustrated, without exiting from the scope of the invention.

Claims

1. Device for feeding a medium in equipment for generating images comprising an imaging forming device, said device for feeding a medium comprising:
 - first feeding means (28a) and (28b) for selectively feeding in a first direction and in a second direction opposite said first direction a stack of media (P₁), (P₂) and (P) piled step-like stag-

gering each medium by a determined distance according to said first direction, said media having a first image on a first face;

- separating means arranged downstream of said first feeding means according to said first direction in order to separate a first of said media from said stack;
- second feeding means (32a) and (32b) for selectively feeding said first of said media separated from said stack in said first direction towards said image forming device, to form a second image on a second face of said first of said media or, alternatively, a second image on said first face of said first of said media;
- guiding means for guiding said media between said first and said second feeding means, including an upper guide (30') and a lower guide (31) substantially parallel to each other,

characterized in that said separating means comprise a plate (50) of determined thickness including a first, substantially flat part and a second part, continuation of said first part, inclined with respect to said first part by a determined angle (α), one extremity of said flat part opposite said inclining part of said plate being attached to an inclined part (30'') of said upper guide, said plate having a first idle position wherein one extremity of said inclining part opposite said flat part is in contact with an upper face of said lower guide, and a second working position wherein it is raised by a loop formed by said first of said media, so that said stack of said media without said first of said media is raised above said second feeding means.

2. Device according to claim 1, **characterized in that** said first feeding means comprise a first roller (28a) having a rubber outer surface, and a second roller (28b) having a resin outer surface with a coefficient of friction lower than that of said rubber, said second roller being free to move vertically and being kept in contact with said first roller by means of a leaf spring.
3. Device according to claim 1, **characterized in that** said plate (50) is made of a material selected from a group consisting of polyester, polyethylene and polyethylene terephthalate.
4. Device according to claim 1, **characterized in that** said determined thickness of said plate (50) is between 0.15 and 0.25 mm.
5. Device according to claim 1, **characterized in that** said determined angle (α) is between 130° and 150°.
6. Device according to claim 1, **characterized in that**

said plate (50) is combshaped, with a determined number of teeth.

7. Device according to claim 6, **characterized in that** said number of teeth is between 2 and 10.
8. Device according to claim 1, **characterized in that** said extremity of said flat part of said plate (50) opposite said inclining part is bonded to said inclined part (30'') of said upper guide (30').
9. Device according to claim 8, **characterized in that** said extremity of said flat part of said plate (50) opposite said inclining part is bonded to said inclined part (30'') of said upper guide (30') by means of a bi-adhesive tape.
10. Device according to claim 1, **characterized in that** said medium consists of a sheet of "plain" paper weighing between 60 and 80 g/m².
11. Device according to claim 1, **characterized in that** said predetermined distance l is between 8 and 15 mm.
12. Device according to claim 1, **characterized in that** it further comprises a second plate (60) with a non-return valve function.
13. Equipment for generating images on both faces of a medium, comprising:
 - an image forming device; and
 - a device for feeding a medium having a first image on a first face towards said image forming device, to form a second image on a second face of said medium,

characterized in that said device for feeding a medium is according to any one of the preceding claims.

14. Equipment for generating multiple images on one face of a medium, comprising:
 - an image forming device; and
 - a device for feeding a medium having a first image on said first face towards said image forming device, to form a second image on said first face of said medium,

characterized in that said device for feeding a medium is according to any one of the claims from 1 to 12.
15. Equipment according to either of the claims 13 or 14, **characterized in that** said image forming device is of the electrophotographic type.

16. Equipment according to either of the claims 13 or 14, **characterized in that** said image forming device is of the ink jet type.

