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DEVICE****Publication Classification**

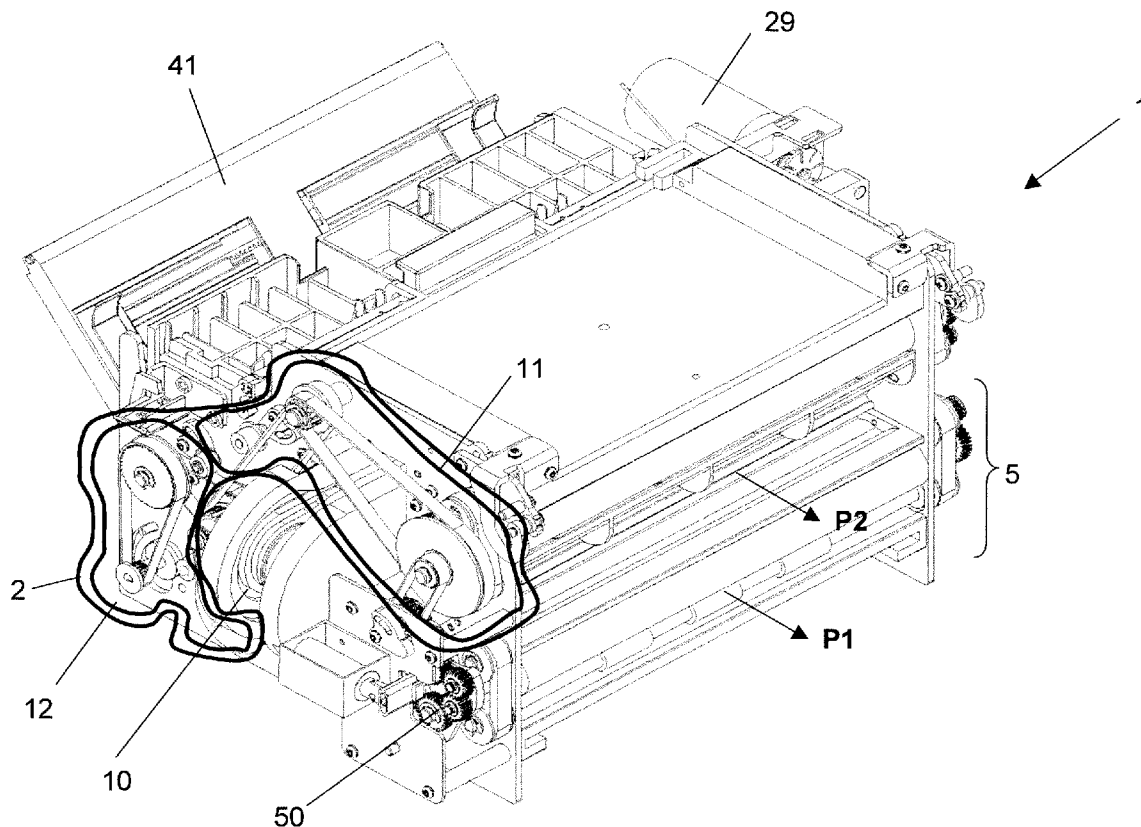
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(57) **ABSTRACT**

The present invention provides a device (1) for creasing, perforating and/or folding paper or other similar media to suit envelopes of various sizes. The device (1) includes a selectable creasing (15) or perforating head (20) which cooperates with an anvil (35), a Top Of Form sensor (46), a jam roller (59), associated pinch rollers (49, 63, 66) and a firmware for entering the paper size and type of paper for folding. After a predetermined paper length is fed into the paper path, the creasing (15) or perforating head (20) traverses a width of the paper to form a crease and after a predetermined length of paper passes the Top Of Form sensor (46), the jam/pinch rollers (59/49, 63, 66) are programmed to reverse in direction to cause the paper to buckle at the crease to form a fold. The types of folding operable by the device (1) are: letter, z, engineering, gate or half-fold.

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Singapore (SG)(21) Appl. No.: **12/475,577**(22) Filed: **May 31, 2009**

