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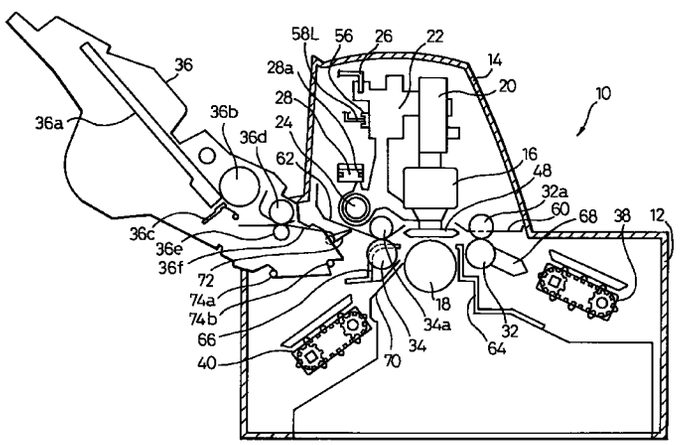
(54) Multi-path type printer

(57) A printer includes a carriage 22, a printing head 16, a platen 18, a rear feed roller 34 and a front feed roller 32. The feed rollers are rotatable in two rotational directions, so that a sheet can be fed to the platen 18 in the front feed direction and in the rear feed direction. A rear tractor 40, a front tractor 38, a rear cut sheet feeder 36, and a front cut sheet feeder 36 can be selectively arranged in the casing 12 of the printer for feeding a cut sheet or a continuous form to the platen 18. Also, a sheet can be manually fed from a table 42. The rear tractor 40 is arranged such that a continuous form is directly fed from the rear tractor 40 to the platen 18 through a gap between the rear feed roller 34 and the platen 18.

Fig.1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a multi-path type printer having feed rollers arranged on either side of a platen so that a sheet to be printed can be conveyed in the forward direction and in the rearward direction.

2. Description of the Related Art

Recently, a demand for multi-path type (forward and rearward conveying) wire dot printers is increasing. For this purpose, the multi-path type printer has feed rollers arranged on either side of a platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction. Therefore, a cut sheet (a paper sheet cut into a predetermined size, such as A4, B5, and so on) can be fed from the front of the printer and the printed sheet can be discharged to the front of the printer or to the rear of the printer, or a cut sheet can be fed from the rear of the printer and the printed sheet can be discharged to the front of the printer or to the rear of the printer. In addition, a continuous form (a continuous paper having feeding holes on the side edges thereof, and also referred to continuous sheet or a continuous form sheet) can be fed from the front of the printer and the printed sheet can be discharged to the rear of the printer, or a continuous form can be fed from the rear of the printer and the printed sheet can be discharged to the front of the printer.

In the multi-path type printer which can satisfy this requirement, it is necessary that the printer includes, for example, a table, a stacker (stackers), a cut sheet feeder (cut sheet feeders), and a tractor (tractors), in addition to the platen and feed rollers, resulting in that the sheet conveying path is complex, adequate sheet guide mechanisms are necessary, and the number of moving parts for changing the sheet conveying path increases so that the arrangement of the printer becomes complex.

In the case where the change of the sheet conveying path is manually carried out, the changing operation for changing the sheet conveying path may not be easy for an operator who is not accustomed to the printer. Therefore, a printer which is relatively simple in construction and easy to operate for any person, and which can be used conveniently is required.

In the conventional printer, for example, in order to feed a continuous form from the tractor to the platen, the continuous form is passed through the gap between one feed roller before the platen in view of the sheet conveying direction and the associated nip roller, but the nip roller is brought into an elevated position relative to the feed roller so that this feed roller does not substantially feed the continuous form. The feed roller after the platen in view of the sheet conveying direction is used to pull the continuous form. This is done to prevent the continuous form from being slack between the roller before the platen and the tractor. Therefore, in the conventional multi-path type printer, elevating mechanisms or spring pressure regulating mechanisms are provided for the nip rollers of two feed rollers on either side of the platen, so the arrangement becomes complex and an available space within the printer becomes narrower. In addition, such elevating mechanisms or spring pressure regulating mechanisms for the nip rollers are constructed to be manually operated by levers, and in some cases, an unaccustomed operator cannot operate the printer.

In addition, a sensor (sensors) is used for detecting the position of a sheet to control the conveyance of the sheet. In the conventional multi-path type printer, such a sensor (sensors) must be arranged in a duplicated manner for the front conveyance of the sheet and for the rearward conveyance of the sheet, and this leads to an increased cost of the printer.

In addition, if the printer is designed such that the platen, the feed rollers and the tractor (tractors) are driven by a single motor, a large motor is necessary, the drive-transmitting mechanism is complex, and this leads to an increase in cost of the printer. Also, a changing mechanism is necessary in the driving system for changing the drive of one element to another, or a speed changing mechanism may be necessary.

In addition, it is sometimes desired that equipment such as the table, the stacker (stackers), the cut sheet feeder (cut sheet feeders), and the tractor (tractors) can be arranged in the printer. For example, it is desired that two tractors can be arranged in the front and rear of the printer, the cut sheet feeder can be also arranged in the printer, and the table and the stacker are also arranged in the printer. However, there is a problem in that the printer becomes larger to hold the above described arrangement. Especially, it is difficult to arranged the cut sheet feeder, the stacker, and the tractor at the rear of the printer.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a printer in which a sheet can be fed in one direction from the front side of the printer and in the other direction from the rear side of the printer, and which is simple in construction and easy in operation.

Another object of the present invention is to provide a printer in which equipment such as a table, a stacker (stackers), a cut sheet feeder (cut sheet feeders), and a tractor (tractors) can be used.

According to the first feature of the present invention, there is provided a printer comprising a casing, a movable carriage, a printing head attached to the carriage, a platen opposed to the printing head, a first feed roller arranged on one side of the platen, and a second feed roller arranged on the other side of the platen, the

first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof. The printer is characterized in that a first securing means is provided in the casing for arranging a first tractor such that a continuous form is directly fed from the first tractor to the platen through a gap between the first feed roller and the platen.

In this feature, the first tractor can be arranged such that a continuous form is directly fed from the first tractor to the platen through a gap between the first feed roller and the platen. According to this arrangement, the first tractor can be arranged at a greater angle (for example, approximately 45 degrees) to the horizontal than a tractor of a conventional arrangement, and it is possible to effectively use a space in the casing of the printer, measured from the end plate of the casing to the platen. Therefore, it is possible to arrange a stacker and a cut sheet feeder along with the tractor, for example, on the rear side of the printer at different heights. Since the continuous form does not pass on the first feed roller, it is possible to omit an elevating mechanism for the nip roller of the first feed roller.

Preferably, a continuous form guide extends from a position near the first securing means toward the platen. According to this arrangement, it is possible to more reliably feed the continuous form directly to the platen, while the first tractor can be arranged at a greater angle to the horizontal than a tractor of a conventional arrangement.

Preferably, a table, a second tractor, a first cut sheet feeder and a second cut sheet feeder, in addition to the first tractor can be selectively arranged in the printer. That is, the printer includes, in addition to the first securing means, a second securing means arranged in the casing for arranging a first cut sheet feeder on the side of the first securing means from the platen, a third securing means arranged in the casing for arranging a table on the opposite side of the first securing means from the platen, a fourth securing means is arranged in the casing for arranging a second tractor on the opposite side of the first securing means from the platen, and a fifth securing means is arranged in the casing for arranging a second cut sheet feeder on the opposite side of the first securing means from the platen. Therefore, the first tractor, the second tractor, the first cut sheet feeder and the second cut sheet feeder can be selectively arranged in the casing, and a sheet can be fed from the table and selected at least one of the tractors and the cut sheet feeders.

Preferably, the table can function as a stacker when the first cut sheet feeder is selected, and a stacker can be arranged in place of the first cut sheet feeder when the second cut sheet feeder is selected. Accordingly, for example, it is possible to arrange the cut sheet feeders on the front side of the printer and a large capacity stacker on the rear side of the printer.

Preferably, the table is movably attached to the casing, and the second cut sheet feeder can be arranged below the table when the table is in a raised position. Preferably, the relationship between the first tractor and the first feed roller is different from the relationship between the second tractor and the second feed roller. Also, a stacker can be arranged between the first tractor and the first cut sheet feeder.

Preferably, the first and second feed rollers include respective nip rollers, and the nip roller of the first feed roller is arranged at a substantially fixed position relative to the first feed roller. Therefore, there is no need of any elevating mechanism or any spring pressure regulating mechanism regarding the nip roller of the first feed roller. In this case, the nip roller of the second feed roller is movably arranged relative to the second feed roller.

According to the second feature of the present invention, there is provided a printer comprising a casing, a movable carriage, a printing head attached to the carriage, a platen opposed to the printing head, a first feed roller arranged on one side of the platen, and a second feed roller arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof. The printer is characterized in that a sheet guide is attached to the carriage at a height substantially the same as the level of the lower end of the printing head, and two indicator lines are provided on the sheet guide in the side-by-side relationship in the sheet conveying direction for indicating printing reference positions in the forward and rearward sheet feeding directions.

In this feature, two indicator lines are provided on the sheet guide attached to the carriage. The sheet guide itself is arranged at a predetermined position relative to the printing head, and the indicator lines are arranged in the side-by-side relationship in the sheet feeding direction for indicating printing reference positions in the forward and rearward sheet feeding directions. Therefore, it is possible to use the indicator lines such that one indicator line indicates the printing reference position when the sheet is conveyed from the front to the rear of the printer, and the other indicator line indicates the printing reference position when the sheet is conveyed from the rear to the front of the printer. Therefore, it is possible to indicate printing reference positions in any feeding direction, and to carry out a fine adjustment of the printing position using the printing reference positions. This is especially suitable for a multi-path type printer.

Preferably, the sheet guide comprises a transparent plate. It is possible to print the indicator lines on the surface of the sheet guide. It is possible to carry out a fine adjustment of the printing position corresponding to the forward or rearward sheet feeding direction, while observing the printing position of the sheet travelling

below the sheet guide and the indicator lines.

According to the third feature of the present invention, there is provided a printer comprising a casing, a movable carriage, a printing head attached to the carriage, a platen opposed to the printing head, a first feed roller arranged on one side of the platen, and a second feed roller arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof. The printer is characterized in that a leading edge detecting means is arranged on a line passing through the printing region of the printing head and extending perpendicular to the sheet conveying direction for detecting a leading edge of a sheet.

In this feature, the leading edge detecting means is arranged on a line passing through the printing region of the printing head and extending perpendicular to the sheet conveying direction. The single leading edge detecting means can detect that a leading edge of a sheet conveyed in the forward or rearward sheet feeding direction passes through the printing region. Thus, when a leading edge of a sheet is detected, it is possible to position the sheet so that the sheet has a predetermined upper margin.

Preferably, a sheet guide is attached to the carriage at a height substantially the same as the level of the lower end of the printing head, and the leading edge detecting means is arranged on the sheet guide. The sheet guide itself is arranged at a predetermined position relative to the printing head, and it is possible to easily arrange the leading edge detecting means on a line passing through the printing region of the printing head and extending perpendicular to the sheet conveying direction.