17. Method of feeding a medium in equipment for generating images, comprising the following steps:

- disposing of a device for feeding a medium comprising:
 - first feeding means (28a) and (28b) for selectively feeding in a first direction and in a second direction opposite said first direction a stack of said media (P1), (P2) and (P) piled step-like staggering each medium by a determined distance according to said first direction, said media having a first image on a first face;
 - second feeding means (32a) and (32b) for selectively feeding a first of said media separated from said stack in said first direction to form a second image on a second face of said first of said media or, alternatively, a second image on said first face of said first of said media;
 - guiding means for guiding said media between said first and said second feeding means, including an upper guide (30') and a lower guide (31) substantially parallel to each other;
 - separating means arranged downstream of said first feeding means according to said first direction for separating said first of said media from said stack, said separating means comprising a plate (50) of determined thickness including a first, substantially flat part and a second part the continuation of said first part, inclined with respect to said first part by a determined angle (β), one extremity of said flat part opposite said inclining part of said plate being attached to an inclined part (30'') of said upper guide, said plate having a first idle position wherein one extremity of said inclining part opposite said flat part is in contact with an upper face of said lower guide, and a second working position wherein it is raised by a loop formed by said first of said media, so that said stack of said media without said first of said media is raised above said second feeding means;
- actuating at a first determined time said first feeding means, to feed in said first direction said stack of said media;
- actuating said second feeding means to feed in said first direction said first of said media at a

second determined time, delayed by a first delay time with respect to said first determined time;

- actuating said first feeding means to feed in said second direction said stack of said media without said first of said media at a third determined time, delayed by a second delay time with respect to said second determined time.

18. Method according to claim 17, **characterized in that** said plate is made of a material selected from a group consisting of polyester, polyethylene and polyethylene terephthalate.

19. Method according to claim 17, **characterized in that** said determined thickness of said plate is between 0.15 and 0.25 mm.

20. Method according to claim 17, **characterized in that** said determined angle is between 130° and 150°.

21. Method according to claim 17, **characterized in that** said plate is comb-shaped, with a determined number of teeth.

22. Method according to claim 21, **characterized in that** said number of teeth is between 2 and 10.

23. Method according to claim 17, **characterized in that** said extremity of said flat part of said plate opposite said inclining part is bonded to said upper guide.

24. Method according to claim 23, **characterized in that** said extremity of said flat part is bonded to said upper guide by means of a bi-adhesive tape.

25. Method according to claim 17, **characterized in that** said medium consists of a sheet of "plain" paper weighing between 60 and 80 g/m².

26. Method according to claim 17, **characterized in that** said predetermined distance 1 is between 8 and 15 mm.

27. Method of feeding a medium in equipment for generating images, comprising the following steps:

- disposing of a device for feeding a medium according to any one of the claims from 1 to 12;
- actuating said first feeding means for feeding in said first direction said stack of said media until said first of said media forms a loop with an upwardly facing convexity in contact with said second feeding means;
- actuating simultaneously in said first direction said first and said second feeding means until

said first of said media is no longer in contact
with said first feeding means;

- actuating said first feeding means in said second direction.