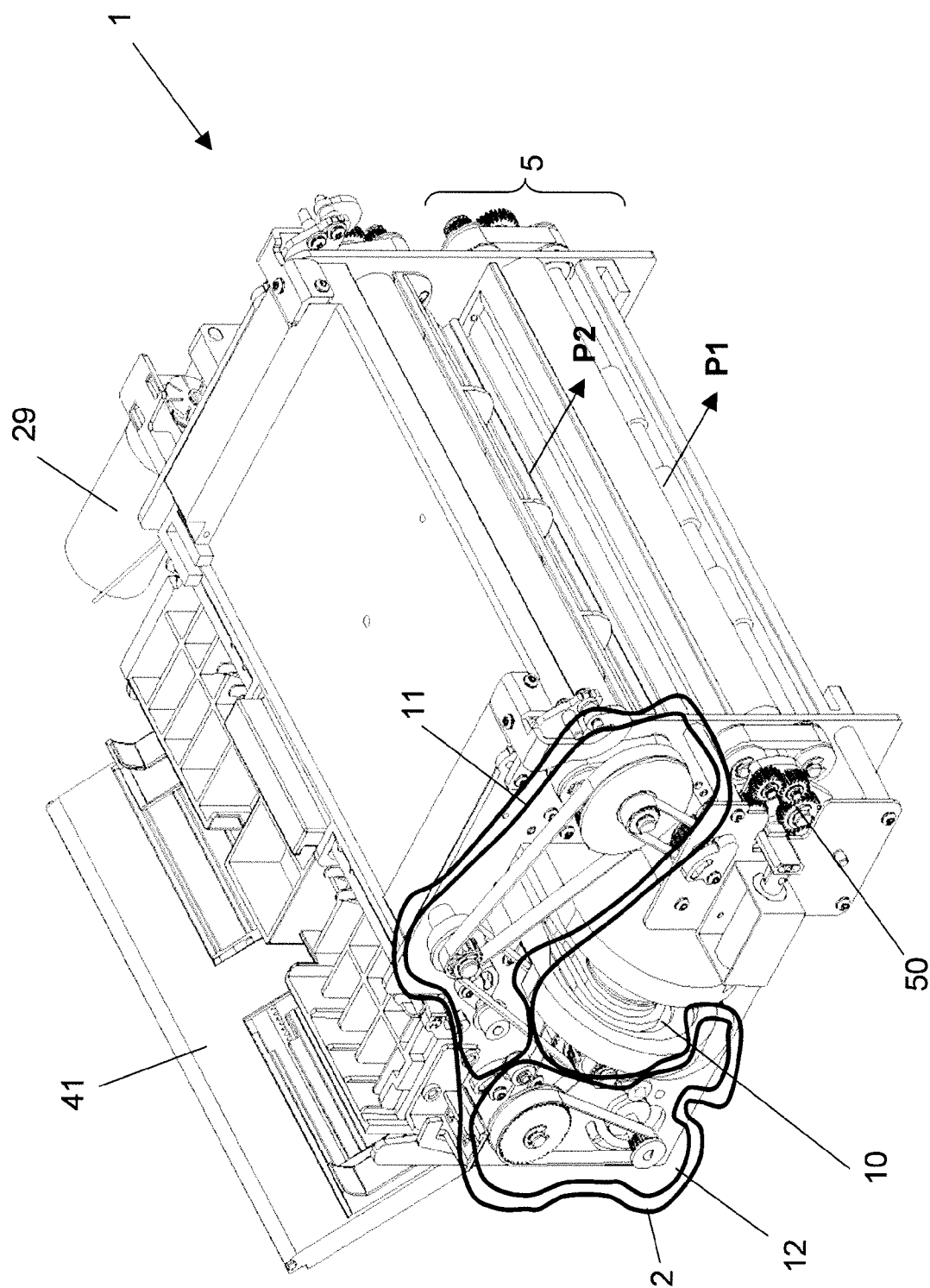


FIG. 1

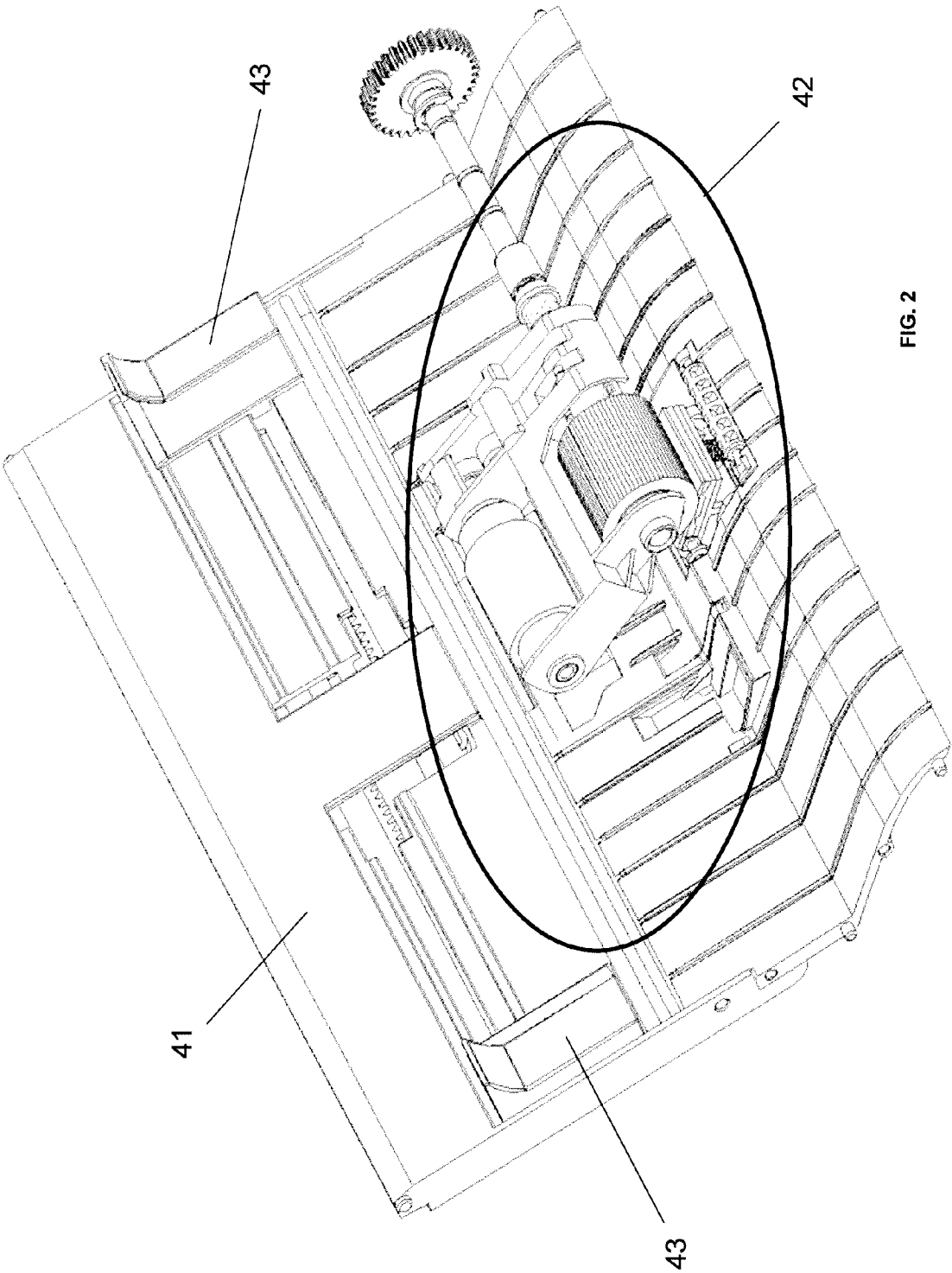


FIG. 2

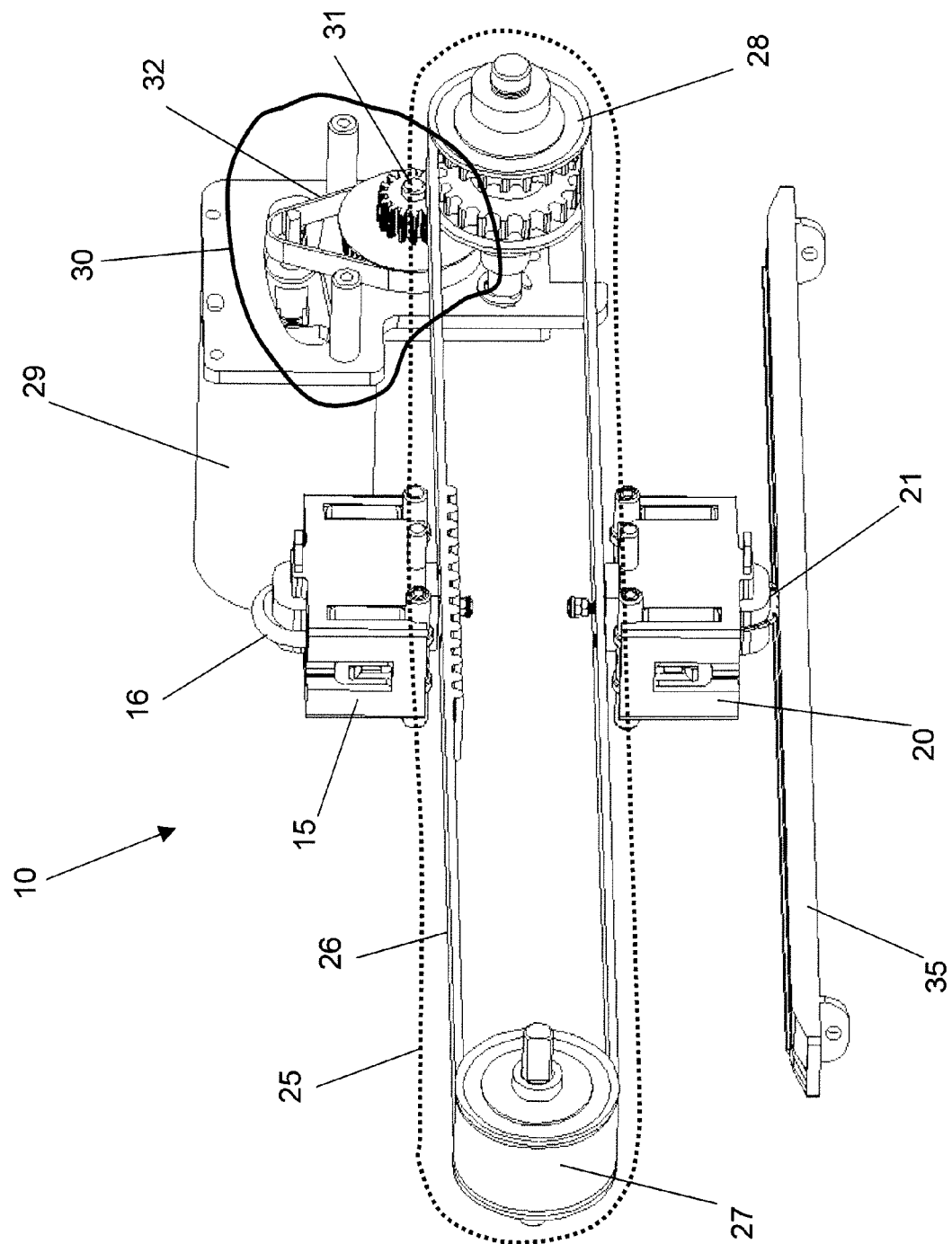


FIG. 3

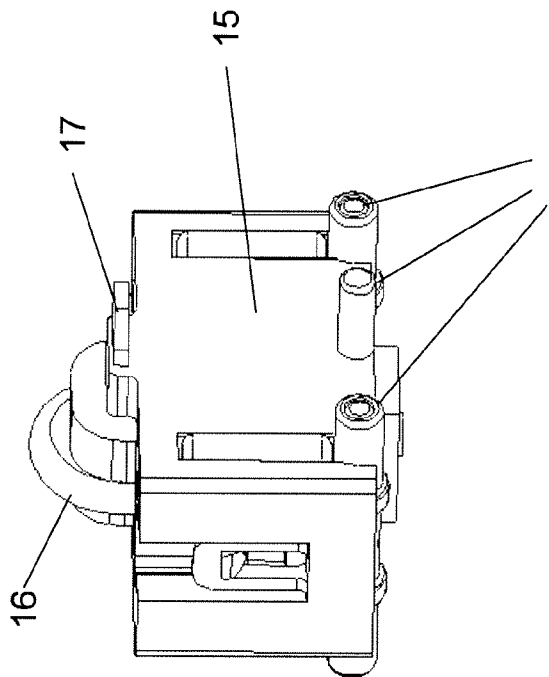


FIG. 4A1

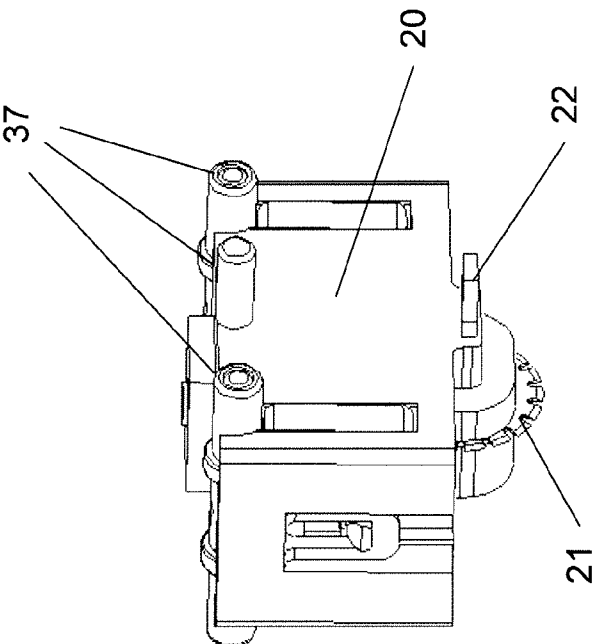
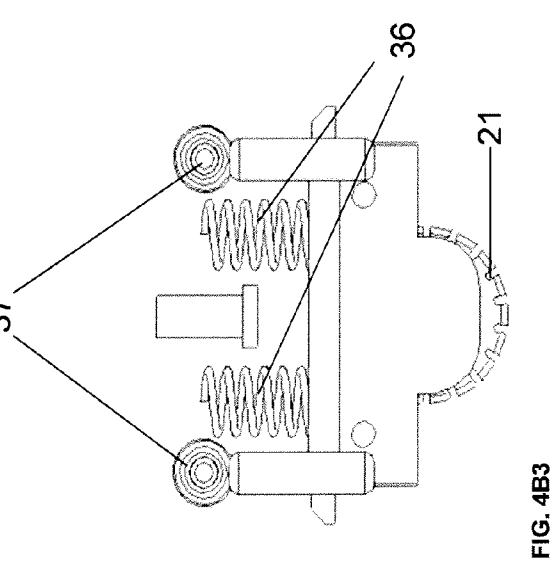
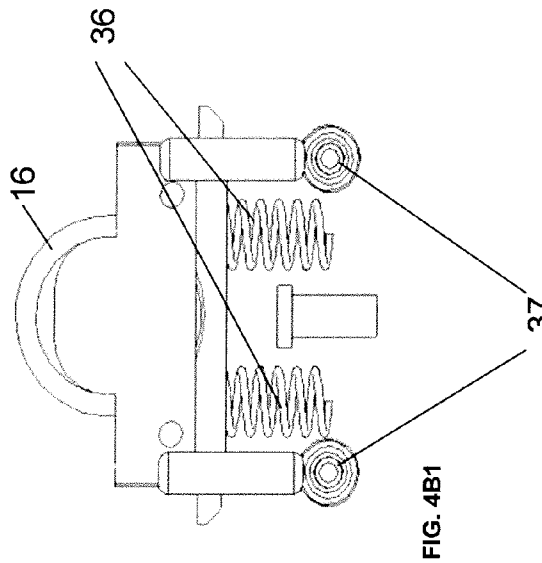
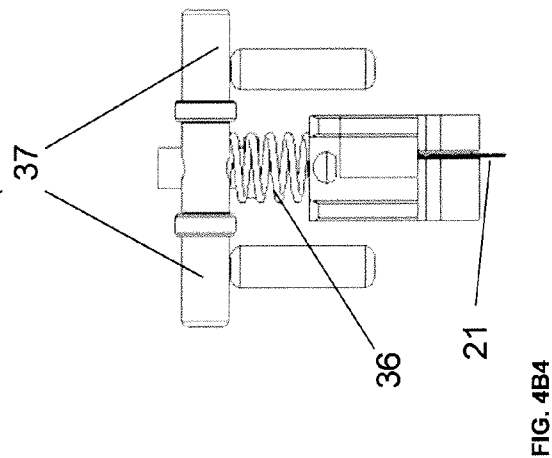
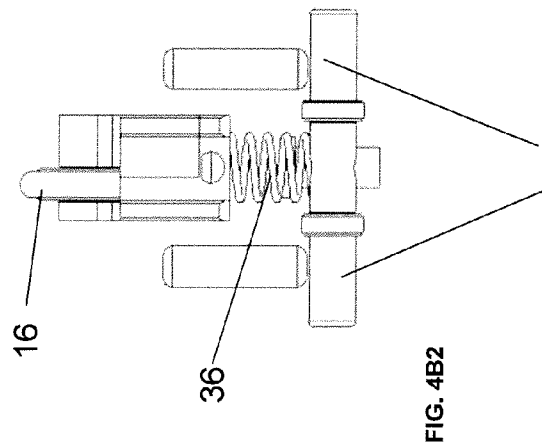