According to the fourth feature of the present invention, there is provided a printer comprising a casing, a movable carriage, a printing head attached to the carriage, a platen opposed to the printing head, a first feed roller arranged on one side of the platen, and a second feed roller arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof. The printer is characterized in that a sheet guide defining a sheet conveying path is provided, and a flap valve is provided for guiding a sheet conveyed toward one of the first and second feed rollers and for guiding a sheet conveyed in reverse from said one feed roller, the flap valve being attached to a shaft rotatably supported by a bearing with the flap valve facing said one feed roller and being urged toward the sheet guide by an elastic member.

In this feature, the flap valve is provided for guiding a sheet conveyed toward one of the first and second feed rollers and for guiding a sheet conveyed in reverse from said one feed roller. The flap valve is attached to a shaft rotatably supported by a bearing with the flap valve facing said one feed roller and being urged toward the sheet guide by an elastic member. When the sheet is fed toward said one feed roller, the sheet causes the flap valve to open and passes through a gap between the flap valve and the sheet guide, and when the sheet is conveyed from said one feed roller, the sheet is prevented from passing through a gap between the flap valve and the sheet guide so that the sheet reliably travels along the travelling path around the flap valve.

Preferably, a cut sheet feeder is arranged in the casing on the side of said one feed roller, and the sheet guide is arranged to define an upper portion of the sheet conveying path extending from the cut sheet feeder toward said one feed roller, so that a sheet fed by the cut sheet feeder passing through a gap between the sheet guide and the flap valve to said one feed roller and a sheet conveyed in reverse by said one feed roller passes below the flap valve, the flap valve being arranged to prevent the reversely conveyed sheet from passing through a gap between the sheet guide and the flap valve, the bearing being attached to a flange of the sheet guide. In this way, for example, the sheet is fed from the feed roller on the rear side of the printer to the platen, and the printed sheet is discharged to the front side of the printer, and oil the other hand, the sheet is fed from the table on the front side of the printer to the platen, and the printed sheet is discharged to the rear side of the printer. It is possible to reliably convey the sheet in the different conveying directions without causing any jamming in the sheet.

Preferably, the shaft is formed as a D-cut shaft having a planar portion, and the bearing has an internal shape corresponding to the shape of the D-cut shaft, the flap valve being displaceable within a play defined by planar portions of the shaft and the bearing. Accordingly, since the flap valve is displaceable within a play defined by planar portions of the shaft and the bearing and urged by the elastic member to maintain the initial position, it is not necessary to manually operate the flap valve or to electrically operate the flap valve.

Preferably, the flap valve is formed by a thin plate which is bent into a wedge-shape, the open side end of the bent plate being fixed to the shaft. Accordingly, the flap valve allows the sheet to smoothly travel along the surface of the flap valve, and the sheet Is not caught by the flap valve. In addition, the flap valve is light in weight, so that the sheet fed, for example, by the cut sheet feeder can easily cause the flap valve to open.

According to the fifth feature of the present invention, there is provided a printer comprising a casing, a movable carriage, a printing head attached to the carriage, a platen opposed to the printing head, a first feed roller arranged on one side of the platen, and a second feed roller arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction

opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof. The printer is characterized in that a table is arranged in the casing on the side of the second feed roller, and a sheet guide is arranged between the second feed roller and the table, the table being capable of being used as a stacker for feeding a sheet therefrom and as a table for receiving a conveyed sheet, the sheet guide being movable and arranged so that the sheet guide can guide a sheet when the table is used as a stacker for feeding a sheet therefrom and the sheet guide becomes a stopper to receive a trailing edge of a sheet when the table is used as a table for receiving a conveyed sheet.

In this feature, the table arranged in the casing on the side of the second feed roller can be used as a table for feeding a sheet therefrom and as a stacker for receiving a discharged sheet thereat. In connection with this, the sheet guide is arranged between the second feed roller and the table to guide a sheet travelling toward the second feed roller when the table is used as a table for feeding a sheet therefrom and to function as a stopper to receive a trailing edge of the discharged sheet when the table is used as a stacker.

Preferably, the table is movable synchronously with the sheet guide. Therefore, the sheet guide is moved according to the use of the table, and functions as a guide or a stopper, as described above.

Preferably, the sheet guide is rotatably arranged about an axis of the second feed roller and urged by an elastic member toward a position at which the sheet guide can guide a sheet conveyed toward the second feed roller. Accordingly, it is possible to effectively arrange the sheet guide in a restricted position near the second feed roller in a movable manner.

According to the sixth feature of the present invention, there is provided a printer comprising a casing, a movable carriage, a printing head attached to the carriage, a platen opposed to the printing head, a first feed roller arranged on one side of the platen, and a second feed roller arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof. The printer is characterized in that a first driving means is provided for driving the platen and the first and second feed rollers, and a second driving means is provided for driving a first tractor capable of feeding a continuous form to the platen from one side thereof and a second tractor capable of feeding a continuous form to the platen from the other side thereof, the first and second driving means being provided independently of each other.

In this feature, the first driving means drives the platen and the first and second feed rollers, and the second driving means drives the tractors. Since the first driving means is provided independently of the second driving means, it is possible to simplify the gear transmitting mechanism or the like, for example, and to reduce the load on the motors. Therefore, it is not necessary to use a larger motor. It is possible to change the speed of the first driving means front that of the second driving means.

Preferably, the first driving means includes a first motor and a first gear train connected to the first motor, and the second driving means includes a second motor and a second gear train connected to the second motor.

Preferably, a cut sheet feeder is arranged, the feeder including a pick roller, an intermediate feed roller, a third motor, a third gear train connected to the third motor for driving the pick roller, and at least one feed roller driving gear for driving the intermediate feed roller, the at least one feed roller driving gear being connected to the gear of the first gear train.

According to the seventh feature of the present invention, there is provided a printer comprising a casing, a movable carriage, a printing head attached to the carriage, a platen opposed to the printing head, a first feed roller arranged on one side of the platen, and a second feed roller arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction reverse to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof. The printer is characterized in that a cut sheet feeder is provided, a printer driving means including gears arranged on one side of the printer is provided for driving the platen and the first and second feed rollers, and a cut sheet feeder driving means is provided for driving the cut sheet feeder, the but sheet feeder including a pick roller driven by the cut sheet feeder driving means, an intermediate feed roller not driven by the cut sheet feeder driving means, and intermediate feed roller driving gears for driving the intermediate feed roller, the intermediate feed roller driving gears comprising a pairs of gears or gear groups arranged on one side and on the other side of the cut sheet feeder so that the intermediate feed roller driving gears can be connected to the gears of the printer driving means arranged on one side of the printer even when the cut sheet feeder is attached to the printer on the front or on the rear of the printer.

In this feature, the printer driving means drives the platen and the first and second feed rollers, and the cut sheet feeder driving means drives the pick roller. The intermediate feed roller driving gears of the cut sheet feeder is not driven by the cut sheet feeder driving means, but can be connected to the gears of the printer driving means. Accordingly, the conveying speed of the sheet is constant throughout the cut sheet feeder and the printer. In addition, the intermediate feed roller driving gears comprise a pairs of gears or gear groups arranged on one side and on the other side of the cut sheet feeder so that the intermediate feed roller driving

gears can be connected to the gears of the printer driving means arranged on one side of the printer even when the cut sheet feeder is attached to the printer on the front or on the rear of the printer.

According to the eighth feature of the present invention, there is provided a printer comprising a casing, a movable carriage, a printing head attached to the carriage, a platen opposed to the printing head, a first feed roller arranged on one side of the platen, and a second feed roller arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof. The printer is characterized in that a securing means is provided in the casing for arranging a tractor for feeding a continuous form to the second feed roller, the first and second feed rollers having respective nip rollers, at least the nip roller of the second roller being movably arranged relative to the second roller when said tractor is used, in addition, a changing means being provided for changing the position of the nip roller relative to the second roller, the changing means including a motor and a transmission means.

In this feature, a continuous form fed by the tractor passes on the second feed roller, but the sheet is not subjected to a feeding action by the second feed roller since the nip roller of the second feed roller is elevated relative to the second feed roller. Therefore, the sheet is conveyed by the feeding action of the tractor and the conveying action of the first feed roller. Accordingly, any slack in the continuous form is prevented from occurring. In addition, when a cut sheet is used, the nip roller of the second feed roller is urged against the second feed roller. The changing means for changing the position of the nip roller relative to the second roller includes a motor and a transmission means. Therefore, in order to change the position of the nip roller relative to the second feed roller between use with a continuous form or use with a cut sheet, it is not necessary to manually operate any member but it is possible electrically operate the printer. It is also possible to arrange that the transmission members driven by the motor can simultaneously move other members necessary to carry out the above change.

Preferably, a further securing means is provided for arranging a further tractor such that a continuous form is directly fed from the further tractor to the platen through a gap between the first feed roller and the platen, said changing means being capable of selectively changing the drive of said tractor and said further tractor. That is, the transmission members driven by the motor can change the using condition of the front and rear tractors.

Preferably, the motor of said changing means is provided separately from a driving means for driving the platen and the first and second feed rollers and a driving means for driving the tractors. That is, the motor of said changing means is provided for the special purpose of the changing operation only, so that an additional load is not applied to the motors of the driving means for driving the platen and the first and second feed rollers and the driving means of the tractors, and a simple and reliable transmission mechanism can be realized.

According to the ninth feature of the present invention, there is provided a printer comprising a casing, a movable carriage, a printing head attached to the carriage, a platen opposed to the printing head, a first feed roller arranged on one side of the platen, and a second feed roller arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof. The printer is characterized in that two means to be detected are arranged at fixed positions for detecting the position of the carriage, and a single detecting means is arranged on the carriage to generate a detection signal when the detecting means reaches the means to be detected, said detecting means being capable of detecting the position of the carriage in the moving direction of the carriage even when the carriage is moved in any of the travelling directions to thereby allow the carriage to be positioned at a print starting position.

In this feature, in order to position a sheet at the print starting position of a sheet, i.e., a left margin position or a right margin position, the single detecting means and two means to be detected are arranged. The detecting means is capable of detecting the position of the carriage in the moving direction of the carriage even when the carriage is moved in any of the travelling directions to thereby allow the carriage to be positioned at a print starting position. Therefore, it is possible to position the carriage at the print starting position using the single detecting means in the multi-path type printer, so a simple arrangement can be realized and a printing throughout can be improved by deciding the reference position of the carriage in one conveying direction and in the other conveying direction.

Preferably, the two means to be detected comprise two members to be detected having an identical width, said detecting means being capable of detecting one of the members to be detected, by moving to a greater amount when said detecting means is at the position of any of the means to be detected.

Preferably, the two means to be detected comprise two members to be detected having different widths, said detecting means being capable of detecting one of the members to be detected, by moving to a greater amount when said detecting means is at the position of any of the means to be detected and by judging whether a shading region is greater than one of the means to be detected which is shorter than the other.