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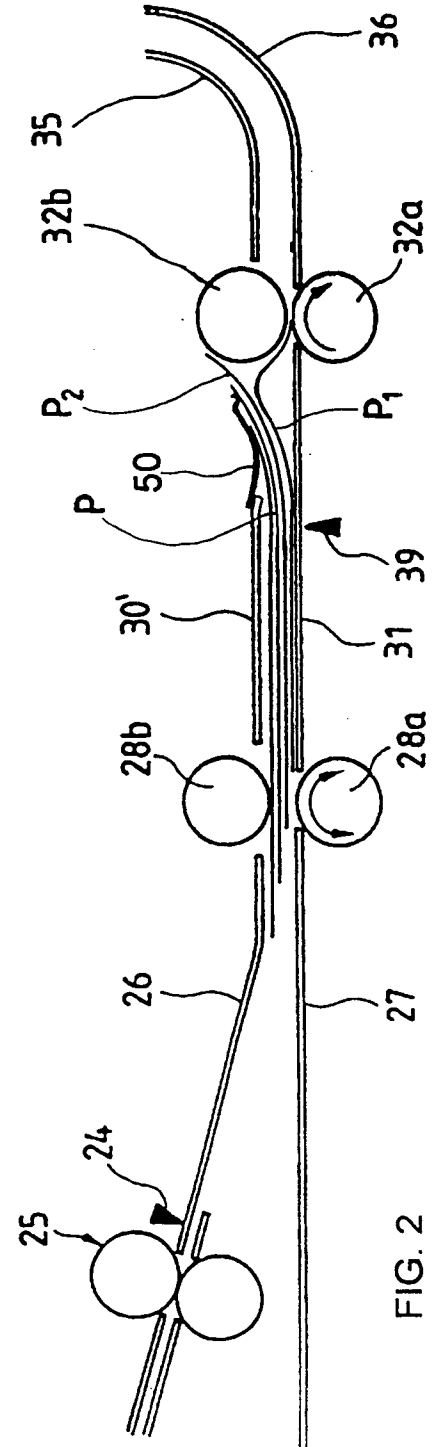
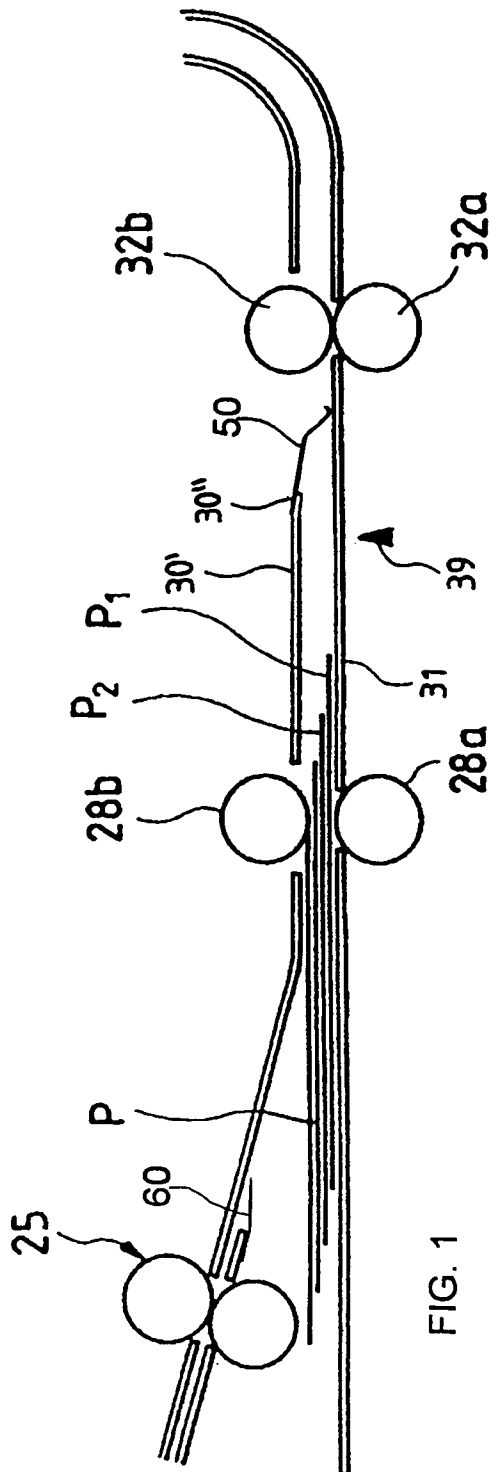
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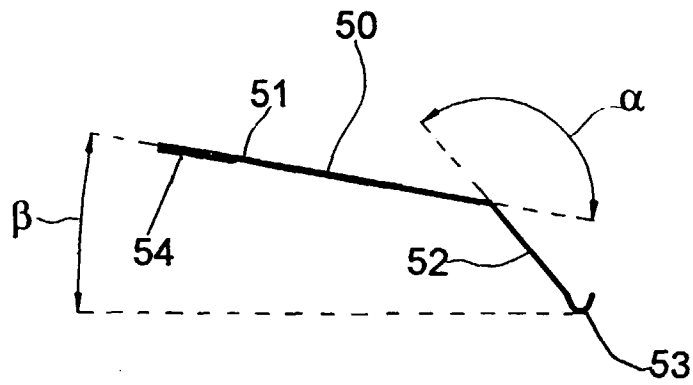