FIG. 4A2



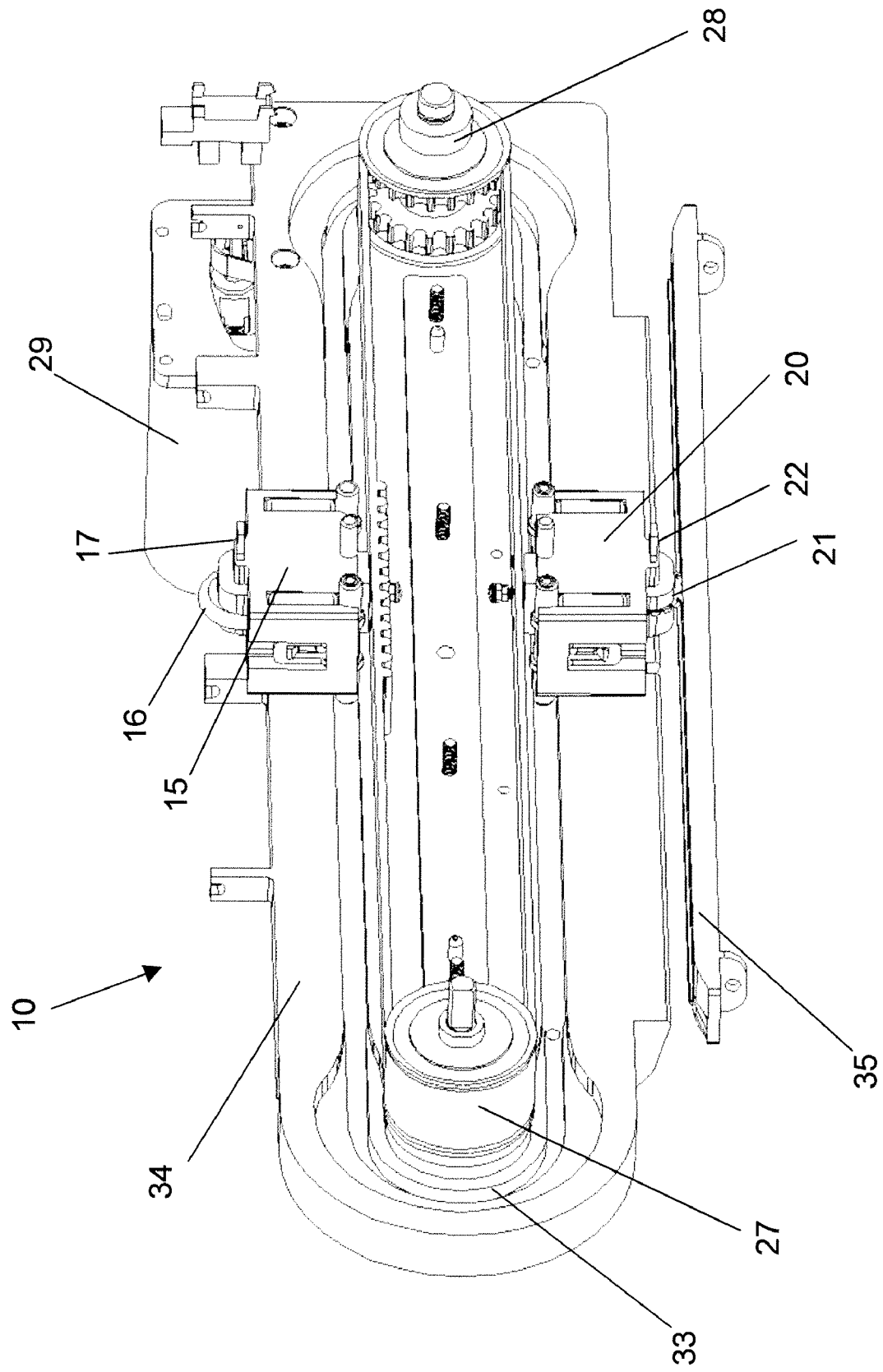


FIG. 5

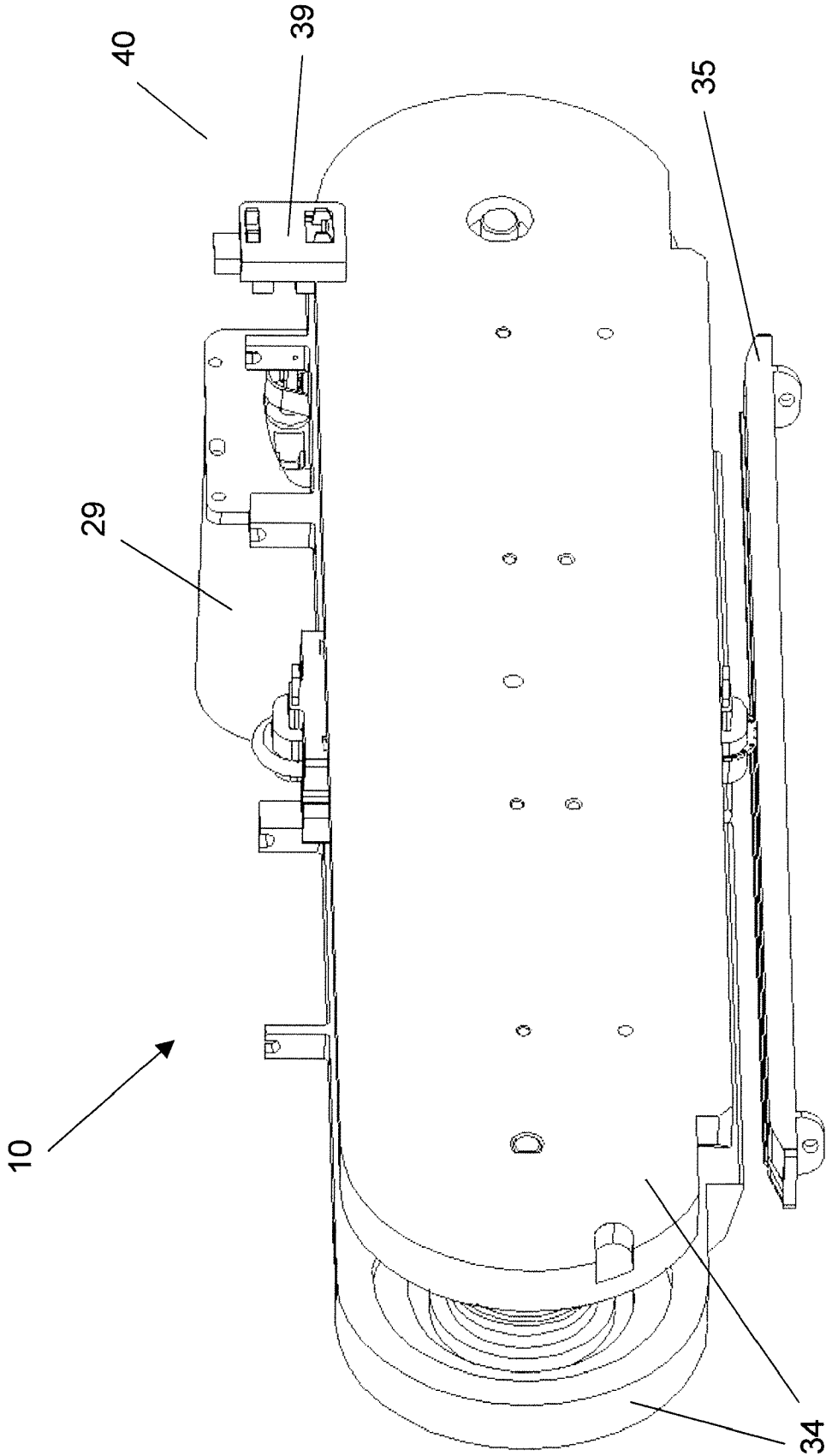
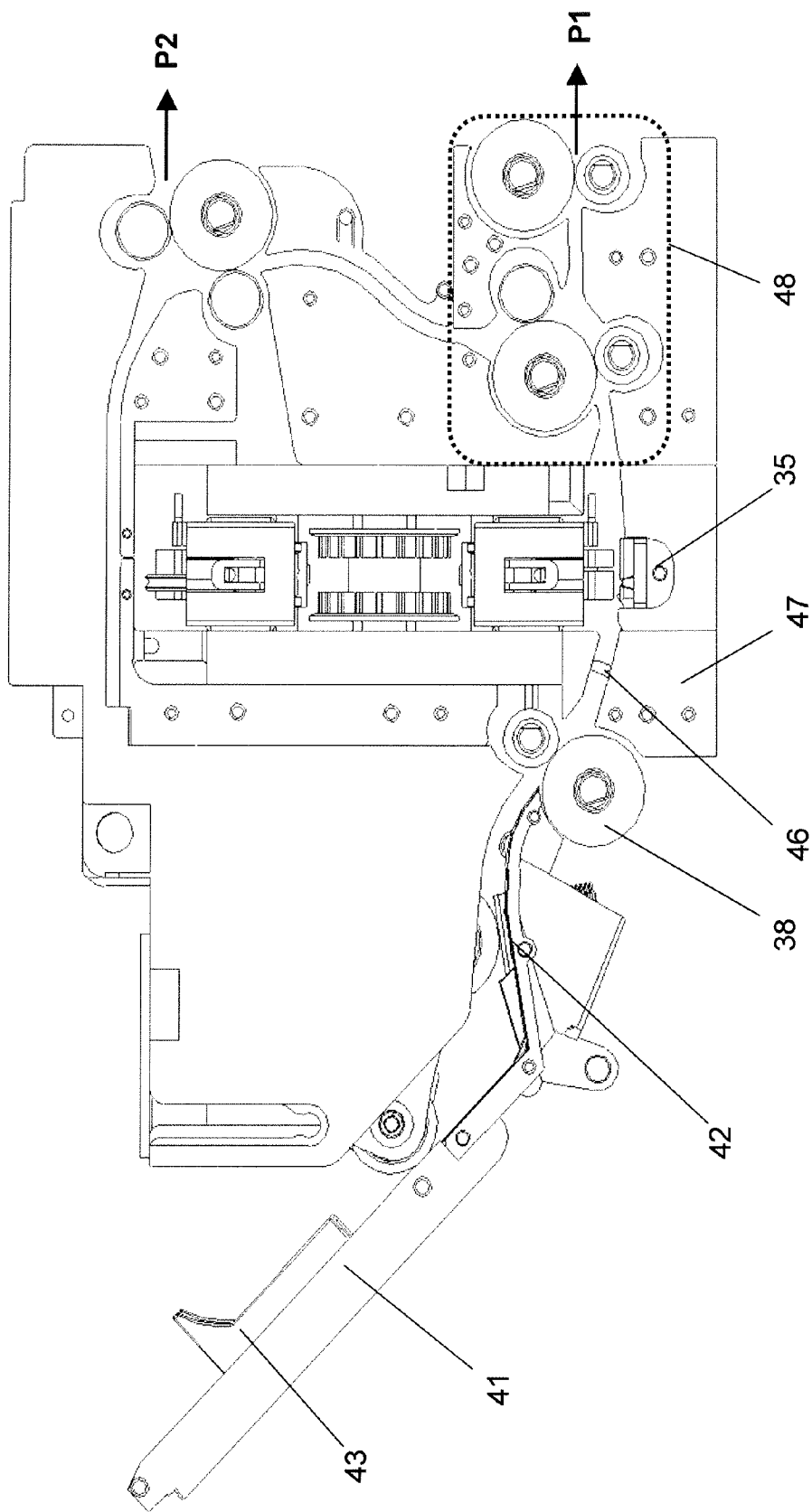
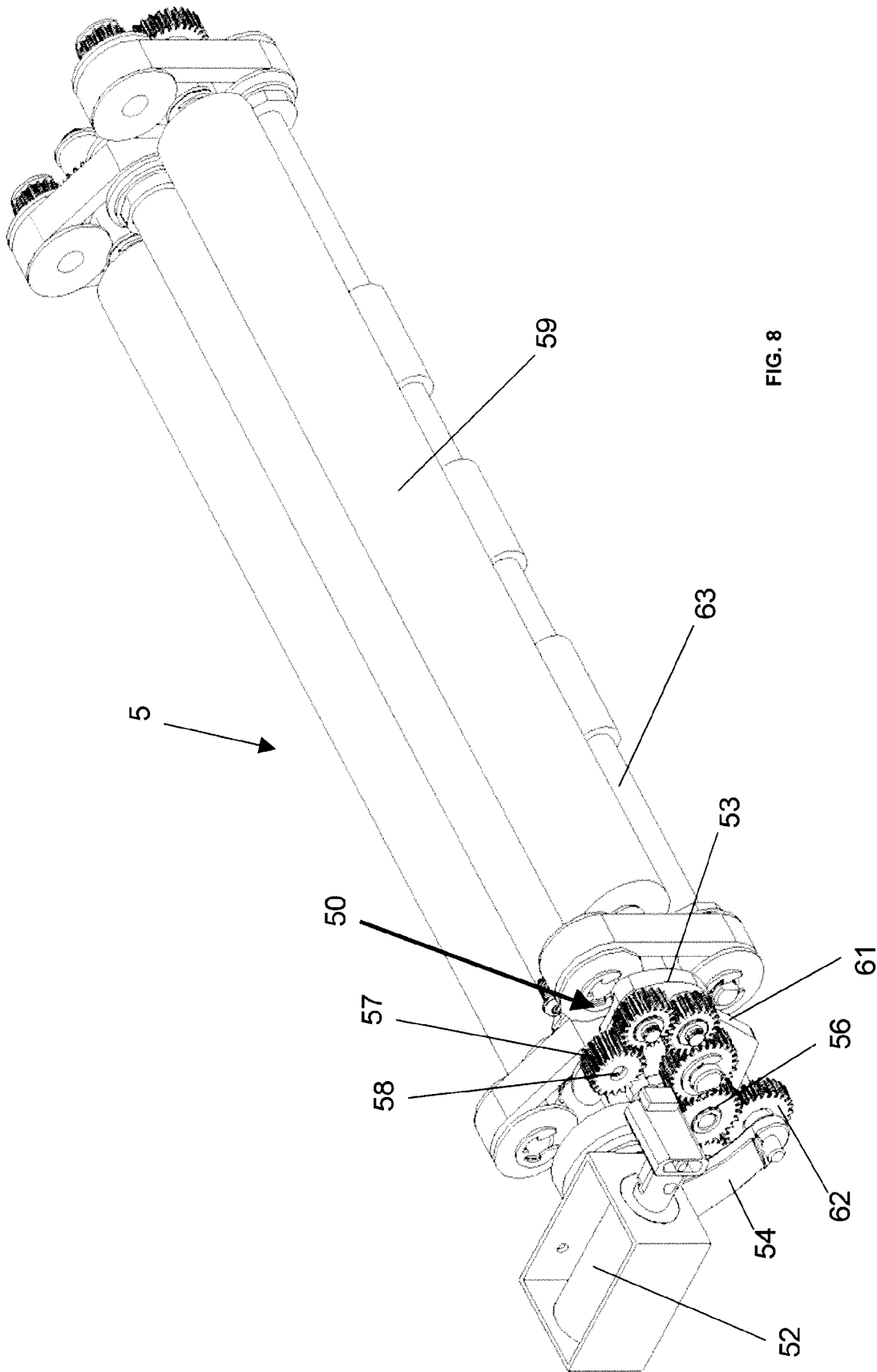