Preferably, a printing operation is carried out such that a printed matter can be read from the side of the printer from which a sheet is fed.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more apparent from the following description of the preferred embodiments, with reference to the accompanying drawings, in which:

Fig. 1 is a diagrammatic cross-sectional view of the multi-path printer according to the embodiment of the present invention;
Fig. 2 is a perspective view of the printer of Fig. 1;
Fig. 3 is a perspective view of the printer of Fig. 1, similar to that of Fig. 2 but the covers being removed therefrom;
Fig. 4 is a plan view of the operating panel of the printer of Fig. 2;
Fig. 5 is a diagrammatic cross-sectional view of a modified example of the multi-path printer of Figs. 1 to 3;
Fig. 6 is a diagrammatic cross-sectional view of a modified example of the multi-path printer of Figs. 1 to 3;
Fig. 7 is a diagrammatic cross-sectional view of a modified example of the multi-path printer of Figs. 1 to 3;
Fig. 8 is a diagrammatic cross-sectional view of a modified example of the multi-path printer of Figs. 1 to 3;
Fig. 9 is a diagrammatic cross-sectional view of a modified example of the multi-path printer of Figs. 1 to 3;
Fig. 10 is a diagrammatic cross-sectional view of a modified example of the multi-path printer of Figs. 1 to 3;
Fig. 11 is a view illustrating the securing devices for arranging the cut sheet feeders and the tractors in the casing of the printer of Fig. 1;
Fig. 12A is a view illustrating the arrangement of the sensor of the printer of Fig. 1 for detecting a leading edge of a sheet;
Fig. 12B is a view illustrating the modified arrangement of the sensor for detecting a leading edge of a sheet;
Fig. 13 is a plan view of the sheet guide carried by the carriage of the printer of Fig. 1, the sheet guide having indicator lines;
Fig. 14A is a view illustrating the relationship between the indicator lines and the sheet conveyed in the forward direction;
Fig. 14B is a view illustrating the relationship between the indicator lines and the sheet conveyed in the rearward direction;
Fig. 15 is a partial rear view of the casing of the printer having the opening for arranging the cut sheet feeder and the stacker;
Fig. 16 is a view of the rear of the casing having stacker supporting means;
Fig. 17 is a view of the front, inner side wall of the casing having guide grooves for securing the table;
Fig. 18 is a view similar to Fig. 17, illustrating the table in the inclined position;
Fig. 19 is a side view of the table and the front guide movable with the table;
Fig. 20 is a view similar to Fig. 19, illustrating the front guide in the vertical position;
Fig. 21 is a view of the printer with the front guide of Fig. 19 in the vertical position and the table functioning as a large capacity stacker;
Fig. 22 is a view of the printer with the front guide of Fig. 19 in the inclined position, the cut sheet feeder being arranged below the table;
Fig. 23 is a view illustrating the relationship between the front feed roller and the front tractor;
Fig. 24 is a view illustrating the relationship between the rear feed roller and the rear tractor;
Fig. 25 is a view of the flap valve attached to the rear upper guide;
Fig. 26 is a view illustrating the relationship between the flap valve and the rear feed roller;
Fig. 27 is a view of gear trains arranged on the side of the casing of Fig. 3;
Fig. 28 is a view of gear train arranged in the cut sheet feeder;
Fig. 29 is a side view of the front and rear cut sheet feeder mounted to the casing with the gear trains of the cut sheet feeders connected to the gear train of the casing;
Fig. 30 is a diagrammatic plan view of the front and rear cut sheet feeder mounted to the casing with the gears of the cut sheet feeders connected to the gears of the casing;
Fig. 31 is a view of the mechanism for moving the nip roller relative to the feed roller and for shifting the drive gears of the front and rear tractors;
Fig. 32 is a view similar to Fig. 31, illustrating the mechanism in the gear shift position;
Fig. 33 is a plan view of the cam plate of Fig. 31;
Fig. 34 is a side view of the cam plate and the gears of Fig. 31;
Fig. 35 is a front view of the carriage sensor and the detecting piece of Fig. 1;
Fig. 36 is a view illustrating an example of the arrangement of the detecting pieces of Fig. 35;
Fig. 37 is a flow chart for controlling the carriage according to the arrangement of the detecting pieces of Fig. 35;
Fig. 38 is a view illustrating another example of the arrangement of the detecting pieces of Fig. 35;
Fig. 39 is a flow chart for controlling the carriage according to the arrangement of the detecting pieces of Fig. 38;
Fig. 40 is a flow chart continuing from that of Fig. 39;
Fig. 41 is a modified example of the tractor arrangement of Fig. 24;
Fig. 42 is a flow chart illustrating the fundamental operation of the fully equipped printer;
Fig. 43 is a diagrammatic view of the fully equipped

printer, illustrating the sheet feeding directions; and

Fig. 44 is a view of the sheets fed to the platen, illustrating that the direction of the printed letters is decided according to the sheet feeding direction.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 is a cross-sectional view of the multi-path printer according to the embodiment of the present invention. Fig. 2 is a perspective view of the printer of Fig. 1, and Fig. 3 is a perspective view of the printer of Fig. 1, similar to that of Fig. 2 but the covers being removed therefrom. In the description in connection with these figures, the right side of the drawings is referred to the front side of the printer, and the left side of the drawings is referred to the rear side of the printer.

Referring to Figs. 1 to 3, the printer 10 has a casing 12 and a cover 14 which is a part of the casing 12. A printing head 16 and a platen 18 opposed to the printing head 16 are arranged at the substantially central region in the casing 12. An ink ribbon cassette 20 is arranged above the printing head 16. The printing head 16 is of an impact type having 24 pins (not shown) driven by known piezoelectric actuators (not shown), and a pin driven toward the platen 18 by the piezoelectric actuator makes a print on a sheet via the ink ribbon in the ink ribbon cassette 20.

A carriage 22 supports the printing head 16 and the ink ribbon cassette 20, and is transversely movably arranged along a guide shaft 24 and a rail 26. A part of the carriage 22 is connected to a belt 28a wound on a pulley 28 which is driven by a motor 30 (Fig. 3). Therefore, the carriage 22 is moved by the motor 30.

A front feed roller 32 and its nip roller 32a are arranged on the front side of the platen 18, and a rear feed roller 34 and its nip roller 34a are arranged on the rear side of the platen 18. These feed rollers 32, 34 and the nip rollers 32a, 34a comprise short roller portions attached to respective shafts 32b, 34b in axially spaced apart relationships and firmly fixed to the respective shafts 32b, 34b by press fitting. (In Fig. 3, only the shafts 32b, 34b of the nip rollers 32a, 34a can be seen, but the feed rollers 32, 34 are attached to similar shafts.) The nip roller 32a can be moved toward and away from the front feed roller 32, but the nip roller 34a is supported at a substantially fixed position relative to the rear feed roller 34.

The front feed roller 32 and the rear feed roller 34 have an identical diameter and are driven in rotation in the same rotational direction at the same speed. Therefore, a sheet can be stably conveyed without any slack at least between the front feed roller 32 and the rear feed roller 34, and the printing head 16 can print the sheet which is in a stable condition on the platen 18. In addition, the front feed roller 32 and the rear feed roller 34 can be driven to rotate in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen 18 from one the front side of the printer and the sheet can also be fed to the platen 18 from the rear side of the printer. From this viewpoint, the front feed roller 32 and the rear feed roller 34 (and roller assembly including shafts) are manufactured under the same manufacturing control so that the manufacturing error is minimizes.

A cut sheet feeder 36 is arranged in the rear of the casing 12. Also, a rear tractor 38 is arranged in the casing 12 obliquely below the rear feed roller 34, and a front tractor 40 is arranged in the casing 12 obliquely below the front feed roller 32. The front tractor 40 is arranged to feed a continuous form onto the front feed roller 32. The rear tractor 38 is obliquely arranged at a greater angle to the horizontal than the front tractor 40. The rear tractor 38 is arranged at an angle of approximately 30 degrees, so that a continuous form can be directly fed at the travelling angle of approximately 45 degrees from the rear tractor 40 to the platen 18 through a gap between the rear feed roller 34 and the platen 18. It will be widely known that the tractors 38, 40 have belts and pin-like projections provided on the belts and the pin-like projections engage in the feeding holes provided in the side edges of a continuous sheet to feed the continuous sheet.

A table 42 is arranged in the front of the printer 10. Also, an operation panel 44 is arranged in the front of the printer 10. The operation panel 44 has several operating buttons and displays, as shown in Fig. 4. Typically, the operation panel 44 includes a sheet selection button 44a. The portions of the operation panel 44 are connected to a computer control device (not shown), and it is possible to select a front continuous sheet mode, a rear continuous sheet mode, and a cut sheet mode, by continuing to press the sheet selection button 44a. The cut sheet mode includes the feeding of a cut sheet from the table 42, a front cut sheet feeder (not shown in Fig. 1) and the rear cut sheet feeder 36. The selection of the table 42, the front cut sheet feeder, the rear cut sheet feeder 36 will be later with reference to Fig. 42.

When the cut sheet mode is selected and the rear cut sheet feeder 36 is to be used, a cut sheet (or cut sheets) is fed from the rear cut sheet feeder 36 into the printer 10, driven by the rear feed roller 34 and the front feed roller 32, printed by the printing head 16, and discharged to the table 42. In this ease, the table 42 functions as a stacker. If the cut sheet mode is selected and a cut sheet is to be manually fed from the table 42, a cut sheet is fed from the table 42, driven by the front feed roller 32 and the rear feed roller 34, printed on the platen 18 by the printing head 16, and discharged to the table 42 or to the discharge place on the rear side of the printer 10.

When the front continuous sheet mode is selected, the nip roller 32a is elevated relative to the front feed roller 32 so as to form a gap between the front feed roller 32 and the nip roller 32a. A continuous sheet placed on the front side of the printer is fed by the front tractor 38 toward the front feed roller 32, passes through

the gap between the front feed roller 32 and the nip roller 32a (the front feed roller 32 does not substantially work in this case), is printed on the platen 18 by the printing head 16, is pulled by the rear feed roller 34 and the nip roller 34a, and is discharged to the discharge place on the rear side of the printer 10.

When the rear continuous sheet mode is selected, the nip roller 32a is urged against the front feed roller 32. A continuous sheet placed on the rear side of the printer is fed by the rear tractor 40 directly to the platen 18 through the gap between the rear feed roller 34 and the nip roller 34a, is printed on the platen 18 by the printing head 16, is pulled by the front feed roller 32 and the nip roller 32a, and is discharged to the table 42 of the printer 10.

The casing 42 of the printer 10 is designed so that the cut sheet feeder 36, the front tractor 38, the rear tractor 40 and the sheet discharging stacker can be selectively arranged in the printer, as shown in Figs. 5 to 10. The cut sheet feeder(s) 36 can be attached to the front and/or the rear of the casing 12. In Figs. 5 to 10, the arrow of the broken line shows the feeding and discharging directions of the cut sheet, and the arrow of the solid line shows the feeding and discharging directions of the continuous form.

In Fig. 5, the front table 42, the front tractor 38 and the rear tractor 40 are arranged in the casing 12. Also, a rear stacker 46 is horizontally arranged. Therefore, when a cut sheet is manually fed from the table 42, a cut sheet is discharged to the table 42 or to the rear stacker 46 after being printed. When a continuous sheet is fed by the front tractor 38, the continuous sheet is discharged to the rear stacker 46 after being printed. When a continuous sheet is fed by the rear tractor 38, the continuous sheet is discharged to the table 42 after being printed.

In Fig. 6, the front table 42 and the front tractor 38 are arranged in the casing 12. Also, the rear stacker 46 is arranged therein.

In Fig. 7, the front table 42 and the rear tractor 40 are arranged in the casing 12. Also, the rear stacker 46a is arranged therein. The stackers 46 in Figs. 5 and 6 are horizontally arranged, but the rear stacker 46a is arranged in an inclined manner with the left end in the upper position.

In Fig. 8, the front table 42, the front cut sheet feeder 36 and the rear tractor 40 are arranged in the casing 12. Also, two rear stackers 46 and 46a are arranged. In this case, the table 42 is arranged in a slightly inclined manner with the right end in the upper position, and the front cut sheet feeder 36 is arranged below the table 42.