FIG. 3a

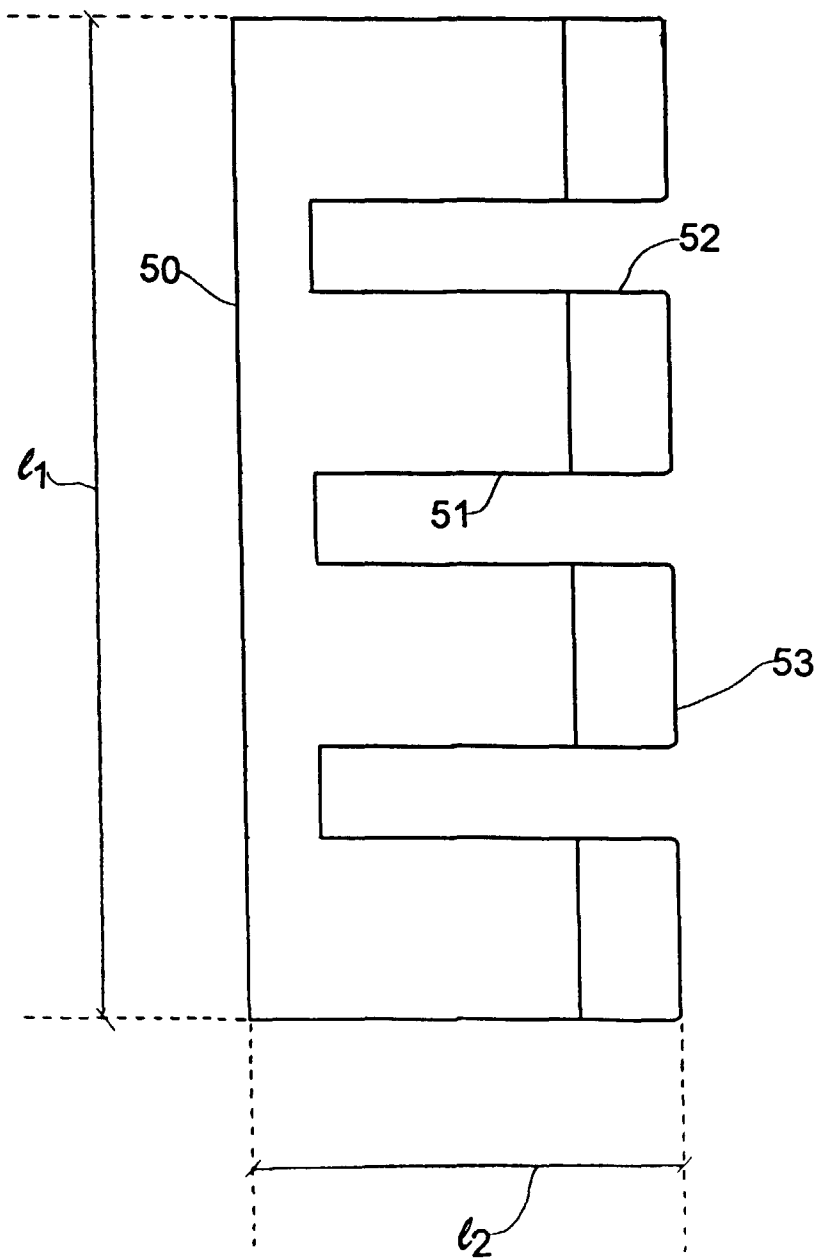


FIG. 3b

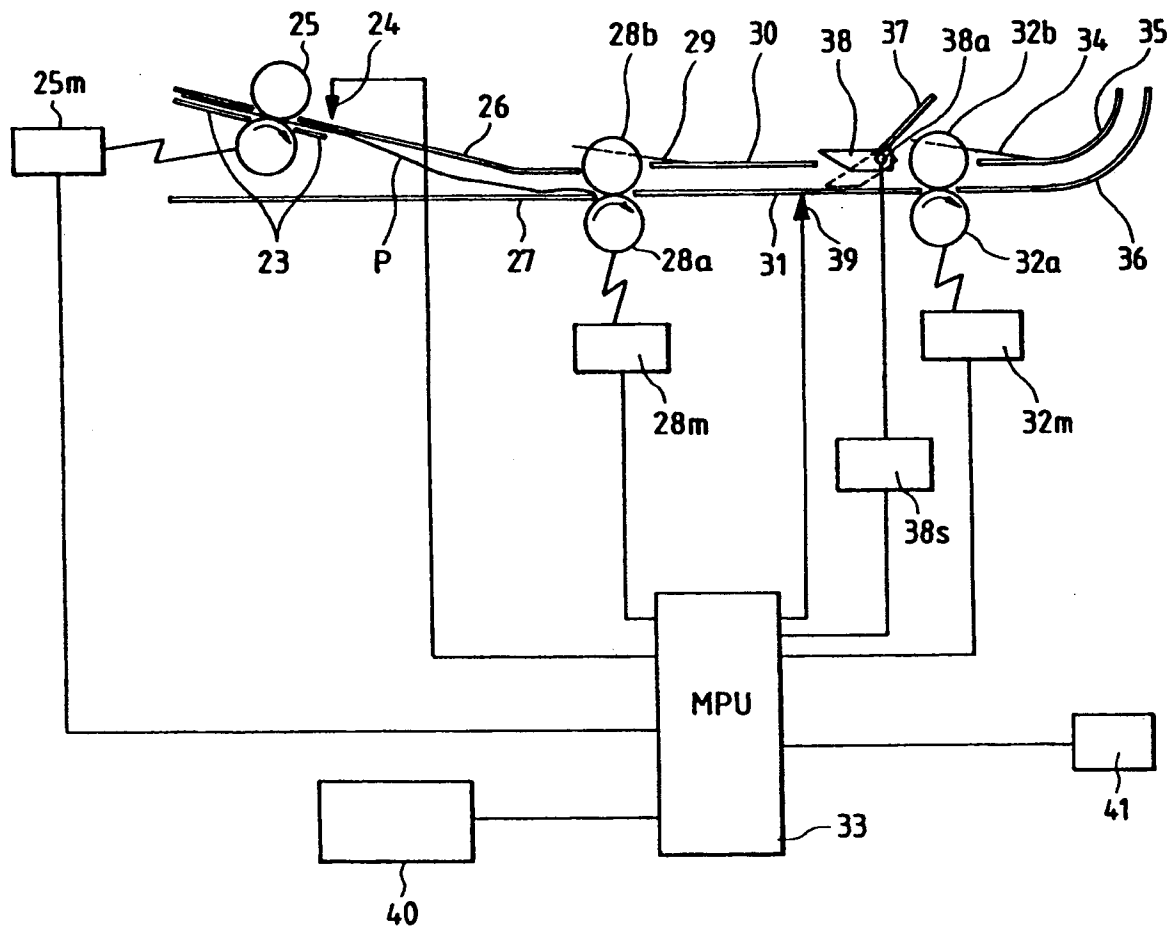