FIG. 6





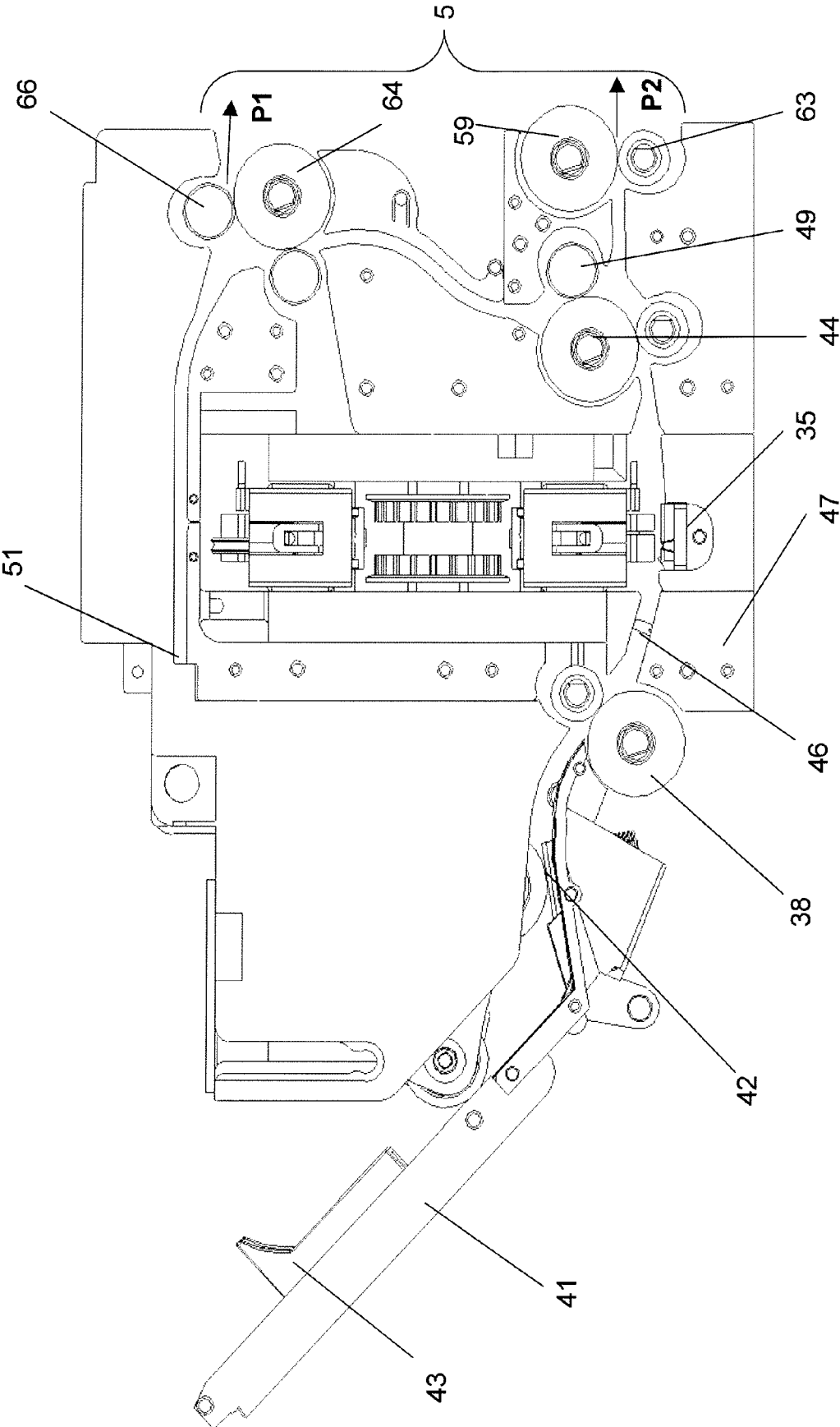


FIG. 9

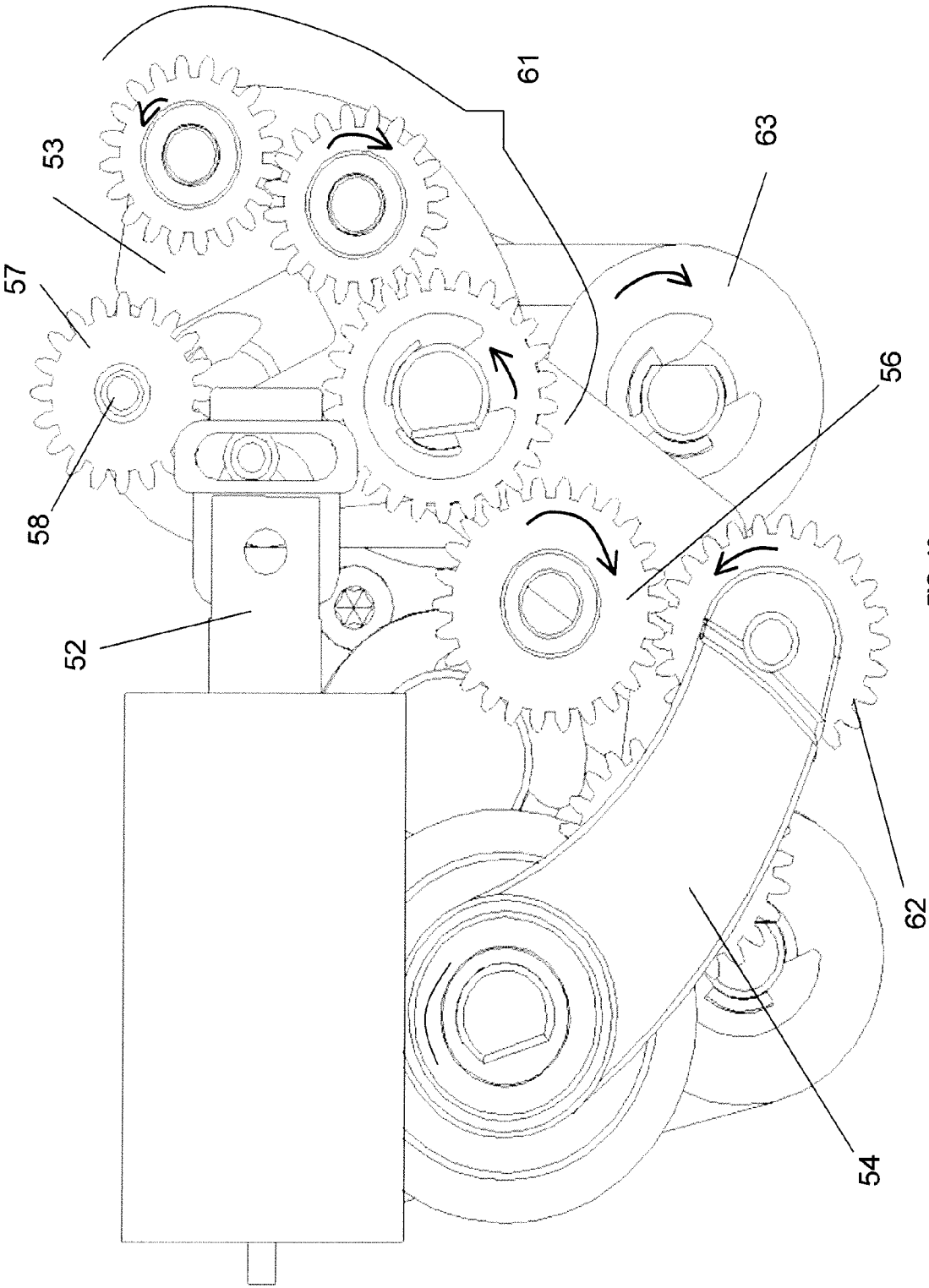


FIG. 10

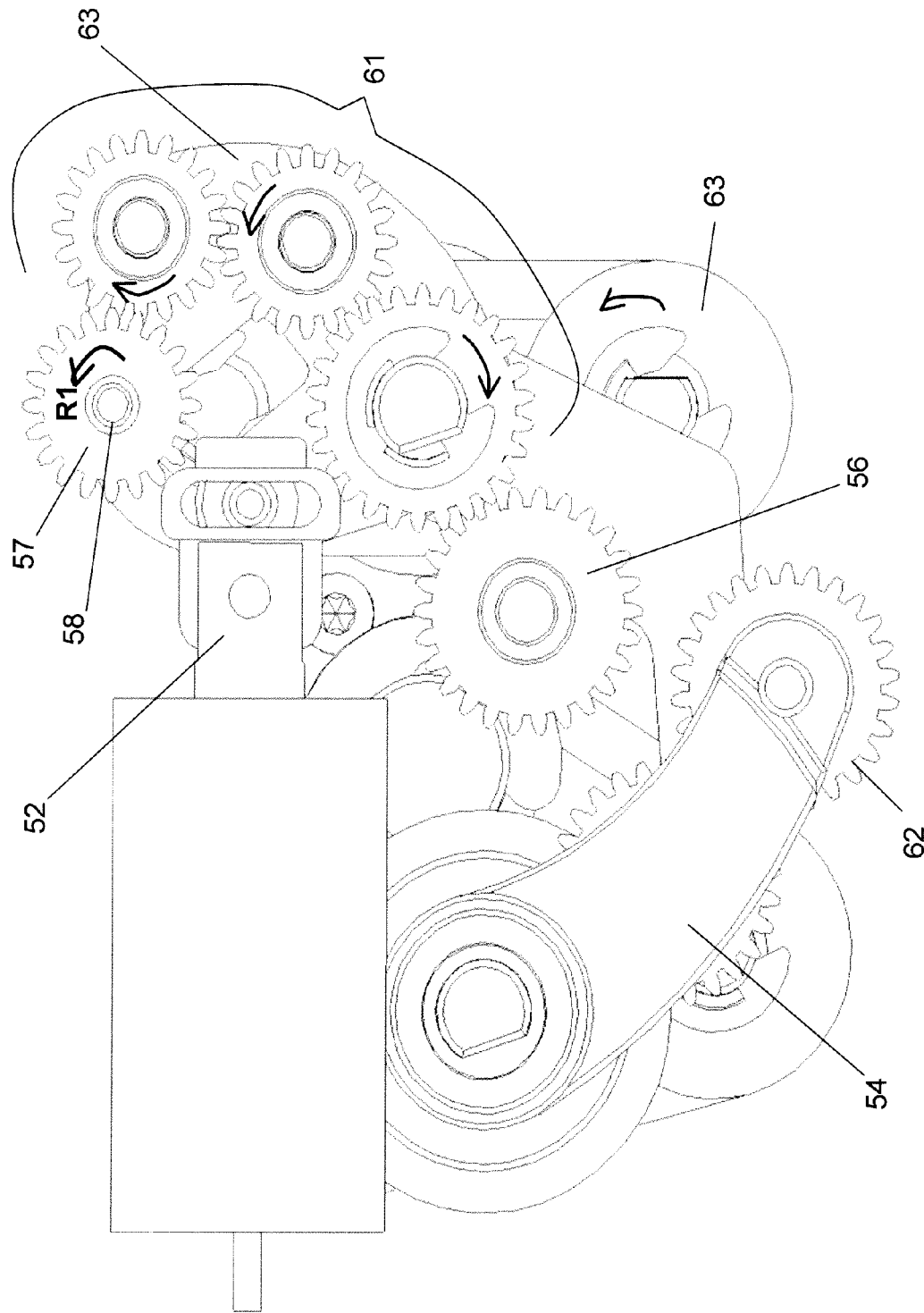
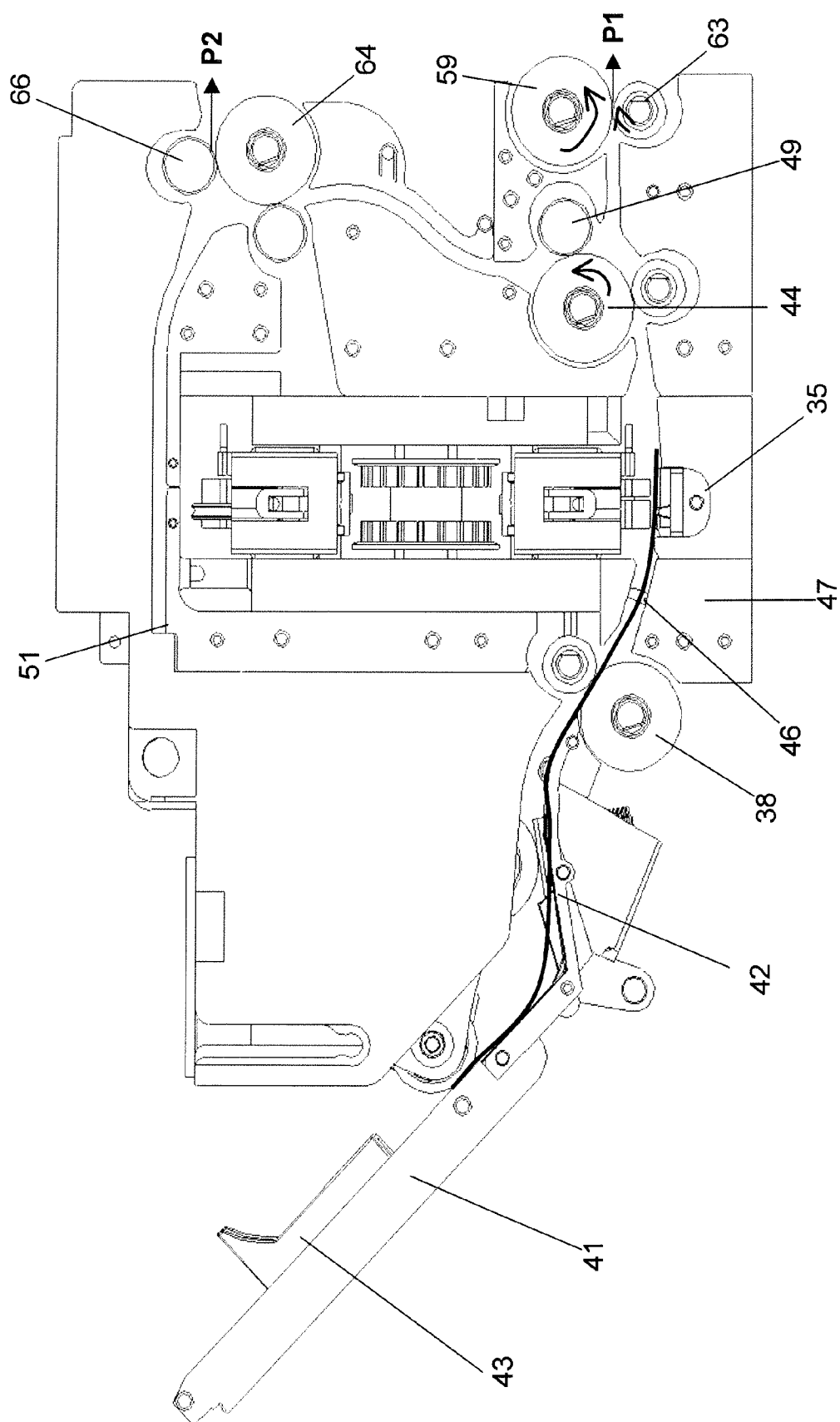