In Fig. 9, the front table 42, the rear tractor 40 and the rear cut sheet feeder 36 are arranged in the easing 12. Also, the rear stacker 46 is arranged. In this case, the table 42 is used as a table when a cut sheet is manually fed therefrom and used as a large capacity stacker when the rear cut sheet feeder 36 is used.

In Fig. 10, the front table 42, the front cut sheet feeder 36, the front tractor 38, the rear tractor 40 and the rear cut sheet feeder 36 are arranged in the casing 12. The printer 50 is shown in the fully equipped condition. In the actual use, however, any one of the front cut sheet feeder 36 and the rear tractor 40 is selectively used. Also, any one of the front tractor 38 and the rear tractor 40 is selectively used.

Figure 11 shows securing means arranged in the casing 12 of the printer for arranging the front cut sheet feeder 36, the front tractor 38, the rear tractor 40 and the rear cut sheet feeder 36. The front cut sheet feeder 36 is intended to be secured by supporting members 74c and 74d in the front of the casing 12. The rear cut sheet feeder 36 is intended to be secured by supporting members 74a and 74b in the rear of the casing 12. A tractor frame 38a of the front tractor 38 is intended to be secured by supporting members 74c and 74d in the front of the casing 12. That is, the front cut sheet feeder 36 and the front tractor 38 can be selectively used. A tractor frame 40a of the rear tractor 40 is intended to be secured by supporting members 41a and 41b in the rear of the casing 12. In addition, there is a securing means for the front table 42, as will be explained later.

The details of several portions of the printer 10 are now explained.

As shown in Figs. 1 and 3, a sheet guide 48 is attached to the carriage 22 at a height substantially the same as the level of the lower end of the printing head 16. The sheet guide 48 has an opening allowing the printing region (the region of the printing pins) of the printing head 16 to pass therethrough. The sheet guide 48 guides a sheet conveyed along the lower surface of the sheet guide 48.

The sheet guide 48 supports a pair of inclined sheet detecting sensors 50 arranged on either side of the printing head 16. The inclined sheet detecting sensors 50 detect whether a sheet is conveyed in a normal position parallel to the conveying direction or not, and if the sheet is not conveyed in a normal position, the feed rollers 32 and 34 are rotated opposite to the conveying direction to return the sheet to thereby prevent the sheet from jamming.

The sheet guide 48 also supports a leading edge detecting sensor 52. The leading edge detecting sensor 52 is used for detecting a leading edge of a conveyed sheet to position the carriage 22 at the print starting position. The inclined sheet detecting sensors 50 and the leading edge detecting sensor 52 can be of optical type sensors such as reflecting type sensors.

The sheet guide 48 comprises a transparent plate and is provided with indicator lines 54 on one side of the printing head 16.

As shown in Fig. 12A, the leading edge detecting sensor 52 is arranged on a line L passing through the center the printing region 16a of the printing head 16 and extending perpendicular to the sheet conveying direction. Therefore, the leading edge detecting sensor 52 produces a detecting signal when a leading edge of a conveyed sheet reaches the center the printing region

16a of the printing head 16. In Fig. 12a, the character P_1 shows a sheet conveyed from the front side of the printer and the character P_2 shows a sheet conveyed from the rear side of the printer. The arrow X indicates the sheet conveying direction from the front side of the printer and the arrow Y indicates the sheet conveying direction from the rear side of the printer. This feature is especially useful for the printer 10 of the embodiment of the present invention in which a sheet is conveyed from the front side and from the rear side of the printer.

A conventional leading edge detecting sensor, for example, was arranged at a position before the center the printing region 16a of the printing head 16, viewed in the sheet conveying direction. Therefore, in a multi-path printer in which a sheet is conveyed from the front side and from the rear side of the printer, two sensors were necessary on either side of the center the printing region 16a of the printing head 16, viewed in the sheet conveying direction. According to this embodiment of the present invention, it is possible to detect a leading edge of a sheet conveyed in the forward direction and in the rearward direction by the single leading edge detecting sensor 52, which can reduce the manufacturing cost of the printer 10. In addition, by detecting a leading edge of a sheet conveyed in the forward direction and in the rearward direction by the common leading edge detecting sensor 52, there is no error of a detection accuracy which may be influenced due to a difference in the conveying paths and it is possible to detect the sheet with high accuracy to contribute to provide the printer 10 with a high performance.

If an upper margin of a not-printed area of a sheet is extremely small, the sheet might not be stopped when the sheet reached the print starting position after the leading edge of the sheet is detected. In such a case too, it is possible to carry out fine positioning by once stopping the sheet after the sheet is advanced at a certain distance then reversely conveying the sheet and again advancing the sheet since the leading edge of the sheet was detected and known. Therefore, there is no actual problem.

Figure 12B shows a modified arrangement of the leading edge detecting sensor 52. In this example, two leading edge detecting sensors 52 are arranged on either side of the printing head 16 on a line L passing through the center the printing region 16a of the printing head 16 and extending perpendicular to the sheet conveying direction. In this example too, the leading edge detecting sensors 52 generate a detection signal when the leading edge of the sheet reaches the sensors 52. In addition, it is possible to omit the inclined sheet detecting sensors 50, since two leading edge detecting sensors 52 can detect an inclined position of a sheet conveyed in the forward direction and in the rearward direction.

In addition, two leading edge detecting sensors 52 can detect side edges of a sheet, since the leading edge detecting sensors 52 are attached to the carriage 22 via the sheet guide 48 and move with the carriage 22 transversely relative to the sheet. Therefore, it is possible to prevent the printing pins from directly hitting the platen 18 by producing alarms or returning the sheet, if a narrow sheet having a transverse dimension smaller than a width of a printing region is conveyed.

Figure 13 shows the indicator lines 54 provided in the sheet guide 48 of transparent plastic. There are two indicator lines 54, and the indicator lines are represented by 54a and 54b in Figs. 14A and 14B. Each indicator line 54 (54A or 54B) is arranged at a reference position of printing depending on the forward conveying direction X and the rearward conveying direction Y. For example, each indicator line 54 (54A or 54B) is arranged at a reference position corresponding to the position of an underline for printed letters.

One indicator line 54a is compared with the bottoms of printed letters of the sheet P_1 conveyed in the forward conveying direction X, as shown in Fig. 14A, and another indicator line 54b is compared with the bottoms of printed letters of the sheet P_2 conveyed in the rearward conveying direction Y, as shown in Fig. 14A. Therefore, it is possible to precisely adjust the conveyance of the sheet, by observing the actually printed letters with reference to the indicator lines 54, 54a, 54b. In the case where a sheet has a pre-printed border line such as a slip, it is possible to precisely adjust the conveyance of the sheet, by observing the border line with reference to the indicator lines 54, 54a, 54b.

In Figs. 1 and 3, a carriage sensor 56 is attached to the rear of the carriage 22 for detecting the position of the carriage 22. Two members to be detected 58L and 58R cooperating with the carriage sensor 56 are fixed to a transverse beam of the casing 12. In the exemplified printer 10, it is possible to detect the position of the carriage 22 in the forward sheet conveying direction and in the rearward sheet conveying direction, to position the carriage 22 at the print starting position, using the carriage sensor 56 and the members to be detected 58L and 58R. The details thereof are described later with reference to Figs. 35 to 40.

In Fig. 1, a front upper guide 60 is arranged in front of the sheet guide 48 and a rear upper guide 62 is arranged behind the sheet guide 48. The front upper guide 60, the sheet guide 48 and the rear upper guide 62 form an upper portion of the sheet conveying path. A front lower guide 64 is arranged in front of the platen 18 and a rear lower guide 66 is arranged behind the platen 18, the front lower guide 64 being integrally formed with the rear lower guide 66. In addition, a front guide 68 is arranged in front of the front feed roller 32, and a continuous form guide 70 is arranged along the continuous form path extending from a position near the securing members 74a, 74b for the rear tractor 40 toward the platen 18. Further, a flap valve 72 is arranged below the rear upper guide 62. The front guide 68, the continuous form guide 70 and the flap valve 72 form a lower portion of the sheet conveying path. However, there is an instance in which the flap valve 72 forms an upper portion of the sheet conveying path.

As shown in Figs. 1 and 15, the rear cut sheet feeder 36 passes through an opening 12a provided in the rear of the casing 12, and is secured at a predetermined position by the rod-like securing members 74a, 74b. The rod-like securing members 74a, 74b extend from side panel members 12b of the casing 12 so as to project into the opening 12a.

Guide holes 12c, 12d are provided in the side walls of the opening 12a, as shown in Figs. 15 and 16. The rear stacker 46 is inserted along the guide hole 12d and the rear stacker 46a is inserted along the guide hole 12c. Supporting members 12e are provided in the casing to support the inner end of the rear stacker 46, 46a. Therefore, the rear cut sheet feeder 36 and the rear stacker 46, 46a can be arranged, in a manner shown in Figs. 5 to 10. The rear stacker 46 is horizontally arranged and the stacker 46a is arranged in an inclined position with the left end thereof at the upper position. A further opening (not shown) is provided in the rear of the casing below the opening 12a, and a continuous form fed by the front tractor 38 can be discharged from the opening 12a or from the further opening.

Figures 17 and 18 show the attachment of the table 42 to the casing 12. As shown in Fig. 2, the casing 12 has side walls 12f at a space in which the table 42 is to be located. Fig. 17 shows one of the side walls 12f, the side wall 12f having two guide grooves 76a, 76b. The table 42 has pins 42a, 42b extending from the side of the table, the pins 42a, 42b being inserted in the guide grooves 76a, 76b, respectively.

The guide groove 76a located on the inner side of the table 42 is formed in a hook-shape, including an upper horizontal portion and a lower inclined portion. The other groove 76b is formed in an inverted T-shape, including an upper vertical portion and a lower horizontal portion.

When the table 42 is in the substantially horizontal position, the inner pin 42a is located at the inner end of the upper horizontal portion of the inner guide groove 76a, and the outer pin 42b is located substantially at the center of the lower horizontal portion of the outer guide groove 76b, as shown in Fig. 17. This position corresponds to the position of the table 42 of Fig. 5, for example.

When the table 42 is in the inclined position, the inner pin 42a is located at the inner end of the lower inclined portion of the inner guide groove 76a, and the outer pin 42b is located at the inner end of the lower horizontal portion of the outer guide groove 76b, as shown in Fig. 18. This position corresponds to the position of the table 42 of Fig. 9, for example.

In addition, the front cut sheet feeder 36 can be arranged in the front of the casing 12, as shown in Figs. 8 and 10. In this instance, the table 12 is further raised and the front cut sheet feeder 36 is inserted below the table 42. In order to raise the table 42 in this way, the inner pin 42a is rearwardly slid in the inner guide groove 76a and located at the center of the hook of the inner guide groove 76a, and the outer pin 42b is moved upward in the upper vertical portion of the outer guide groove 76b. In order to secure the front cut sheet feeder 36 inserted in the front of the casing 12, the rod-like securing members 74c, 74d are provided in the casing (Figs. 11, 29), as described above. As shown in Fig. 29, the front cut sheet feeder 36 is identical to the rear cut sheet feeder 36, the portions (recessed walls) of the front cut sheet feeder 36 with which the securing members 74c, 74d engage are at different positions from those of the portions (recessed walls) of the rear cut sheet feeder 36 with which the securing members 74a, 74b engage.