FIG. 4

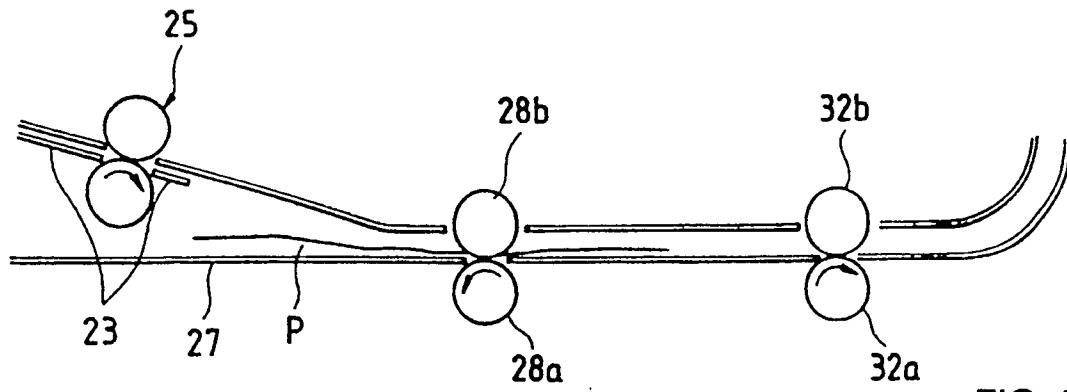


FIG. 5a

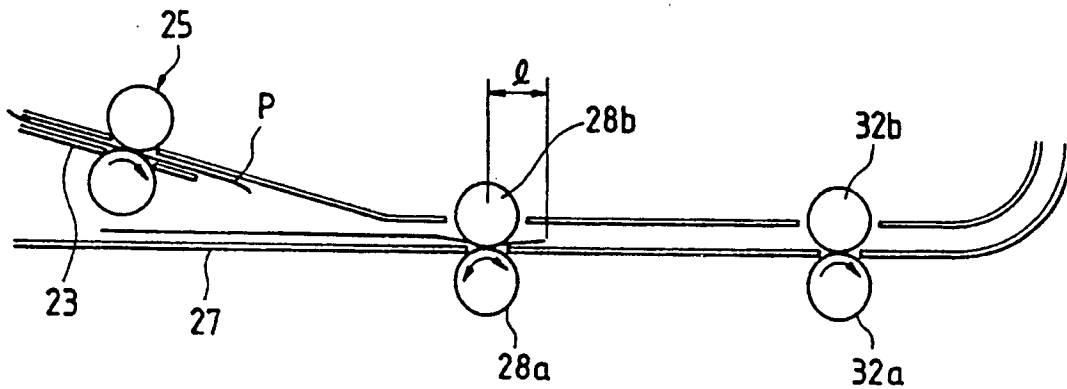


FIG. 5b