FIG. 11



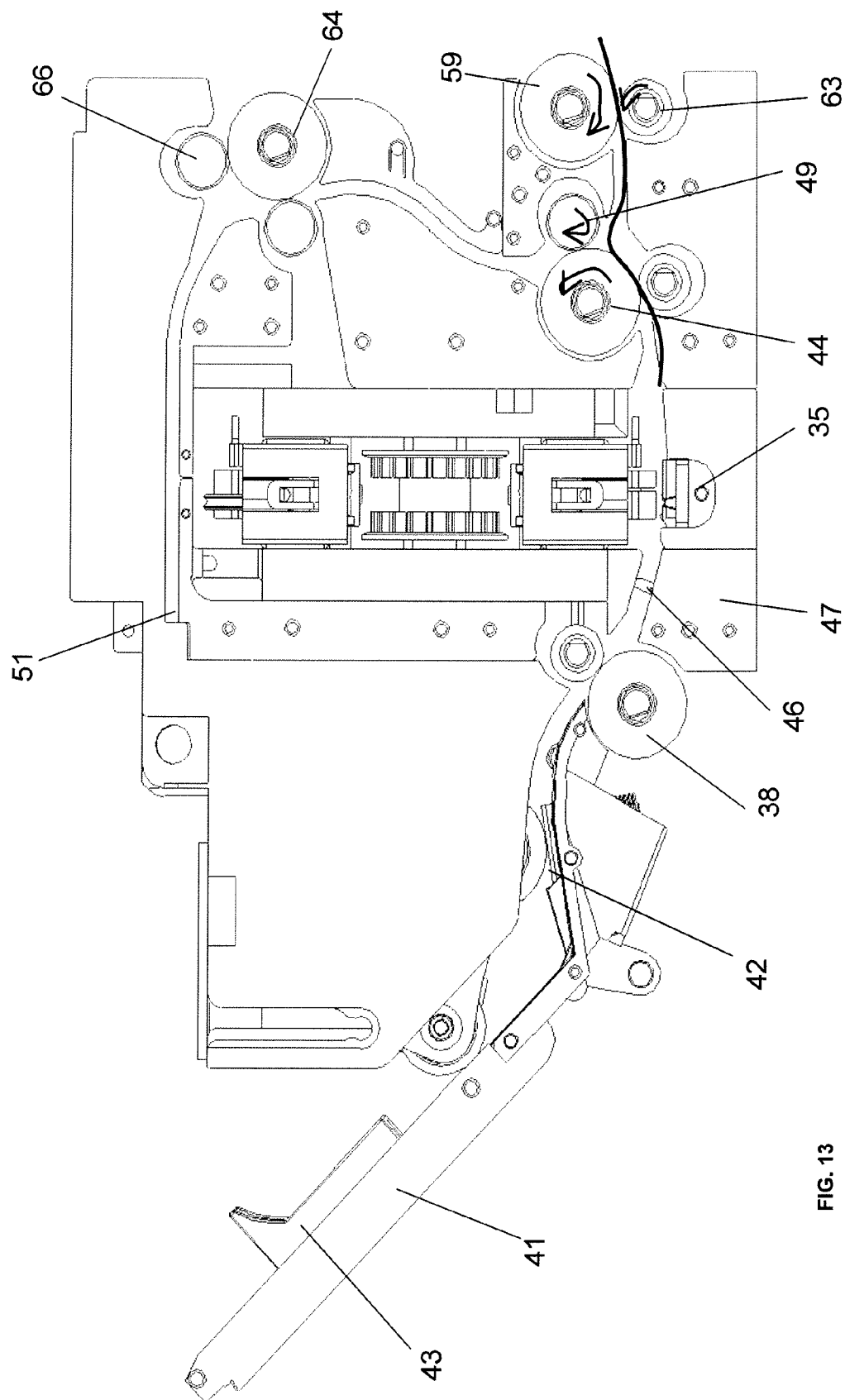


FIG. 13

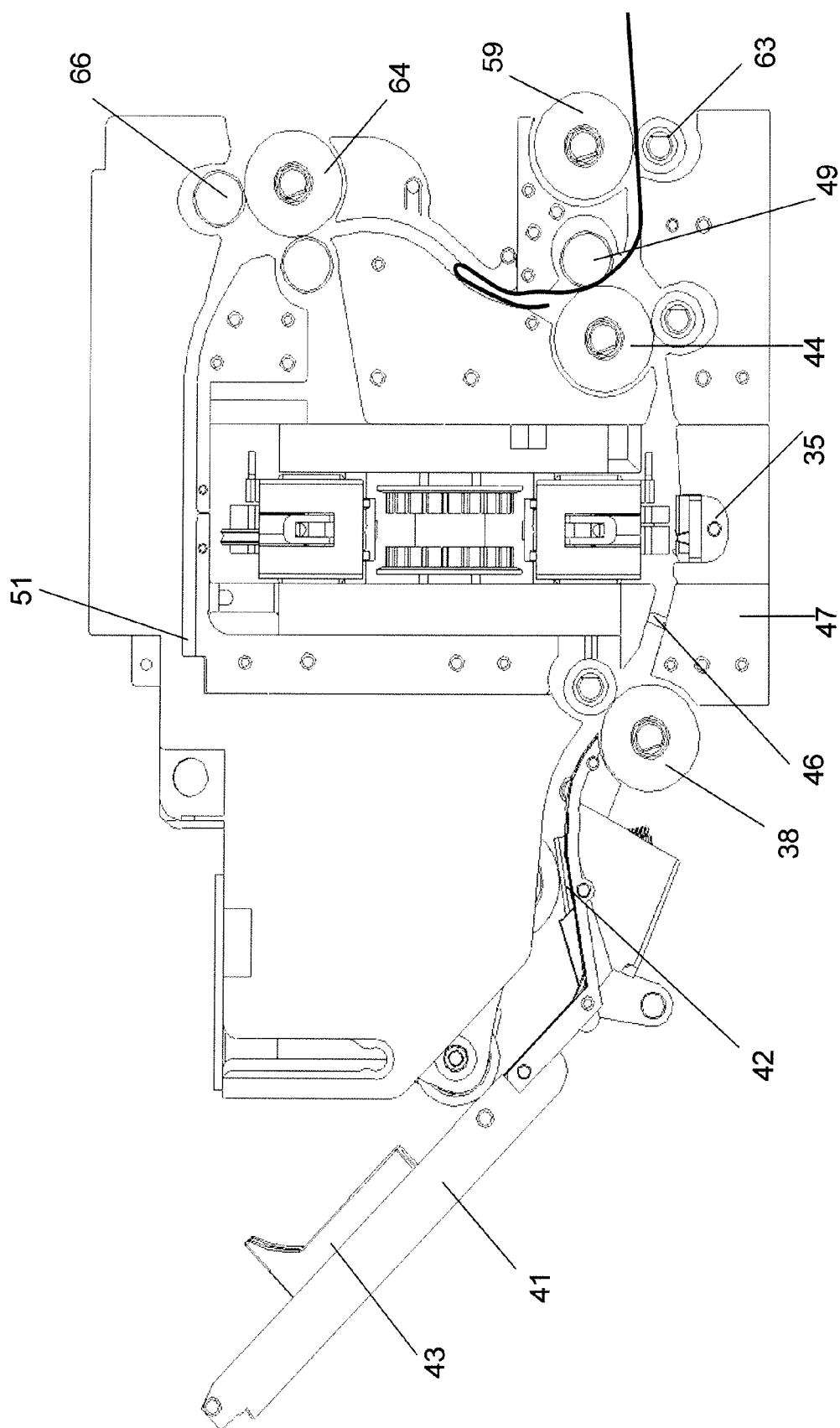


FIG. 14

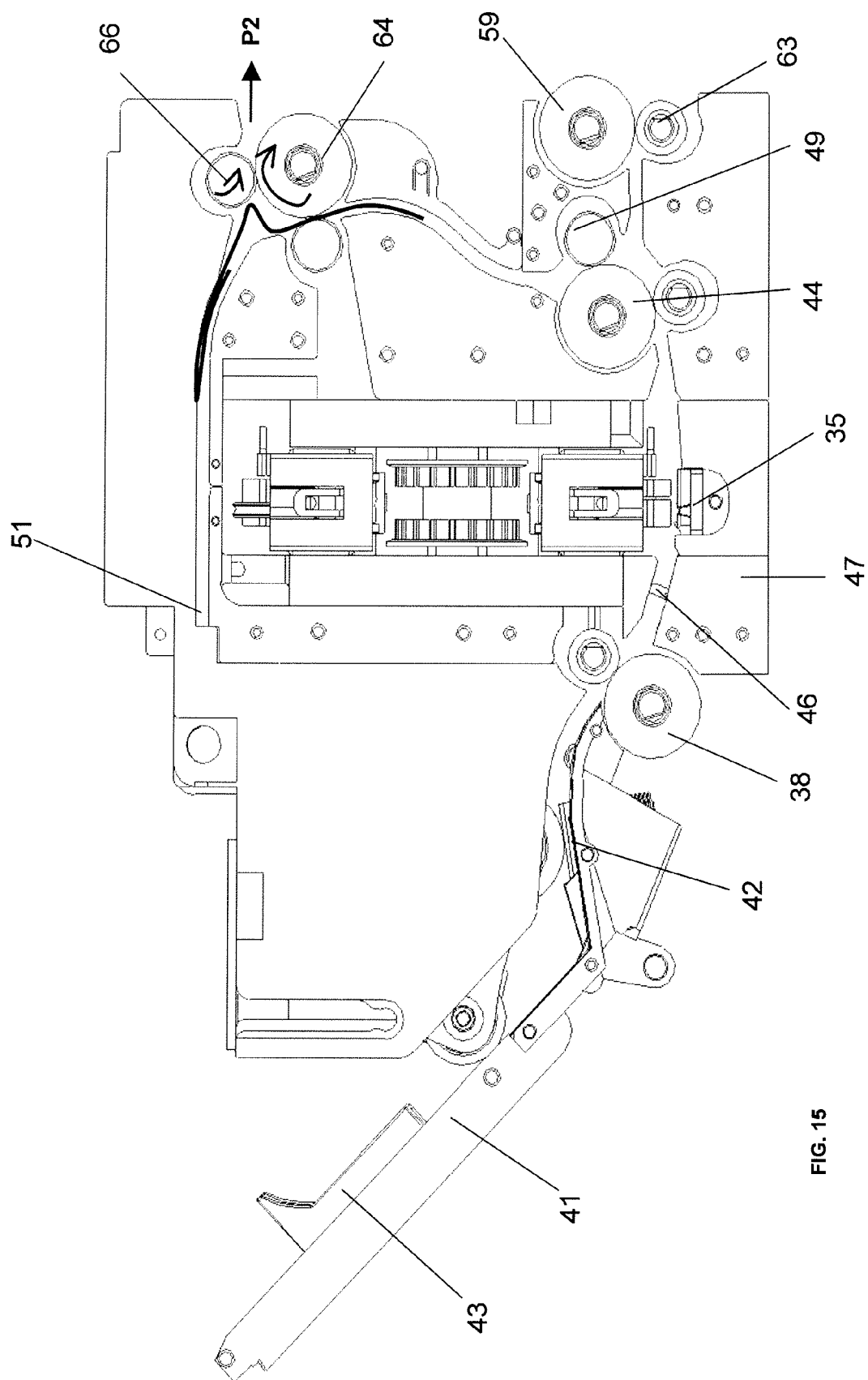


FIG. 15

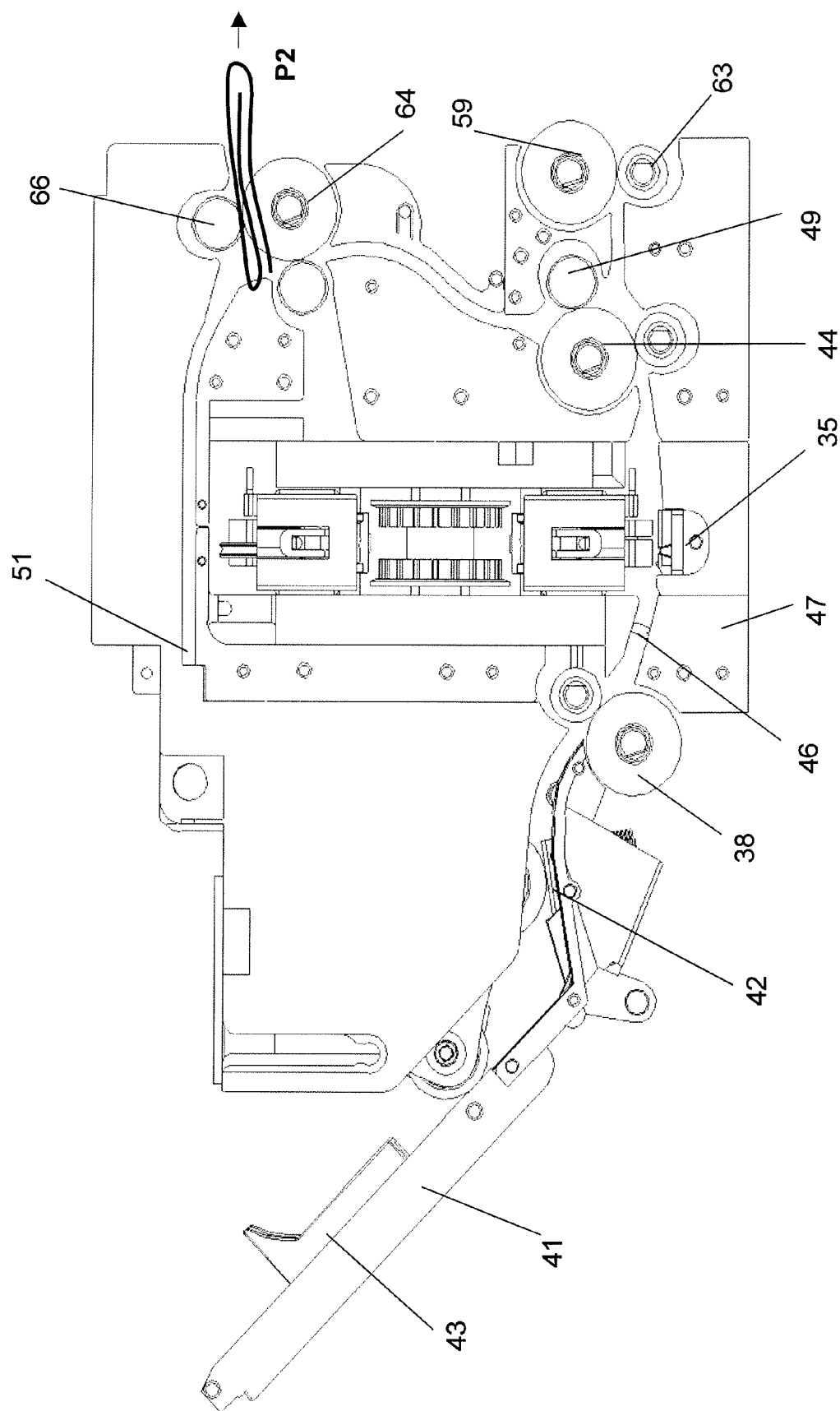


FIG. 16

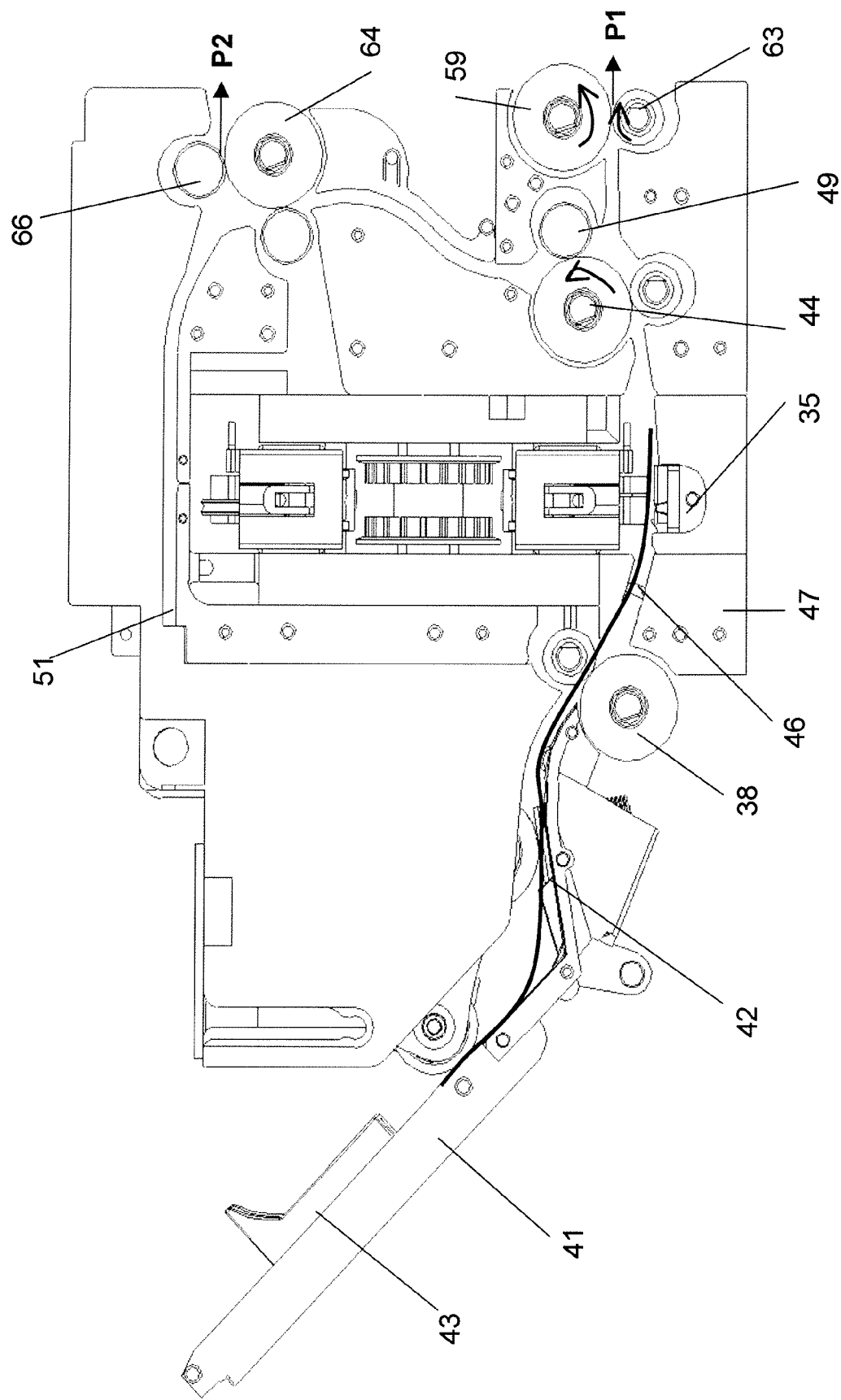


FIG. 17

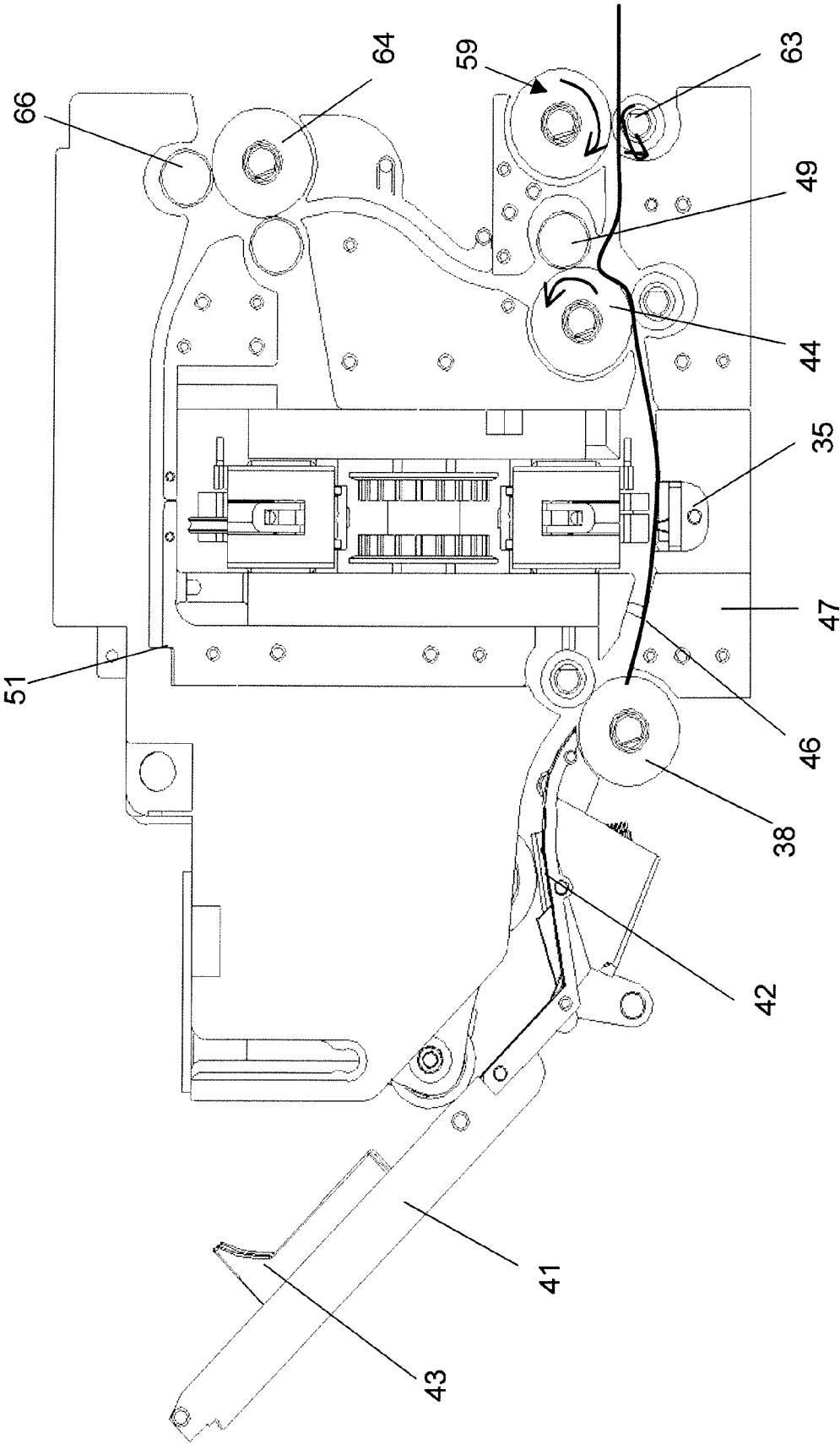


FIG. 18

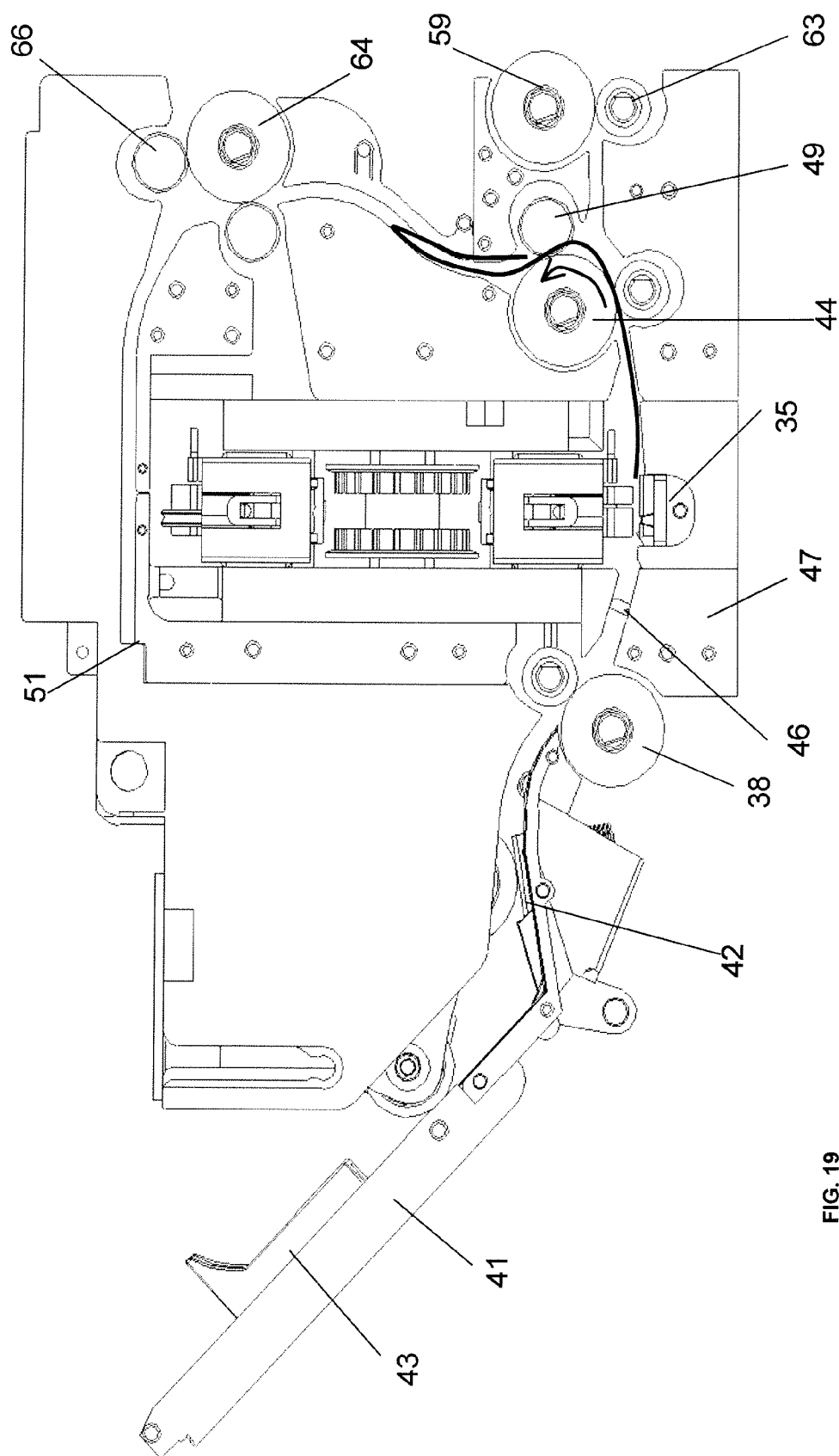