Figures 19 and 20 show the detail of the front guide 68 arranged in front of the front feed roller 32. The front guide 68 is movably arranged and can move with the table 42. The front guide 68 includes a guide portion 68a comprising a smoothly curved surface facing the sheet conveying path, and side panels 68b connected on the opposite ends of the guide portion 68a. The side panels 68b are rotatably arranged about an axis of the shaft 32b of the front feed roller 32. A spring 78 urges the side panels 68b in the anti-clockwise direction, so that the side panels 68b are in abutment with the side panels of the front upper guide 60 arranged above the front guide 68.

The table 42 includes a sheet support member 42c arranged in a slightly inclined position with the lowered inner end so that the sheet support member 42c is smoothly continuous to the guide portion 68a of the front guide 68, and side panels 42d connected on the opposite ends of the sheet support member 42c. The inner end portion 42e of the sheet support member 42c is rotatably attached to the pin 42a, so that the sheet support member 42c can rotate in the clockwise direction within a limit. The side panels 42d of the table 42 move synchronously with the side panels 68b of the front guide 68b.

In the horizontal position of the table 42 shown in Fig. 19, the side panels 42d of the table 42 are not in contact with the side panels 68b of the front guide 68b. Therefore, the guide portion 68a of the front guide 68 can stably maintain an inclined position with the free end lowered, by the action of the spring 78 and the abutment of the side panels 68b with those of the front upper guide 60. The inner end portion 42e of the sheet support member 42c of the table 42 is located in proximity with the guide portion 68a of the front guide 68 so as to form a continuous sheet conveying path. In this condition, the front guide 68 acts as a guide for a sheet fed from the table 42 or a sheet discharged to the table 42. Also, the front guide 68 is smoothly continuous to the sheet conveying path for a continuous form fed by the front tractor 38, and acts as a guide for a continuous form.

In the inclined position of the table 42 shown in Fig. 20, the side panels 42d of the table 42 are in contact with the side panels 68b of the front guide 68b, so that the front guide 68 is rotated downwardly as the table 42 is moved to its inclined position. The table 42 in this

position functions as a large capacity stacker for a sheet fed by the rear cut sheet feeder 36 arranged in the rear of the printer 10.

That is, as shown in Fig. 21, the rear cut sheet feeder 36 is arranged in the rear of the printer 10, and the printed sheet is discharged to the table 42 which thus acts as a stacker. The front guide 68 is maintained in the downwardly rotated position, and functions as a trailing stopper for sheets discharged on the table 42 acting as a stacker. Therefore, many sheets can be stacked on the table 42 acting as a stacker.

Also, as shown in Fig. 22, when the front cut sheet feeder 36 is arranged in the front of the printer 10 and the table 42 is in the inclined position, it is possible to attach the large capacity stacker 46 in the rear of the printer 10. In this case, the table 42 is in the upwardly raised position and the side panels 42d of the table 42 are not in contact with the side panels 68d of the front guide 68, so the front guide 68 is maintained at the position as that of Fig. 19. Therefore, it is possible to feed a sheet from the front cut sheet feeder 36 to the front feed roller 32 via the front guide 68.

Figure 23 shows the front continuous form mode in which the nip roller 32a is elevated relative to the feed roller 32, and a continuous form is fed by the front tractor 38 and pulled by the rear feed roller 34.

Figure 24 shows the rear continuous form mode in which a continuous form is fed by the rear tractor 40 directly to the platen 18, while skipping over the rear feed roller 34, and pulled by the front feed roller 32 and the nip roller 32a.

In the case of a continuous form, the front tractor 38 and the rear tractor have the conveying capability, and it is not necessary to use one of the front feed roller 32 and the rear feed roller 34 located before the platen 18 in view of the conveying direction. On the contrary, a problem arises in that a slack occurs in the continuous form if such a feed roller is used. Therefore, it was necessary to elevate the nip rollers 32q, 34a relative to the feed rollers 32, 34 (or to loosen biasing springs), and in the conventional multi-path type printer, elevating mechanisms or spring pressure regulating mechanisms are provided. In the embodiment of the present invention, a continuous form is fed by the rear tractor 40 directly to the platen 18 in the rear continuous form mode, and it is not necessary to have such an elevating mechanism or spring pressure regulating mechanism for the nip roller 34a of the rear feed roller 34. Accordingly, the printer can be made in a relatively simple arrangement and at a lower cost.

In the arrangement in which a continuous form is fed directly to the platen 18, the rear tractor 40 is arranged at a greater angle relative to the horizontal than the angle at which the front tractor 38 is arranged. The angle of this portion of the sheet conveying path for the rear continuous form is about 45 degrees, for example. Accordingly, an extra space is available in the rear of the casing 12, and it is possible to arrange the rear tractor 40, the rear cut sheet feeder 36 and the rear stacker 46 in the rear of the casing 12. Also, the provision of the continuous sheet guide 70 extending from the rear tractor 40 to the platen 18 makes it possible to directly feed a continuous form to the platen 18. In this embodiment, the rear tractor 40 only is arranged so that a continuous form is directly fed to the platen 18, but it is possible also to arrange that the front tractor 40 only can feed a continuous form directly to the platen 18. In addition, it is also possible that both the front and rear tractors 38 and 40 can feed a continuous form directly to the platen 18, as shown in Fig. 41. In this case, it is preferable to arrange a front continuous form guide 70a extending from the front tractor 38 to the platen 18.

As shown in Fig. 1, the cut sheet feeder 36 has a hopper portion 36a, a pick roller 36b, and a sheet separating member 36c for preventing a plurality of sheets being fed together. Also, the cut sheet feeder 36 has an intermediate feed roller 36d and its nip roller 36e, and a sheet guide 36f. The sheet guide 36f extends to below the rear lower guide 62 to guide a sheet through a gap between the rear lower guide 62 and the flap valve 72.

Figures 25 and 26 show the details of the flap valve 72. The flap valve 72 is formed of a very thin stainless steel plate which is bent into a wedge-shape, and the open ends of the bent plate are fixed to a shaft 72a having two flat portions. A supporting flange 62a extends perpendicularly and downwardly from the side ends of the rear lower guide 62. A bearing 72b is arranged in the flange 62a and the shaft 72a of the flap valve 72 is rotatably arranged in the bearing 72b.

The end portion of the shaft 72a is formed in the D-shape having a planar portion, and the bearing 72b also has an internal shape corresponding to the shape of the D-cut shaft. However, there is a gap between the planar portions of the shaft 72a and the bearing 72b, and the flap valve 72 is rotatable within the allowable range of this gap or play, as shown in Fig. 21. A torsion spring 72c is arranged around the shaft 72a, one end of the torsion spring 72c being secured to the flange 62a and the other end of the torsion spring 72c being secured to the flap valve 72. The torsion spring 72c is arranged in a pre-stressed condition in the opening direction of the coil and generates a spring force in the closing direction of the coil.

The flap valve 72 is arranged facing to the rear feed roller 34 and urged toward the rear upper guide 62 by the torsion spring 72c. That is, the flap valve 72 is urged into contact with the rear upper guide 62 on the side of the rear feed roller 34, as shown by the solid line in Fig. 26. Therefore, a sheet P_1, which is fed from the front of the printer 10 and conveyed to the rear of the printer 10, as shown by the arrow X, hangs down due to its own weight after it passes through the rear feed roller 34, travels below the flap valve 72, and is discharged. However, there is a possibility that a relatively thick sheet P_1, a reproduction sheet P_1 comprising a plurality of layers or an upwardly curled sheet P_1 may not hang down and may tend to travel above the flap valve 72. A printed sheet P_1 may then travel to the rear cut sheet feeder 36.

However, the flap valve 72 prevents the sheet P_1 from traveling above the flap valve 72, and to directs the sheet P_1 in the normal discharge direction.

A sheet P_2, which is fed by the rear cut sheet feeder 36 and conveyed to the front of the printer 10, as shown by the arrow Y, travels toward above the flap valve 72, and opens the flap valve 72 under the conveying force of the intermediate feed roller 36d against the spring force of the torsion spring 72c, and continues to travel to the rear feed roller 34. Therefore, the sheet P_2 reliably travels to the rear feed roller 34.

In the flap valve 72 in this embodiment, it is possible to control the conveyance of the sheets with a simple construction, by the provision of the gap or play between the simple D-cut shaft 72a and the bearing 72b and only the spring force of the torsion spring 72c. It is not necessary to move the flap valve 72 by an electric actuating mechanism or the like, and it is not cumbersome since it is not necessary to carry out any manual operation.

The casing 12 shown in Fig. 3 has a left side panel on which driving means including gear trains driven by respective motors are arranged.

Figure 27 shows the details of the driving means. The driving means is separated into a driving mechanism for driving the platen 18 and the feed rollers 32, 34, and a driving mechanism for driving the tractors 38, 40.

The driving mechanism of the tractors 38, 40 includes a motor Ma, a motor gear Ga, a front tractor driving gear 38g, and a rear tractor driving gear 40g. The motor gear Ga, the front tractor driving gear 38g, and the rear tractor driving gear 40g are interconnected by intermediate gears Gb to Gg. The gears Gb and Gd are shift gears and it is possible to drive only one of the tractors 38a and 40 by releasing one of the gears Gb and Gd.

The driving mechanism of the platen 18 and the feed rollers 32, 34 includes a motor Mb, a motor gear Gh, a platen driving gear 18g, a front feed roller driving gear 32g, and a rear feed roller driving gear 34g. The platen driving gear 18g, the front feed roller driving gear 32g, and the rear feed roller driving gear 34g are interconnected by intermediate gears Gi to Gn. Nip roller driving gears 32h, 34h are connected to respective feed rollers driving gear 32g, 34g.

Since the driving mechanism of the tractors 38, 40 and the driving mechanism of the platen 18 and the feed rollers 32, 34 are separately arranged in this way, it is possible to simplify the arrangement and connection of the gears and the motors can be small. Also, gear transmissions are used in the embodiment, but it is possible to use belt transmissions. In addition, since the driving mechanism of the tractors 38, 40 and the driving mechanism of the platen 18 and the feed rollers 32, 34 are separately arranged, it is possible to change the conveying speed of the feed rollers 32, 34 and the feeding speed of the tractors 38, 40 to prevent the sheet from slackening.

Figure 28 shows the driving mechanism of the pick roller 36b in the cut sheet feeder 36. This driving mechanism includes a motor Mc, a motor gear Go, and a pick roller driving gear 36g. The motor gear Go and the pick roller driving gear 36g are interconnected by intermediate gears Gp to Gs. In addition, the intermediate feed roller 36d in the cut sheet feeder 36 is driven by a intermediate feed roller driving gear 36h. This gear 36h is not connected to a gear in the driving mechanism of the pick roller 36b, but is connected to a gear of the driving mechanism in the printer 10.

Figure 29 shows the situation that the intermediate feed roller driving gear 36h in the cut sheet feeder 36 is connected to the gear of the driving mechanism in the printer 10 when the cut sheet feeder 36 is attached to the printer 10.

In the printer 10, there are the front feed roller driving gear 32g and the rear feed roller driving gear 34g, as described with reference to Fig. 27. Further gears Gt, Gx are connected to these gears 32g, 34g in the printer 10. Further gears Gu, Gv, Gw are connected to the intermediate feed roller driving gear 36h in the cut sheet feeder 36. The intermediate feed roller driving gear 36h is connected to the gears Gt or Gx via the gears Gu to Gw.