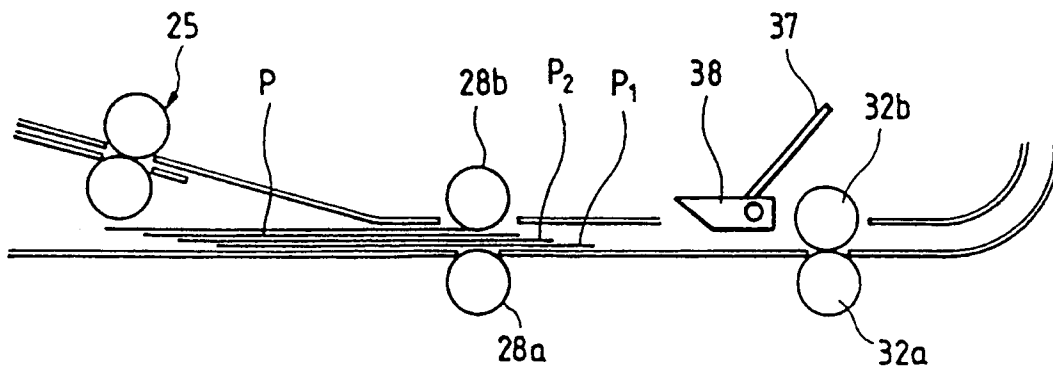


FIG. 5c

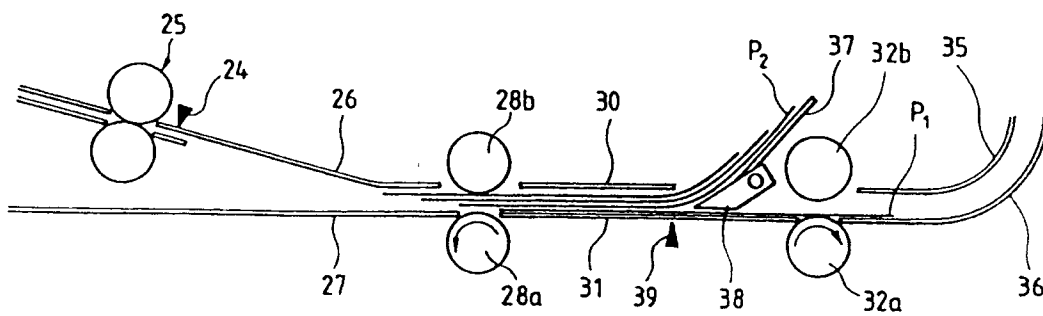


FIG. 5d