FIG. 19

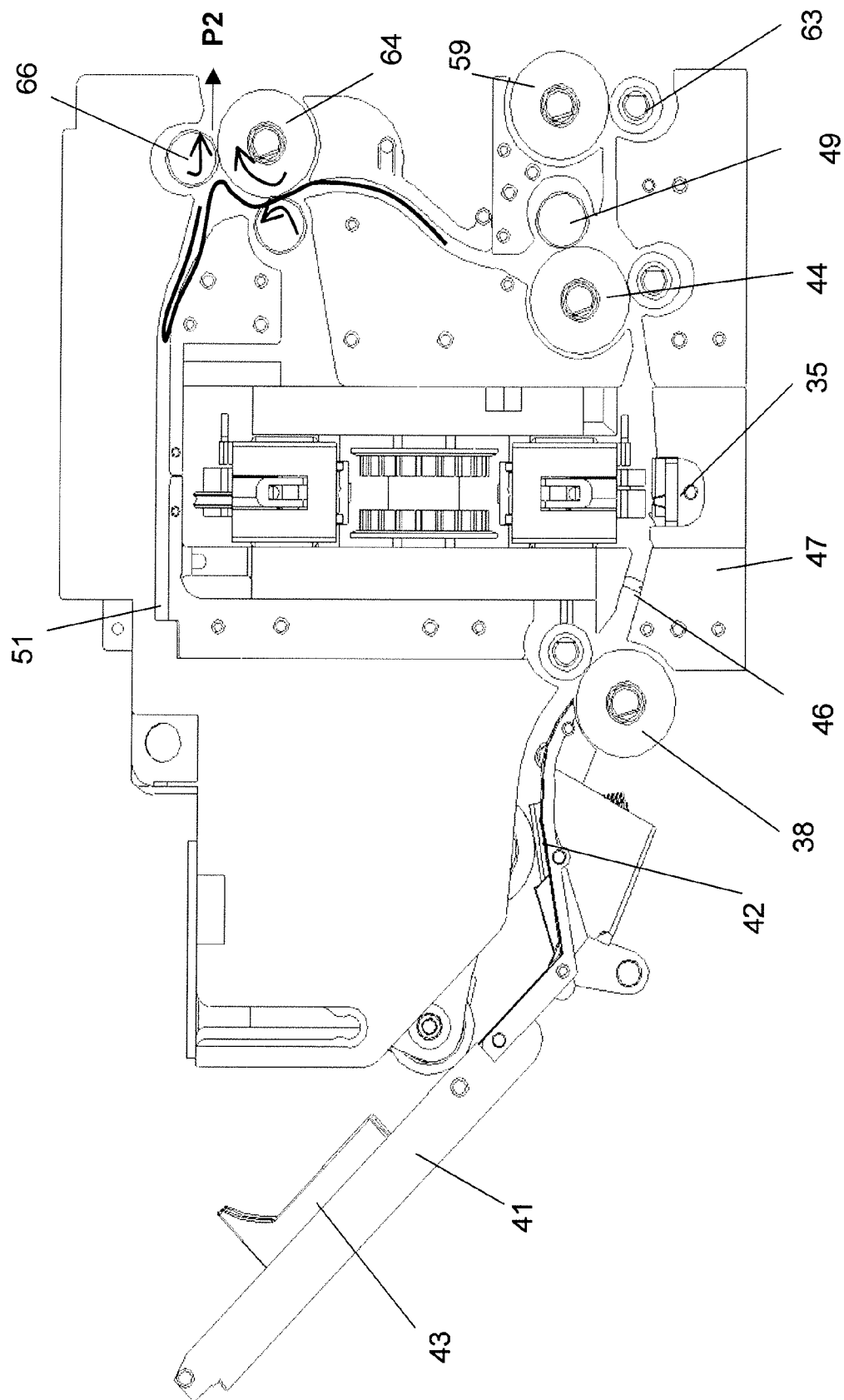


FIG. 20

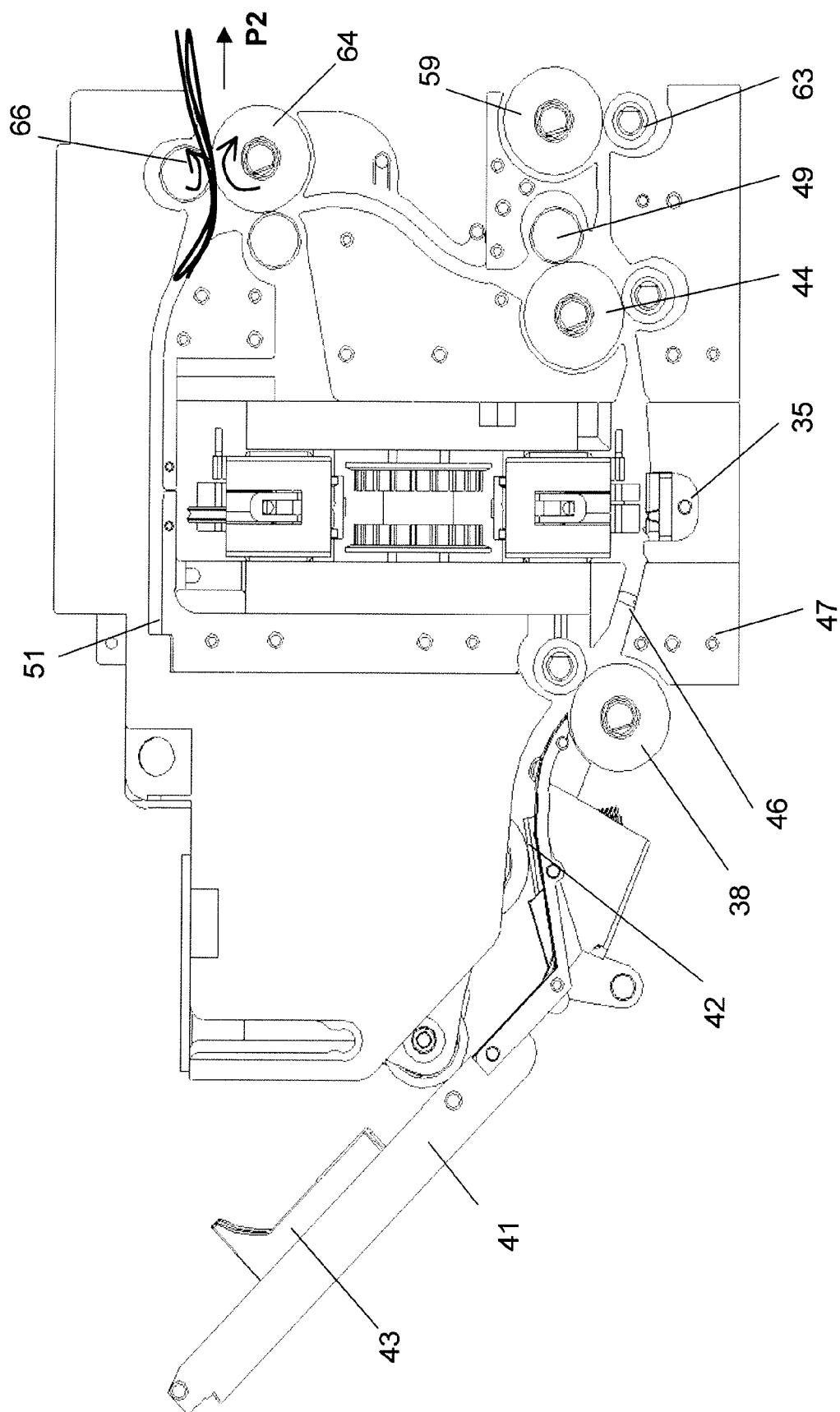


FIG. 21

CREASING, PERFORATING AND FOLDING DEVICE

FIELD OF THE INVENTION

[0001] The present invention generally relates to a machine for creasing, perforating and folding paper or other similar media to suit envelopes of various sizes.