Figure 30 diagrammatically shows the situation in which the front and rear cut sheet feeders 38, 40 are attached to the printer 10. The front and rear cut sheet feeders 38, 40 are of the identical construction. The intermediate feed roller driving gears 36h and other gears Gu, Gv, Gw (not shown in Fig. 30) are arranged in pairs on either side of the frame of each of the front and rear cut sheet feeders 38, 40, and the intermediate feed roller driving gears 36h on either side of the cut sheet feeder 36 are interconnected by a shaft 36s. In contrast, the gears Gt, Gx are arranged only on one side of the casing 12 of the printer 10. It will be apparent that the left side and the right side of the front cut sheet feeder 36 are reversed to those of the rear cut sheet feeder 36. However, according to the arrangement of Fig. 30, when any of the front and rear cut sheet feeders 38, 40 is attached to the printer 10, the intermediate feed roller driving gear 36h in the cut sheet feeder is easily and reliably connected to the gears Gt or Gx in the printer 10 (via the gears Gu to Gw.)

Figures 31 to 34 shows the elevating mechanism of the nip roller 32a of the front feed roller 32 and the shift mechanism of the shift gears Gb, Gd connected to the front and rear tractor driving gears 38g, 40g.

This mechanism uses a cam plate 80 shown in Fig. 33. The cam plate 80 is rotatably arranged about an axis of a support shaft 80a and has a sector gear 80b provided on a portion of the cam plate 80. An exclusive motor Md is provided, the motor Md being connected to the sector gear 80b via a motor gear Gaa and a gear Gab. Therefore, the motor Md can rotate the cam plate 80.

The cam plate 80 has an elevating portion 80c for the nip roller 32a and a shifting portion 80d. The elevating portion 80c includes a pin 80e which engages in an

elongated hole 82a in a cam gear 82. The cam gear 82 has a cam surface 82b which engages with the shaft 32b or the portion associated with the shaft 32b of the nip roller 32a of the front feed roller 32. Therefore, by rotating the cam plate 80, it is possible to elevate the nip roller 32a relative the front feed roller 32 via the cam gear 82. Fig. 32 shows the situation in which the nip roller 32a is elevated. The nip roller 32a is urged to the front feed roller 32 by a spring (not shown).

The shifting portion 80d has cam surfaces 80f, 80g for the shift gears Gb, Gd for driving the front and rear tractors 38, 40. When the cam plate 80 is at the position shown in Fig. 31, the cam surface 80f raises the shift gear Gb to release the shift gear Gb from the motor gear Ga, as shown in Fig. 34. Therefore, in this case, the rotation of the motor gear Ga is transmitted to the rear tractor 40 only. On the other hand, when the cam plate 80 is at the position of Fig. 32, the cam surface 80g raises the shift gear Gd to release the shift gear Gd from the motor gear Ga. Therefore, in this case, the rotation of the motor gear Ga is transmitted to the front tractor 38 only. The shift gears Gb, Gd are urged toward the cam plate 80 by a spring (not shown).

In addition, a switch 84 is arranged and the cam plate 80 has a switch engaging portion 80h. The switch 84 produces an OFF signal when the cam plate 80 is at the position shown in Fig. 31, and produces an ON signal when the cam plate 80 is at the position shown in Fig. 32. Therefore, the using condition of the cam plate 80, i.e., whether the nip roller 32a is elevated or not, and whether the front continuous form mode is selected or the rear continuous form mode is selected, can be detected.

In this way, it is possible to carry out the elevation of the nip roller 32a and the change of the front continuous form mode between the rear continuous form mode by the motor Md. Therefore, it is possible to automate the change of the several operations of the printer 10, and such a change can be established by simply pressing the sheet selection button 44a in the operation panel 44.

Figures 35 to 40 illustrate that the position of the carriage 22 is detected by the carriage sensor 56 and the members to be detected 58L, 58R in the forward and rearward sheet conveying directions to position the transverse ends of the carriage 22. The members 58L, 58R are referred to as detection members.

As shown in Fig. 35, the carriage sensor 56 is of a light transmission-block type sensor in the form of C-shape, and produces light blocked signals when the detection members 58L, 58R as light blocking members are between the two arms of the C-shape.

Figure 36 shows an example in which two detection members 58L, 58R have an identical size (W) and are located at the ends of the movable region A of the carriage sensor 56. It is assumed that the carriage sensor 56 can carry out a detection at the center thereof. In Fig. 36, the movable region A is divided into regions I, II and III, and it is considered that the carriage sensor 56 is positioned in any of the regions I, II, and III. The regions I and III are the regions at which the center of the carriage sensor 56 is covered by one of the detection members 58L, 58R.

Figure 37 is a flow chart for controlling the carriage 22 to position the latter using the arrangement of Fig. 36. In step S1, it is determined whether the carriage sensor 56 is blocked or not. If the result of step S1 is NO, the program goes to step S7. If the result of the step S1 is YES, the program goes to step S2. Here, it is supposed that the carriage sensor 56 is blocked, but it is not known which of the detection members 58L, 58R is blocking the carriage sensor 56.

In step S2, the carriage sensor 56 (i.e., the carriage 22) is moved to the left by the distance W. In step S3, it is determined whether the carriage sensor 56 is in the blocking region or not. If the carriage sensor 56 is initially in the region I (at the position of the carriage sensor 56 shown by the solid line in Fig. 36, the carriage sensor 56 cannot actually move to the left by the distance W since the movement is obstructed by the lefthand side frame member or the like, and the carriage sensor 56 continues to produce the block signal. In this case, the motor 30 is subjected to loss of synchronism. If the result of the step S3 is YES, the program goes to step S4.

If the carriage sensor 56 is initially in the region III, the carriage sensor 56 moves to the left by the distance W and enters the region II, without producing a blocking signal. Therefore, the result of the step S3 is NO, and the program goes to step S7.

In step S4, the carriage sensor 56 is moved to the right by the distance W, and in step S5, it is determined whether the carriage sensor 56 is in the blocking region or not. The carriage sensor 56, which was initially in the region I and is moved to the right by the distance W, must enter the region II. Therefore, if the result of step S5 is NO, the program goes to step S6 and the carriage sensor 56 is stopped at an appropriate position in the region II. If the result of step S5 is YES, it is assumed that the motor 30 is abnormal and the program goes to step S10 to produce an alarm signal.

In step S7, it is considered that the carriage sensor 56 is at any position in the region II. Thus, a signal is delivered to move the carriage sensor 56 to the left by the distance B, and in step S8, it is determined whether the carriage sensor 56 is in the blocking region or not. The distance B is a large distance generally corresponding to the movable region A, and the judgement of step 8 is carried out for every operation cycle of the computer while continuously moving the carriage sensor 56 a short distance for every operation cycle. Therefore, the judgement of step S8 becomes YES when the carriage sensor 56 comes from the region II to the region I, irrespective of where the carriage sensor 56 was. The carriage sensor 56 is now positioned at the left reference position. Then in step S9, the carriage sensor 56 (i.e., the carriage 22) is positioned based on a command of a designated left printing margin. If the result of step S8 is NO, it is assumed that the carriage sensor 56

does not eventually come from the region II to the region I and the motor 30 is abnormal, so the program goes to step S10 to produce an alarm signal.

This explanation corresponds to the case where a sheet is fed or conveyed from the front of the printer 10 to the rear of the printer 10. In the case where a sheet is fed or conveyed from the rear of the printer 10 to the front of the printer 10, a printing scan is carried out from the right to the left when viewed from the front of the printer 10, since a printing operation is carried out such that a printed matter can be read from the side of the printer 10 from which a sheet is fed (from the rear side in this case). Therefore, the designation of the left printing margin is based on the right end of a sheet when viewed from the front. In this case, it is possible to carry out the positioning of the carriage sensor 56 (the carriage 22), by reversing the relationship of the right and the left of the operations of Fig. 37. Therefore, in this embodiment, it is possible to detect and position the carriage 22 depending on the forward and rearward feeding or conveying directions, by the single carriage sensor 56.

Figure 38 shows another example in which two detection members 58L, 58R have different identical sizes (W_L, W_R) from each other and located at positions slightly inward from the ends of the movable region A of the carriage sensor 56. In this example, the width of the right detection members 58R is smaller than that of the left detection members 58L. In Fig. 38, the movable region A is divided into regions I, II, III, IV and V, and it is considered that the carriage sensor 56 is positioned in any of the regions I to V. The region starting from the left side moving limit point and covered by the left detection members 58L, is divided into two regions at a dividing point corresponding to the width W_R of the right detection member 58R from the right end of the left detection member 58L. One of the divided regions located on the left side of the dividing point is the region I, and the other region located on the right side of the dividing point is the region II. The region III is between the left detection members 58L and the right detection member 58R, the region IV is covered by the right detection member 58R, and the region V is on the right side of the right detection member 58R.

Figures 39 and 40 are a flowchart for controlling the carriage 22 to position the latter using the arrangement of Fig. 38. Fig. 39 shows the case where a sheet is fed or conveyed from the front to the rear of the printer 10, and Fig. 40 shows the case where a sheet is fed or conveyed from the rear to the front of the printer 10.

In step S11 in Fig. 39, it is determined whether the carriage sensor 56 is blocked or not. If the result of step S11 is NO, the program goes to step S15. In this case, the carriage sensor 56 is in the region III or V.

If the result of the step S11 is YES, the program goes to step S12 to move the carriage sensor 56 (i.e., the carriage 22) to the right by the distance B, and then in step S13, it is determined whether the block region is greater than the width W_R of the right detection member 58R or not. The distance B in this case also a large value corresponding to the movable region A.

If the result of the step S13 is YES, it is judged that the carriage sensor 56 is in the region I and the program goes to step S18. In step S18, it is determined whether the block region is greater than the width W_L of the left detection member 58L or not. If the result of the step S18 is YES, it is judged that the carriage sensor 56 cannot leave the region I and the computer causes an alarm (A) to be produced. If the result of the step S18 is NO, the program goes to step S19 where the carriage sensor 56 is once stopped after it is confirmed that the carriage sensor 56 is in the transmission condition (after it is confirmed that the carriage sensor 56 has entered the region II). The program then goes to step S20 to move the carriage sensor 56 to the left by the distance B. The program then goes to steps S25 and S26 to position the carriage sensor 56 (the carriage 22). The meaning of steps S20, S25 and S26 are identical to that of steps S7, S8 and S9 of Fig. 37, that is, the carriage sensor 56 is positioned based on a command for a designated left printing margin.

If the result of the step S13 is NO, it is judged that the carriage sensor 56 moves from the region II or Iv to the region III or V and the program goes to step S14 where the carriage sensor 56 is stopped at an appropriate position. The program then goes to step S15. Also, if the result of the step S11 is NO, as described above, it is judged that the carriage sensor 56 is in region III or V and the program goes to step S15.

In step S15, the carriage sensor 56 is moved to the left by the distance B. In step S16, if the carriage sensor 56 does not eventually produce a blocked signal, the computer causes an alarm (A) to be produced. If a blocked signal appears, the program goes to step S17 where it is determined whether the block region is greater than the width W_R of the right detection member 58R or not. This judgement is made for determining whether the carriage sensor 56 moves from the region III through the region II to the region I or the carriage sensor 56 moves from the region V through the region IV to the region III.

The judgement of step S17 is YES in the former case, and the judgement of step S17 is NO in the latter case. When the judgement of step S17 is YES, the carriage sensor 56 goes far into the region I, and stops at step S21. The carriage sensor 56 is then moved to the right by the distance C into the region III at step S22, and after the carriage sensor 56 is stopped at step S23, the carriage sensor 56 is again moved to the left by the distance B at step S24. In this case, the positioning is carried out by the combination of steps S24, S25 and S26.