BACKGROUND OF THE INVENTION

[0002] In a conventional creasing or perforating machine, a crease is obtained by compressing the entire length of a paper in between an anvil and a press plate or by compressing the paper in between two rotating rollers, with one roller having a groove and the other roller having a cooperating protrusion profile. On the other hand, perforation is obtained by passing the paper in between two rotating rollers, with one roller having a groove and the other roller having a cutting wheel or by rolling the perforating wheel or other mechanical cutter onto an anvil. Normally, the conventional creasing and perforating machines are not equipped with both features of creasing and perforating in a single machine, or if they are, interchanging of the creasing and perforating head unit will often involve manual work.

[0003] Conventional folding machines that allow multiple types of folding, are complicated in design and they require large footprints. Most of the folding machines are limited to fold paper or the like in one specific paper size. Hard stops are commonly used for buckling the paper, which inevitably resulted in large footprints. When the folding machine is reduced to a portable size, typically it can only achieve one type of folding, mostly letter fold.

[0004] U.S. Pat. No. 6,582,348 issued to Bacciottini, et al, discloses a machine for the creasing, perforating or circular cutting of sheets of paper. This machine shows improvement in terms of the system for feeding the starting sheets, the means for advancing each sheet and the creasing or perforating mechanism. The operations for perforating or cutting the sheets of paper are carried out with the same procedure for creasing, using suitable rotating tools mounted on the tool-handling shafts.

[0005] U.S. Pat. No. 5,918,542, assigned to Hans E. Ruprecht Holding AG, discloses a device for perforating, die-cutting or creasing in printing machines. The device comprises a supporting foil which at two of its opposite sides is provided with strips for mounting onto a rubber blanket cylinder of a printing unit, whereby a component for perforating, die-cutting, cutting or creasing is affixed to the supporting foil.

[0006] U.S. Pat. No. 5,147,275, assigned to Hunt Holdings, Inc., discloses an apparatus for automatically folding one or more sheets of paper into three substantially equal sections for later insertion into a mailing envelope. The design of the folding apparatus can only be used to achieve one type of folding, which is letter-fold in this case.

[0007] U.S. Pat. No. 4,834,699 by Martin discloses an apparatus for sequentially folding paper, comprising three pair of rollers, an uncovered buckle chute and a paper stop mechanism. The paper stop mechanism makes use of a hard stop, such as an abutment or a flange, for stopping the forward movements of the paper.

[0008] Despite the above development, there is still a need to provide a machine for creasing, perforating and folding paper and print media.

SUMMARY OF THE INVENTION

[0009] The following presents a simplified summary to provide a basic understanding of the present invention. This summary is not an extensive overview of the invention and is not intended to identify key features of the invention. Rather, it is to present some of the inventive concepts of this invention in a generalized form as a prelude to the detailed description that is to follow.

[0010] The present invention provides a device for creasing, perforating and folding paper or other similar media to suit envelopes of various sizes. According to one aspect of the invention, there is provided a paper folding and perforating device comprises a Top Of Form sensor, a selectable creasing or perforating head which cooperates with an anvil disposed in a paper path after the Top Of Form sensor, a jam roller and associated pinch roller disposed in the paper path after the anvil, and a firmware for entering the paper size and type of paper folding so that creasing and/or perforating positions are predetermined, wherein after a predetermined paper length is fed into the paper path, the creasing or perforating head traverses a width of the paper to form a crease and after the leading edge goes through the jam/pinch rollers, the jam/pinch rollers reverse in direction to cause the paper to buckle at the crease to form a fold.

[0011] In one embodiment of the present invention, the creasing and perforating heads are separately mounted on opposite sections of a belt, which is strung on two pulleys.

[0012] In another embodiment of the present invention, the creasing head comprises a ring whilst the perforating head comprises a perforating wheel, wherein the ring or perforating wheel is supported on a resilient means.

[0013] In yet another embodiment of the present invention, each of the creasing and perforating heads comprise rollers at two sides for guiding traverse of the respective heads on two side plates.

[0014] In another embodiment of the present invention, the creasing and perforating heads comprise rollers at two sides for guiding traverse of the respective heads on two side plates.

[0015] According to another aspect of the present invention, the jam roller is coupled to a jam roller mechanism, wherein the jam roller mechanism comprises a unidirectional drive gear having a one-way clutch, a solenoid, a jam swing arm equipped with a drive train, said jam swing arm is pivotable about an end of the jam roller and operable by the solenoid from an initial or paper feed position to an activated or paper folding position, a transmission swing arm coupled to a feed roller disposed in the paper path before the jam/pinch rollers, said transmission arm is operable to pivot about said feed roller by swinging from a feed-through position to an activated position as a result of activation of the solenoid and jam swing arm, wherein the said jam and transmission swing arms are disposed on the same side of the device, such that after the predetermined leading edge of the paper goes through the jam/pinch rollers, activation of the solenoid engages the drive train on the jam swing arm to engage with said unidirectional drive gear, thereby reversing the direction of the jam/pinch rollers.

[0016] In one embodiment of the present invention, when the solenoid is not activated, the paper continues to feed through the jam/pinch rollers.

[0017] In another embodiment of the present invention, the jam roller mechanism can be used to form a z-fold or letter-fold, wherein in the formation of letter fold, the first fold is formed at about $\frac{1}{3}$ of paper length measured from the paper's trailing edge by means of the jam roller mechanism, and wherein in the formation of z-fold, the first fold is formed at about $\frac{2}{3}$ of paper length measured from the paper's trailing edge by means of the jam roller mechanism.

[0018] In yet another embodiment of the present invention, the second fold is formed after the front portion of the paper hits the hard stop at its first folding edge, while the back portion of the paper continues to be fed upwards.

[0019] The objectives and advantages of the present invention will become apparent from the following detailed description of embodiments thereof in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Preferred embodiments according to the present invention will now be described with reference to the figures accompanied herein, in which like reference numerals denote like elements.

[0021] FIG. 1 illustrates a perspective view of a creasing, perforating and folding device according to one embodiment of the present invention;

[0022] FIG. 2 illustrates a perspective view of an input system of the device shown in FIG. 1 in accordance with one embodiment of the present invention;

[0023] FIG. 3 illustrates a perspective view of a creasing/perforating module of the device shown in FIG. 1 according to another embodiment of the present invention;

[0024] FIGS. 4A1 and 4A2 illustrate perspective views of creasing and perforating head units of the creasing/perforating module of the device shown in FIG. 3 according to another embodiment of the present invention;

[0025] FIGS. 4B1, 4B2, 4B3 and 4B4 illustrate side views of internal configuration of the creasing and perforating head units shown in FIGS. 4A1 and 4A2;

[0026] FIG. 5 illustrates a perspective view of the creasing/perforating module of the device shown in FIG. 3 having an additional side plate, in accordance with one embodiment of the present invention;

[0027] FIG. 6 illustrates a perspective view of the creasing/perforating module of the device shown in FIGS. 3 and 5 having a sensor at one of the side plates, in accordance with one embodiment of the present invention;

[0028] FIG. 7 illustrates a side view of the creasing, perforating and folding device shown in FIG. 1;

[0029] FIG. 8 illustrates a perspective view of a folding module of the device shown in FIG. 1 in accordance with one embodiment of the present invention;

[0030] FIG. 9 illustrates a side view of the folding module of the device shown in FIG. 1 in accordance with one embodiment of the present invention;

[0031] FIG. 10 illustrates a side view of a Jam Roller mechanism of the device shown in FIG. 1, before the solenoid is activated, in accordance with one embodiment of the present invention;

[0032] FIG. 11 illustrates a side view of the Jam Roller mechanism of the device shown in FIG. 1, after the solenoid is activated, in accordance with one embodiment of the present invention;

[0033] FIGS. 12-16 illustrate side views of the letter-folding process using the folding module of the device, in chronological order; and

[0034] FIGS. 17-21 illustrate side views of the Z-folding process using the folding module of the device, in chronological order.

DETAILED DESCRIPTION OF THE INVENTION

[0035] Embodiments of the present invention shall now be described in detail, with reference to the attached drawings. It is to be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

[0036] FIG. 1 shows a perspective view of a paper handling device 1 according to one embodiment of the present invention. The paper handling device 1 is adapted for creasing, perforating or folding sheet materials, such as paper or similar print media. For simplicity, a paper is used in the following description but is not so limited. The handling device 1 comprises a folding module 5 (not shown in FIG. 1), a creasing and perforating module 10, a belt transmission system 2, an input tray 41 and output P1, P2. The folding module 5 and the creasing and perforating module 10 are generally assembled between the input tray 41 and the output P1, P2.

[0037] Operationally, the paper is fed into the handling device 1 through the input tray 41, processed at creasing and perforating module 10 and/or folding module 5, and finally outputted through output P1, P2, as a finished product. The operations are carried out through series of interconnected rollers and shafts mounted within the assemblies 41, 5, 10 that are driven by the belt transmission system 2. The belt transmission system 2 comprises a motor (not shown), an upper belt transmission assembly 11 and a lower belt transmission assembly 12. Having the belt transmission system 2 separated into the upper 11 and lower belt transmission assembly 12 allows a relatively small footprint and low height of the handling device 1.

[0038] FIG. 2 shows a configuration of the input system of the device 1, in accordance with one embodiment of the present invention. The folding module 5 shares the same input system with the creasing and perforating module 10, whereby multiple sheets of paper or other similar media are first placed on the input tray 41. Each sheet of the paper will then be picked by a pick and separation module 42, and passed to the input-feed roller 38. In one embodiment of the present invention, the input tray 41 has a loading capacity of 30 sheets of paper. A width adjuster 43 is provided to align the stack of paper, as well as to prevent skewing of the paper during the pick and separation process.

[0039] FIG. 3 shows the creasing and perforating module 10 of the handling device 1 in accordance with one embodiment of the present invention. The creasing and perforating module 10 comprises a creasing head 15, a perforating head 20, a belt and pulley system 25, a speed reduction module 30 and an anvil 35.

[0040] The creasing head 15 and perforating head 20 are equipped with a creasing rubber ring 16 and a perforating knife 21, respectively. The rubber ring or knife are removable from the respective head unit and can be replaced with other rubber rings or knives meant for other functions, as desired in another embodiment of the present invention.

[0041] The belt and pulley system 25 is made up of a timing belt 26 that loops over two pulleys, a follower pulley 27 and a drive pulley 28. The drive pulley 28 is connected to a motor 29 through a speed reduction module 30. The speed reduction module 30 comprises a set of reduction gears 31 and a belt drive 32. The reduction gears 31 work in conjunction with the belt drive 32 for stepping down the speed of the motor 29 in order to step up the torque on the drive pulley 28. The combined use of reduction gears and belt drive is well known in the art, and hence, will not be described further herein. The anvil 35 is assembled in parallel to the belt and pulley system 25. The anvil 35 has a similar length as the straight portion of the belt and pulley system 25 and supports the paper during the creasing or perforating process when a force from the creasing/perforating head exerts on the paper.

[0042] The creasing head 15 and perforating head units 20 are mounted on the opposite sections of the timing belt 26. Operationally, the two head units 15, 20 travel along the timing belt loop in a manner that when one of the head units is shifted over the anvil 35, the other is disposed on the other side of the belt and pulley system 25. When the head unit is over the anvil 35, it will perform its respective function according to the rubber ring or knife mounted thereon. Such configuration allows the two head units 15, 20 to be used interchangeably by driving appropriately the belt and pulley system 25.

[0043] Toggling of the creasing and perforating functions in the present invention is automated and controlled by means of a firmware. The head unit recognition is also done by the firmware. The switching between creasing and perforating is done by conveying the appropriate head unit towards the anvil 35. One end of the machine allows the flexibility for function toggling. The creasing and perforating head units 15, 20 are mounted to travel perpendicular to the paper feeding direction. Thus, the creasing and perforating processes are carried out across the width of the paper. The firmware is configurable to carry out multiple creases, perforations, or both on the same paper as required. The firmware operably controls the relevant rollers to carry out the necessary paper feeding towards the anvil 35, and the belt and pulley system 25 conveys the appropriate head unit over the anvil 35 for creasing or perforating the paper thereon.

[0044] FIGS. 4A1-4A2 and 4B1-4B4 show details of the head units shown in FIG. 3. Each head unit is equipped with two compression springs 36, as can be seen in FIGS. 4B1-4B4 so that the creasing rubber ring 16 and perforating knife 21 are supported by the compression springs 36. In this way, the contact force between the creasing rubber ring 16/perforating knife 21 and the anvil 35 is controllable and optimized. In one embodiment of the present invention, 30 N of spring force, for example, is used to achieve an effective creasing and perforating process. In another embodiment of the present invention, the compression springs 36 is made up of a resilient piece of rubber.

[0045] The head units 15, 20 are also equipped with tabs 17, 22 and metal rollers 37, as shown in FIGS. 4A1-4A2. The creasing 17 and perforating tabs 22 are parts of the device's sensing system, which will be described further hereinafter. The metal rollers 37 serve the purpose of reducing frictional forces as the two head units 15, 20 travel back and forth along guiding grooves 33 on side plates 34 located on both sides of the belt and pulley system 25, as can be seen in FIG. 5.

[0046] FIG. 6 shows a head unit recognition system 40 of the creasing and perforating module 10 in accordance with

one embodiment of the present invention. The head unit recognition system 40 comprises a sensor 39 located on the side plate 34 opposite that of the motor 29. The creasing 17 and perforating tabs 22 on the head units 15, 20 are used by the sensor 39 to differentiate the creasing head 15 from the perforating head 20. In one embodiment, the perforating tab 22 is shorter in length than the creasing tab 17. By monitoring the length difference of the tabs, the sensors 39 is able to identify which head unit is currently facing downwards towards the anvil 35. Based on the determination, a respective head unit is then shifted over the anvil 35 for the process to be carried out, according to the selection previously set within the firmware.

[0047] FIG. 7 shows a side view of the creasing/perforating module, together with its input and output system. A Top Of Form (TOF) sensor 46 located near the middle of a base support 47 is used to detect the leading and trailing edges of the paper to be creased or perforated. The Top Of Form (TOF) sensor 46 is used together with the firmware for accurate distance calculation, thus allowing precise creasing and perforating at the desired predetermined locations on the paper.

[0048] The use of the Top Of Form (TOF) sensor 46 combined with the firmware in the present invention allows the user to have multiple crease and perforation lines on the paper or other similar media in a single pass. There is also no distance limitation between lines in a single pass. Hence, the paper or similar media to be processed on, only have to go through the device 1 once. This eliminates the need for the paper to be restacked on the input tray 41 every time another crease/perforation process need to be done on it, as required in the conventional creasing or perforating device. An output system comprised of rollers 48 is utilized for ejecting the paper from the lower exit path P1 of the device 1, once the creasing and perforating processes are completed.

[0049] The creasing and perforating module 10 of the present invention offers advantages of a simple design with an automated toggling between the creasing and perforating functions and smaller footprint, as compared with the conventional creasing or perforating device.

[0050] FIG. 8 and FIG. 9 show perspective view and side view respectively of the folding module 5, according to one embodiment of the present invention. The folding module 5 is provided to handle different types of folding and different paper sizes, for example, ranging from A4 to B sizes. Conventional folding device normally relies on hard stops as means for folding or buckling. This folding module 5 utilizes a "Jam-Roller" mechanism 50 to form the first fold and hard stop for any subsequent folding.

[0051] The Jam-Roller mechanism 50 comprises a solenoid 52, a drive train 61 coupled to a jam swing arm 53, a transmission gear train 62 coupled to a transmission swing arm 54, a unidirectional drive gear 57 built in with a one-way clutch 58, a jam roller 59 and a compression roller 63. A set of four feed rollers 38, 44, 59, 64 is used to transport the paper from one point to another along the paper-folding path, as will be better explained later. The feed rollers 38, 44, 59, 64 will be further described in details hereinafter.

[0052] The jam swing arm 53 and the drive train 61 are coupled to the jam roller 59, whereas the transmission swing arm 54 and the transmission gear train 62 are coupled to the second feed roller 44. There is an additional gear 56 used to connect the transmission gear train 62 to the drive train 61. This additional connecting gear 56 is always in contact with the drive train 61. The swinging up or down motion of the transmission swing arm 54 results in the transmission gear

train 62 engaging or disengaging with the drive train 61, through the additional connecting gear 56. The solenoid 52 is linked to the jam swing arm 53, such that upon its activation by the firmware, the jam 59 and compression roller 63 change in reverse direction for forming the first fold on the paper. The details of how the Jam Roller mechanism 50 works will be described further hereinafter.

[0053] The same Top Of Form sensor 46 is also used in the folding module 5 for the same purpose of detecting the leading and trailing edge of the paper to be folded. The use of Top Of Form sensor 46 together with the firmware facilitates accurate distance measurement, such that precise folding on the desired predetermined locations of the paper can be achieved.

[0054] With the Top Of Form sensor 46, the firmware is then able to control the time of activation of the solenoid 52. Activating the solenoid is the first step of starting the folding process by the Jam Roller mechanism 50. FIG. 10 and FIG. 11 show the configuration of the Jam Roller mechanism 50, before and after the solenoid is activated, respectively.

[0055] Before the solenoid 52 is activated, the plunger of the solenoid 52 is extended and the transmission swing arm 54 is in the swung up position, such that the transmission gear train 62 is engaged directly with the connecting gear 56 and indirectly with the drive train 61. As a result, the second roller 44 and jam roller 59 rotate in the same direction i.e. anticlockwise as seen in FIG. 10, thus feeding the paper outward from the lower exit path, as indicated by the arrow P1 in FIG. 9.

[0056] When the solenoid 52 is activated and the plunger of the solenoid 52 is retracted, the jam swing arm 53 together with the drive train 61, are being pulled towards the gear 57. At the same time, the transmission gear train 62 is disengaged from both the connecting gear 56 and the drive train 61. A bottom part of the jam swing arm 53 is designed in such a way that once the jam swing arm 53 is swung up, it causes the transmission swing arm 54 to swing down thereby disengaging the transmission gear train 62 from the connecting gear 56 and the drive train 61.

[0057] The gear 57 with one-way clutch 58 is only allowed to rotate in one direction, as indicated by the arrow R1 in FIG. 1. Once the drive train 61 is engaged with the gear 57, its rotating direction will be reversed. Since, the jam roller 59 is connected to the drive train 61, its rotating direction is reversed as well, thus stopping the paper from being fed outward from the lower exit path P1. The rotating direction reversal of the jam roller 59 is followed by two actions: engagement of drive train 61 to the gear 57 with one way clutch 58 and disengagement of transmission gear train 62 from the connecting gear 56 and the drive train 61. This is done after a predetermined paper length has been fed outward from the lower exit path P1, while the paper itself is still being fed forward by the second feed roller 44. As a result, the paper buckle at the desired predetermined location and the first fold is formed. The designated point of buckling is pulled in between the second feed roller 44 and a buckling roller 49 to achieve the fold edge. The use of one-way clutch 58 ensures immediate release of hold, such that once the rotating direction of the jam roller 59 is reversed, the portion of the paper which has been fed outward from the lower exit path is fed smoothly backwards. This is done with help from the compression roller 63, located right below the jam roller 59, by reversing its direction at substantially the same time as the jam roller 59. This configuration is able to minimize risk of

the paper being halted or any other possible error at the point of the rollers' direction reversal.

[0058] The types of folding, be it letter-fold or Z-fold, is determined by the amount of paper length that has been fed outward from the lower exit path P1. As mentioned previously, the firmware uses the information obtained from the Top Of Form sensor 46 to control the length of the paper to be fed outward from the lower exit path P1, based on the type of folding chosen by the user.

[0059] When the device 1 is in use, the user selects one or more desired functions; creasing, perforating and/or folding function. Regardless of the function(s) selected by the user, firstly the paper from the input tray 41 will be passed to the input-feed roller 38 and the Top Of Form sensor 46 will subsequently detect its leading edge.

[0060] In one embodiment of the present invention, the user selects creasing and/or perforating function, without any folding. First, the user determines the setting of the crease and perforation in terms of the sequence and locations. The firmware then controls the relevant rollers to perform necessary paper feeding towards the anvil 35. The appropriate head unit is then conveyed over the anvil 35 for creasing or perforating the paper thereon, according to the user settings. When the necessary creasing and perforating processes are completed, the paper is ejected from the lower exit path P1 of the device 1, by a set of output rollers 48.

[0061] In another embodiment of the present invention, the user selects folding function, without any creasing or perforating. The user then first enters the desired type of folding and paper size as variables in the firmware. Once the Top Of Form sensor 46 detects the leading edge of the incoming paper, the firmware uses the user settings to control the time of activation of the solenoid 52.

[0062] FIGS. 12-16 show how a letter fold is formed chronologically using this folding module 5. The solenoid 52 is activated when the portion of the paper fed outward from the lower exit path P1 reaches a predetermined length, such that the first buckle or fold is then formed at about $\frac{1}{3}$ of paper length measured from the paper's trailing edge, by means of the previously explained Jam Roller mechanism 50. The paper, now having its first fold, continues to be fed upwards until it hits a hard stop 51. The second fold is then formed after the front portion of the paper hits the hard stop 51 at its first folding edge, while the back portion of the paper continues to be fed upwards. The designated point of buckling is pulled in between the second buckling roller 66 and the discharge roller 64, which is also the last out of four feed rollers used in this folding module 5. The second folding edge is then created at about $\frac{1}{3}$ of paper length measured from the paper's initial leading edge. Finally, the letter-folded paper is discharged from the device's upper exit path, as indicated by the arrow direction P2.

[0063] As can be seen from FIGS. 17-21, the process of forming a Z-fold is very similar to the letter-folding process as explained above. The only difference is the solenoid activation timing, which is set in such a way that the first buckle or fold is formed at about $\frac{2}{3}$ of the paper length, measured from the paper's trailing edge, instead of $\frac{1}{3}$ of the paper length as for the case of letter-fold. The second folding edge is then formed at about $\frac{2}{3}$ of paper length, measured from the paper's initial leading edge, instead of $\frac{1}{3}$ as for the case of letter-fold.

[0064] Other types of folding such as engineering-fold, gate-fold or half-fold can also be made by utilizing the same Jam-Roller mechanism 50.

[0065] With present invention, the user may even select the combination of all the creasing, perforating and folding functions. In this case, all the necessary creasing and perforating processes are first carried out on the paper in the creasing and perforating module 10. The paper is then fed to the folding module 5, to be folded according to the user selection, instead of relying on buckling of the paper between relevant feed rollers. The paper is then ejected from the device 1 from the upper exit path P2, as a finished product.

[0066] The folding module 5 of the present invention improves on the method used by conventional folders, which rely solely on hard stops for folding. The present invention is able to achieve multiple folds without the need of multiple hard stops, hence increasing flexibility in folding and reducing the required footprints at the same time. In addition to that, the device 1 of the present invention allows different types of folds for different paper sizes.

[0067] While specific embodiments have been described and illustrated, it is understood that many changes, modifications, variations and combinations thereof could be made to the present invention without departing from the scope of invention. For example, instead of setting the folding positions from the trailing edge of a paper, the leading edge can be used.

What is claimed is:

1. A paper folding and perforating device comprising:
 - a top-of-form sensor;
 - a selectable creasing or perforating head which cooperates with an anvil, said anvil is disposed in a paper path after said top-of-form sensor;
 - a jam roller and associated pinch roller disposed in the paper path after said anvil; and
 - a firmware for inputting the paper size and type of paper folding so that creasing and/or perforating positions are predetermined;
 wherein after a predetermined paper length is fed into the paper path and after the leading edge goes through the jam/pinch rollers, the jam/pinch rollers reverse in direction to cause the paper to buckle at the crease to form a fold.
2. A device according to claim 1, wherein when the creasing head is selected, the creasing head traverses a width of the paper to form a crease.
3. A device according to claim 1, wherein when the perforating head is selected, a perforated line is formed on the paper by the perforating head.
4. A device according to claim 1, wherein the creasing and perforating heads are separately mounted on opposite sections of a belt, which is strung between a driver pulley and a follower pulley.
5. A device according to claim 1, wherein the creasing head comprises a ring whilst the perforating head comprises a perforating wheel.

6. A device according to claim 5, wherein the ring or perforating wheel is supported on a resilient means.

7. A device according to claim 5, wherein each of the creasing and perforating heads further comprises a tab and a sensor for differentiating the tab on the creasing head from the tab on the perforating head.

8. A device according to claim 1, wherein the creasing and perforating heads comprise rollers at two sides for guiding traverse of the respective heads on two side plates.

9. A device according to claim 1, wherein the jam roller is coupled to a jam roller mechanism.

10. A device according to claim 9, wherein the jam roller mechanism comprises:

- a unidirectional drive gear having a one-way clutch;
- a solenoid;

- a jam swing arm pivotable about an end of the jam roller, said jam swing arm has a drive train and said jam swing arm is operable by the solenoid from an initial or paper feed position to an activated or paper folding position; and

- a transmission swing arm coupled to a feed roller disposed in the paper path before the jam/pinch rollers, said transmission arm is operable to pivot about said feed roller by swinging from a feed-through position to an activated position as a result of activation of the solenoid and jam swing arm, wherein said jam and transmission swing arms are disposed on the same side of said device;

such that after the predetermined leading edge of the paper goes through the jam/pinch rollers, activation of the solenoid causes the drive train on the jam swing arm to engage with said unidirectional drive gear, thereby reversing the direction of the jam/pinch rollers.

11. A device according to claim 9, wherein the solenoid is not activated and the paper continues to feed through the jam/pinch rollers.

12. A device according to claim 9, wherein the first fold is formed at about $\frac{1}{3}$ of paper length measured from the paper's trailing edge, by means of the jam roller mechanism, in the formation of letter fold.

13. A device according to claim 9, wherein the first fold is formed at about $\frac{2}{3}$ of paper length measured from the paper's trailing edge, by means of the jam roller mechanism, in the formation of Z-fold.

14. A device according to claim 12, wherein the second fold is formed between buckling and discharge rollers after the first folded edge of the paper hits a hard stop, while the rear portion of the paper continues to said buckling and discharge rollers.

15. A device according to claim 13, wherein the second fold is formed between buckling and discharge rollers after the first folded edge of the paper hits a hard stop, while the rear portion of the paper continues to said buckling and discharge rollers.

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