When the judgement of step S17 is NO, the movement to the left of step S15 is continued and the positioning is carried out by the combination of steps S15, S25 and S26, in a manner similar to that described above.

In Fig. 40, the identical characters are given to

steps similar to those of Fig. 39, and a similar judgement is carried out as to in what region the carriage sensor 56 is located. Also in Fig. 40, steps S15, S19, S20 and S23 of Fig. 30 are omitted, and steps S27, S28 and S30 are added. The omission and the addition of the steps is done to bring the carriage sensor 56 to the right end side (the left end side in view of the conveying direction) while the carriage sensor 56 is finally positioned.

In this way, according to this embodiment, it is possible to detect and position the carriage 22 depending on the forward and rearward feeding or conveying directions, by the single carriage sensor 56. By the way, it is possible to design the right detection member 58R in a very small size, but it must have a size greater than a distance necessary to transfer from the completion of acceleration and deceleration to the stable state of the carriage sensor 56 since it is not possible to carry out the detection while the carriage sensor 56 (the carriage 22) is being accelerated and decelerated.

Referring to Figs. 42 to 43, the present invention is summarized.

Figure 43 shows the printer 10 in the fully equipped condition, in which the printer 10 has the front table 42, the front cut sheet feeder 36, the front tractor 38, the rear tractor 40 and the rear cut sheet feeder 36 attached to the casing 12. However, in the actual use, any one of the front cut sheet feeder 36 and the rear tractor 40 is selectively used, and any one of the front tractor 38 and the rear tractor 40 is selectively used.

When the front table 42, the front cut sheet feeder 36 and the front tractor 38 are used, a sheet is fed from the front side of the casing 12 to the platen 18 in the direction of the arrow X. This is referred to as the front feed. When the rear tractor 40 and the rear cut sheet feeder 36 are used, a sheet is fed from the rear side of the casing 12 to the platen 18 in the direction of the arrow Y. This is referred to as the rear feed.

As shown in Fig. 44, the printer 10 is designed such that the direction of the printed letters can be read by an operator 0 standing on the side of the printer 10 from which a sheet is fed. That is, an operator 0 standing on the front side of the printer 10 can read the letters in the case of the front feed, and an operator 0 standing on the rear side of the printer 10 can read the letters in the case of the rear feed. Therefore, it is possible to detect a leading edge of a sheet conveyed in the forward direction and in the rearward direction by the single leading edge detecting sensor 52, to thereby position the sheet at the position of the designated upper margin thereof to start the printing operation. This does not rely on the kind of paper to be used and is determined depending on the sheet feed direction.

Figure 42 is a flow chart for illustrating the operation of the printer of Fig. 43. The operation is controlled by a not shown computer and carried out by the above described mechanisms. The computer receives a command as to which sheet feeding means is to be used. In the embodiment, the computer receives a signal from the sheet selecting button 44a in Fig. 4. It is possible to select the cut sheet mode, the front continuous form mode and the rear continuous form mode, by continuing to press the sheet selecting button 44a.

When the front continuous form mode is selected by the sheet selecting button 44a at step S30, the front continuous form feed is recognized at step S31, and the front feed roller 32 is opened (the nip roller 32a is elevated relative to the front feed roller 32) at step S32. The front feed roller 32 and the rear feed roller 34 are then driven for rotation in the first rotational direction to convey the sheet at step S33. After the upper margin position of the sheet is set, the sheet is printed by the printing head 16 at step S34. In this case, the printing operation is carried out so that the printed letters can be read from the front side, as viewed in the direction of the arrow X in Fig. 44.

In a similar manner, when the rear continuous form mode is selected by the sheet selecting button 44a at step S35, the rear continuous form feed is recognized at step S36, and the front feed roller 32 is closed (the nip roller 32a is urged to the front feed roller 32) at step S37. The front feed roller 32 and the rear feed roller 34 are then driven for rotation in the second rotational direction opposite to the first rotational direction to convey the sheet at step S33. After the upper margin position of the sheet is set, the sheet is printed by the printing head 16 at step S34. In this case, the printing operation is carried out so that the printed letters can be read from the rear side, as viewed in the direction of the arrow Y in Fig. 44.

When the cut sheet mode is selected by the sheet selecting button 44a at step S38, it is determined whether the front cut sheet feeder (CSF) 36 is set in the printer 10 or not at step S39. For example, it is determined whether the connector of the front cut sheet feeder 36 is connected to the corresponding connector of the printer 10 or not. When the front cut sheet feeder 36 is set in the printer 10, the front cut sheet feed is recognized at step S40, and the front feed roller 32 is closed (the nip roller 32a is urged to the front feed roller 32) at step S37. The front feed roller 32 and the rear feed roller 34 are then driven for rotation in the first rotational direction to convey the sheet at step S33. After the upper margin position of the sheet is set, the sheet is printed by the printing head 16 at step S34. In this case, the printing operation is carried out so that the printed letters can be read from the front side, as viewed in the direction of the arrow X in Fig. 44.

When the cut sheet mode is selected by the sheet selecting button 44a at step S38 and the result of step S39 is NO, the program goes to step S41 and it is determined whether the rear cut sheet feeder (CSF) 36 is set in the printer 10 or not. In this case too, it is determined whether the connector of the rear cut sheet feeder 36 is connected to the corresponding connector of the printer 10 or not. When the rear cut sheet feeder 36 is set in the printer 10, the rear cut sheet feed is recognized at step S42, and the front feed roller 32 is closed (the nip roller

32a is urged to the front feed roller 32) at step S37. The front feed roller 32 and the rear feed roller 34 are then driven for rotation in the second rotational direction opposite to the first rotational direction to convey the sheet at step S33. After the upper margin position of the sheet is set, the sheet is printed by the printing head 16 at step S34. In this case, the printing operation is carried out so that the printed letters can be read from the rear side, as viewed in the direction of the arrow Y in Fig. 44.

When the cut sheet mode is selected by the sheet selecting button 44a at step S38 and the result of step S41 is NO, the program goes to step S43 and the front cut sheet feed (manual feeding from the front table 42) is recognized. The front feed roller 32 is closed (the nip roller 32a is urged to the front feed roller 32) at step S37. The front feed roller 32 and the rear feed roller 34 are then driven for rotation in the first rotational direction to convey the sheet at step S33. After the upper margin position of the sheet is set, the sheet is printed by the printing head 16 at step S34. In this case, the printing operation is carried out so that the printed letters can be read from the rear side, as viewed in the direction of the arrow X in Fig. 44.

As described above in greater detail, according to the present invention, it is possible to obtain a printer in which a sheet can be fed in one direction from the front side of the printer and in the other direction from the rear side of the printer, and which is simple in construction and easy in operation. The printer according to the present invention can be selectively equipped with cut sheet feeders and tractors.

Claims

1. A printer comprising:

   a casing (12), a movable carriage (22), a printing head (16) attached to the carriage, a platen (18) opposed to the printing head, a first feed roller (34) arranged on one side of the platen, and a second feed roller (32) arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof,

   characterized in that a first securing means (41a, 41b) is provided in the casing for arranging a first tractor (40) such that a continuous form is directly fed from the first tractor (40) to the platen (18) through a gap between the first feed roller (34) and the platen (18).

2. A printer according to claim 1, characterized in that a continuous form guide extends from a position near the first securing means toward the platen (18).

3. A printer according to claim 1, characterized in that:

   a second securing means (74a, 74b) is arranged in the casing for arranging a first cut sheet feeder (36) on the side of the first securing means (41a, 41b) from the platen (18);
   a third securing means (76a, 76b) is arranged in the casing for arranging a table (42) on the opposite side of the first securing means (41a, 41b) from the platen (18);
   a fourth securing means (74c, 74d) is arranged in the casing for arranging a second tractor (38) on the opposite side of the first securing means (41a, 41b) from the platen (18);
   a fifth securing means (74c, 74d) is arranged in the casing for arranging a second cut sheet feeder (36) on the opposite side of the first securing means (41a, 41b) from the platen (18); and

   wherein the first tractor (40), the second tractor (38), the first cut sheet feeder (36) and the second cut sheet feeder (36) can be selectively arranged in the casing, and a sheet can be fed from the table and selected by at least one of the tractors and the cut sheet feeders.

4. A printer according to claim 3, characterized in that the table (42) can function as a stacker when the first cut sheet feeder (36) is selected, and a stacker can be arranged in place of the first cut sheet feeder (36) when the second cut sheet feeder (36) is selected.

5. A printer according to claim 3, characterized in that the table (42) is movably attached to the casing, and the second cut sheet feeder (36) can be arranged below the table (42) when the table (42) is at a raised position.

6. A printer according to claim 3, characterized in that the relationship between the first tractor (40) and the first feed roller (34) is different from the relationship between the second tractor (38) and the second feed roller (32).

7. A printer according to claim 1, characterized in that a stacker can be arranged between the first tractor and the first cut sheet feeder.

8. A printer according to claim 7, characterized in that the first and second feed rollers (34, 32) include respective nip rollers (34a, 32a), and the nip roller (34a) of the first feed roller (34) is arranged at a substantially fixed position relative to the first feed roller (34), and the nip roller (32a) of the second feed roller (32) is movably arranged relative to the

second feed roller (32).

9. A printer comprising:

a casing (12), a movable carriage (22), a printing head (16) attached to the carriage, a platen (18) opposed to the printing head, a first feed roller (34) arranged on one side of the platen, and a second feed roller (32) arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof,

characterized in that a sheet guide (48) is attached to the carriage (22) at a height substantially the same as the level of the lower end of the printing head (16), and two indicator lines (54, 54a, 54b) are provided on the sheet guide (48) in the side-by-side relationship in the sheet conveying direction for indicating printing reference positions in the forward and rearward sheet feeding directions.

10. A printer according to claim 9, characterized in that the sheet guide (48) comprises a transparent plate.

11. A printer comprising:

a casing (12), a movable carriage (22), a printing head (16) attached to the carriage, a platen (18) opposed to the printing head, a first feed roller (34) arranged on one side of the platen, and a second feed roller (32) arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof,

characterized in that a leading edge detecting means (52) is arranged on a line (L) passing through the printing region of the printing head (16) and extending perpendicular to the sheet conveying direction for detecting a leading edge of a sheet.

12. A printer according to claim 11, characterized in that a sheet guide (48) is attached to the carriage (22) at a height substantially the same as the level of the lower end of the printing head (16), and the leading edge detecting means (52) is arranged on the sheet guide (48).

13. A printer comprising:

a casing (12), a movable carriage (22), a printing head (16) attached to the carriage, a platen (18) opposed to the printing head, a first feed roller (34) arranged on one side of the platen, and a second feed roller (32) arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof,

characterized in that a sheet guide (62) defining a sheet conveying path is provided, and a flap valve (72) is provided for guiding a sheet conveyed toward one of the first and second feed rollers (34) and for guiding a sheet conveyed in reverse from said one feed roller (34), the flap valve (72) being attached to a shaft (72a) rotatably supported by a bearing (72b) with the flap valve (72) facing said one feed roller (34) and being urged toward the sheet guide (62) by an elastic member (72c).

14. A printer according to claim 13, characterized in that a cut sheet feeder (36) is arranged in the casing on the side of said one feed roller (34), and the sheet guide (62) is arranged to define an upper portion of the sheet conveying path extending from the cut sheet feeder (36) toward said one feed roller (34), so that a sheet fed by the cut sheet feeder passing through a gap between the sheet guide (62) and the flap valve (72) to said one feed roller (34) and a sheet conveyed in reverse by said one feed roller (34) passes below the flap valve (72), the flap valve (72) being arranged to prevent the reversely conveyed sheet from passing through a gap between the sheet guide (62) and the flap valve (72), the bearing (72b) being attached to a flange (62a) of the sheet guide (62).

15. A printer according to claim 14, characterized in that the shaft (72a) is formed as a D-cut shaft having a planar portion, and the bearing (72b) has an internal shape corresponding to the shape of the D-cut shaft, the flap valve (72) being displaceable within a play defined by planar portions of the shaft and the bearing.

16. A printer according to claim 13, characterized in that the flap valve (72) is formed by a thin plate which is bent into a wedge-shape, the open ends of the bent plate being fixed to the shaft (72a).

17. A printer comprising:

a casing (12), a movable carriage (22), a printing head (16) attached to the carriage, a platen (18) opposed to the printing head, a first feed

roller (34) arranged on one side of the platen, and a second feed roller (32) arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof,

characterized in that a table (42) is arranged in the casing on the side of the second feed roller (32), and a sheet guide (68) is arranged between the second feed roller (32) and the table (42), the table (42) being capable of being used as a table for feeding a sheet therefrom and as a stacker for receiving a discharged sheet, the sheet guide (68) being movable and arranged so that the sheet guide (68) can guide a sheet when the table (42) is used as a stacker for feeding a sheet therefrom and the sheet guide (68) becomes a stopper to receive a trailing edge of a sheet when the table (42) is used as a table for receiving a conveyed sheet.

18. A printer according to claim 17, characterized in that the table (42) is movably arranged and can move with the sheet guide (68).

19. A printer according to claim 17, characterized in that the sheet guide (68) is rotatably arranged about an axis of the second feed roller (32) and is urged by an elastic member (78) toward a position at which the sheet guide (68) can guide a sheet conveyed toward the second feed roller (32).

20. A printer comprising:

a casing (12), a movable carriage (22), a printing head (16) attached to the carriage, a platen (18) opposed to the printing head, a first feed roller (34) arranged on one side of the platen, and a second feed roller (32) arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof,

characterized in that a first driving means (Mb, Hh-Gn, 32g, 34g, Gt, Gx) is provided for driving the platen (18) and the first and second feed rollers (34, 32), and a second driving means (Ma, Ga-Gg, 38g, 40g) is provided for driving a first tractor (40) capable of feeding a continuous form to the platen (18) from one side thereof and a second tractor (38) capable of feeding a continuous form to the platen (18) from the other side thereof, the first and second driving means being independently provided.

21. A printer according to claim 20, characterized in that the first driving means includes a first motor (Mb) and a first gear train (Hh-Gn, 32g, 34g, Gt, Gx) connected to the first motor, and the second driving means includes a second motor (Ma) and a second gear train (Ga-Gg, 38g, 40g) connected to the second motor.

22. A printer according to claim 20, characterized in that a cut sheet feeder (36) includes a pick roller (36b), an intermediate feed roller (36d), a third motor (Mc), a third gear train (Go-Gs) connected to the third motor for driving the pick roller (36b), and at least one feed roller driving gear (36h, Gu-Gw) for driving the intermediate feed roller (36d), the at least one feed roller driving gear is connected to the gear (Gt, Gx) of the first gear train.

23. A printer comprising:

a casing (12), a movable carriage (22), a printing head (16) attached to the carriage, a platen (18) opposed to the printing head, a first feed roller (34) arranged on one side of the platen, and a second feed roller (32) arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof,

characterized in that a cut sheet feeder (36) is provided, a printer driving means (Mb, Hh-Gn, 32g, 34g, Gt, Gx) including gears arranged on one side of the printer is provided for driving the platen (18) and the first and second feed rollers (34, 32), and a cut sheet feeder driving means (Mc, Go-Gs, 36g) is provided for driving the cut sheet feeder (36), the cut sheet feeder (36) including a pick roller (36b) driven by the cut sheet feeder driving means, an intermediate feed roller (36d) not driven by the cut sheet feeder driving means, and intermediate feed roller driving gears (36h, Gu-Gw) for driving the intermediate feed roller (36d), the intermediate feed roller driving gears comprising a pairs of gears or gear groups arranged on one side and on the other side of the cut sheet feeder (36) so that the feed roller driving gears can be connected to the gears (Gt, Gx) of the driving means arranged on one side of the printer even when the cut sheet feeder (36) is attached to the printer on the front or on the rear of the printer.

24. A printer comprising:

a casing (12), a movable carriage (22), a printing head (16) attached to the carriage, a platen (18) opposed to the printing head, a first feed roller (34) arranged on one side of the platen, and a second feed roller (32) arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof,

characterized in that a securing means (74c, 74d) is provided in the casing for arranging a tractor (38) for feeding a continuous form to the second feed roller (32), the first and second feed rollers (34, 32) having respective nip rollers (34a, 32a), at least the nip roller (32a) of the second roller (32) being movably arranged relative to the second roller (32) when said tractor (38) is used, in addition, a changing means being provided for changing the position of the nip roller (32a) relative to the second roller (32), the changing means including a motor (Md) and a transmission means (Gaa, Gab, 80, 82).

25. A printer according to claim 24, characterized in that a further securing means (41a, 41b) is provided for arranging a further tractor (40) such that a continuous form is directly fed from the further tractor (40) to the platen (18) through a gap between the first feed roller (34) and the platen (18), said changing means being capable of selectively changing the drive of said tractor (38) and said further tractor (40).

26. A printer according to claim 24, characterized in that the motor (Md) of said changing means is provided separately from a driving means for driving the platen (18) and the first and second feed rollers (34, 32) and a driving means for driving the tractors (40, 38).

27. A printer comprising:

a casing (12), a movable carriage (22), a printing head (16) attached to the carriage, a platen (18) opposed to the printing head, a first feed roller (34) arranged on one side of the platen, and a second feed roller (32) arranged on the other side of the platen, the first and second feed rollers being rotatable in a first rotational direction and in a second rotational direction opposite to the first rotational direction so that a sheet can be fed to the platen from one side thereof and a sheet can also be fed to the platen from the other side thereof,

characterized in that two means to be detected (58L, 58R) are arranged at fixed positions for detecting the position of the carriage (22), and a single detecting means is arranged on the carriage (22) to generate a detection signal when the detecting means reaches the position of the means to be detected (58L, 58R) is provided, said detecting means being capable of detecting the position of the carriage in the moving direction of the carriage even when the carriage is moved in any of the travelling directions to thereby allow the carriage to be positioned at a print starting position.

28. A printer according to claim 27, characterized in that the two means to be detected (58L, 58R) comprise two members to be detected having an identical width, said detecting means being capable of detecting one of the members to be detected, by moving greater amount when said detecting means is at the position of any of the means to be detected.

29. A printer according to claim 27, characterized in that the two means to be detected (58L, 58R) comprise two members to be detected having different widths, said detecting means being capable of detecting one of the members to be detected, by moving a greater amount when said detecting means is at the position of any of the means to be detected and by judging whether a shading region is greater than one of the means to be detected which is shorter than the other.

30. A printer according to claim 27, characterized in that a printing operation is carried out such that a printed matter can be read from the side of the printer from which a sheet is fed.

Fig.1

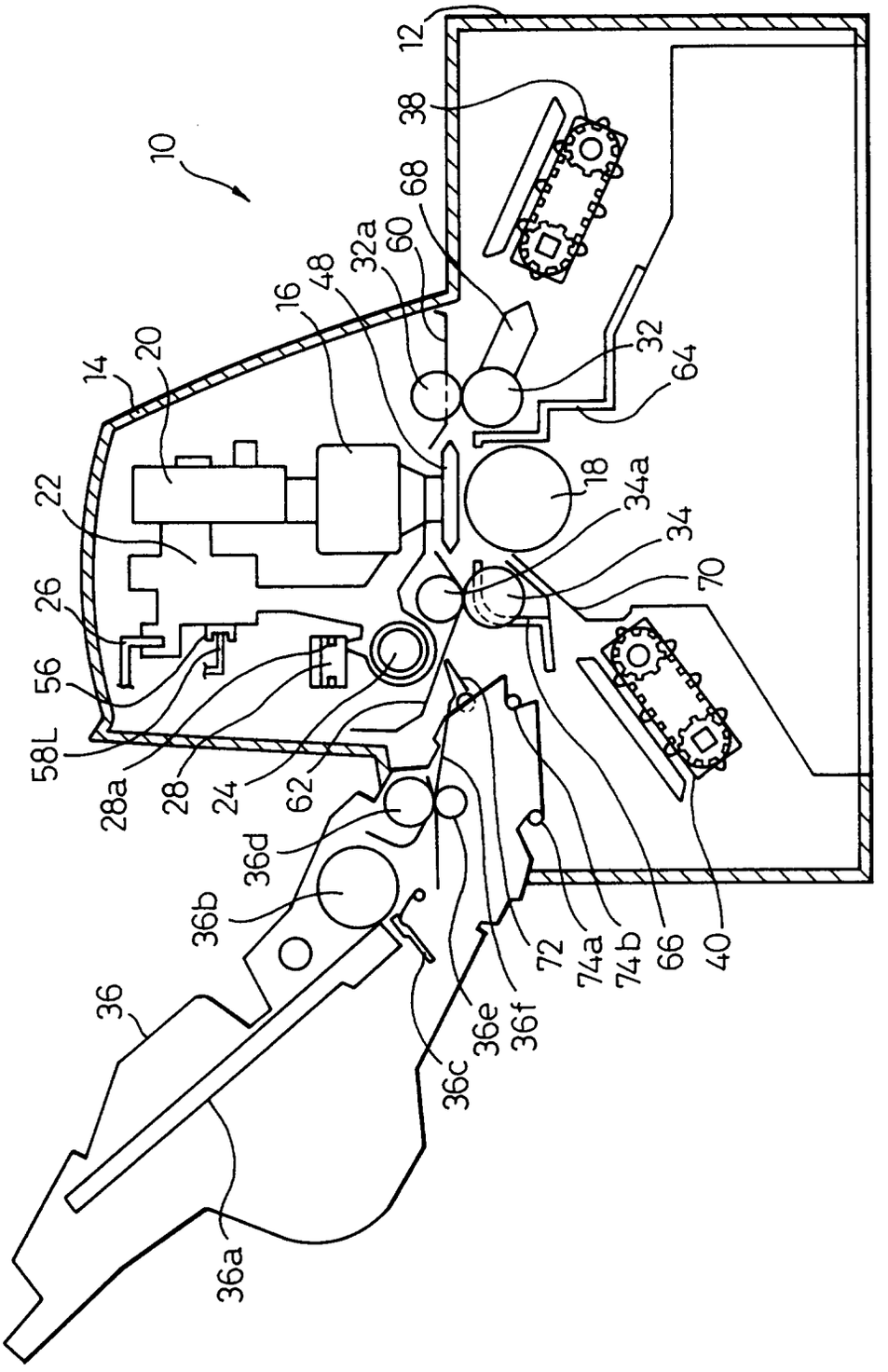

10
12
38
68
60
32a
48
16
20
14
22
26
56
58L
28a
28
24
62
36d
36b
36
36a
36c
36e
36f
72
74a
74b
66
40
64
32
18
34a
34
70

Fig.2

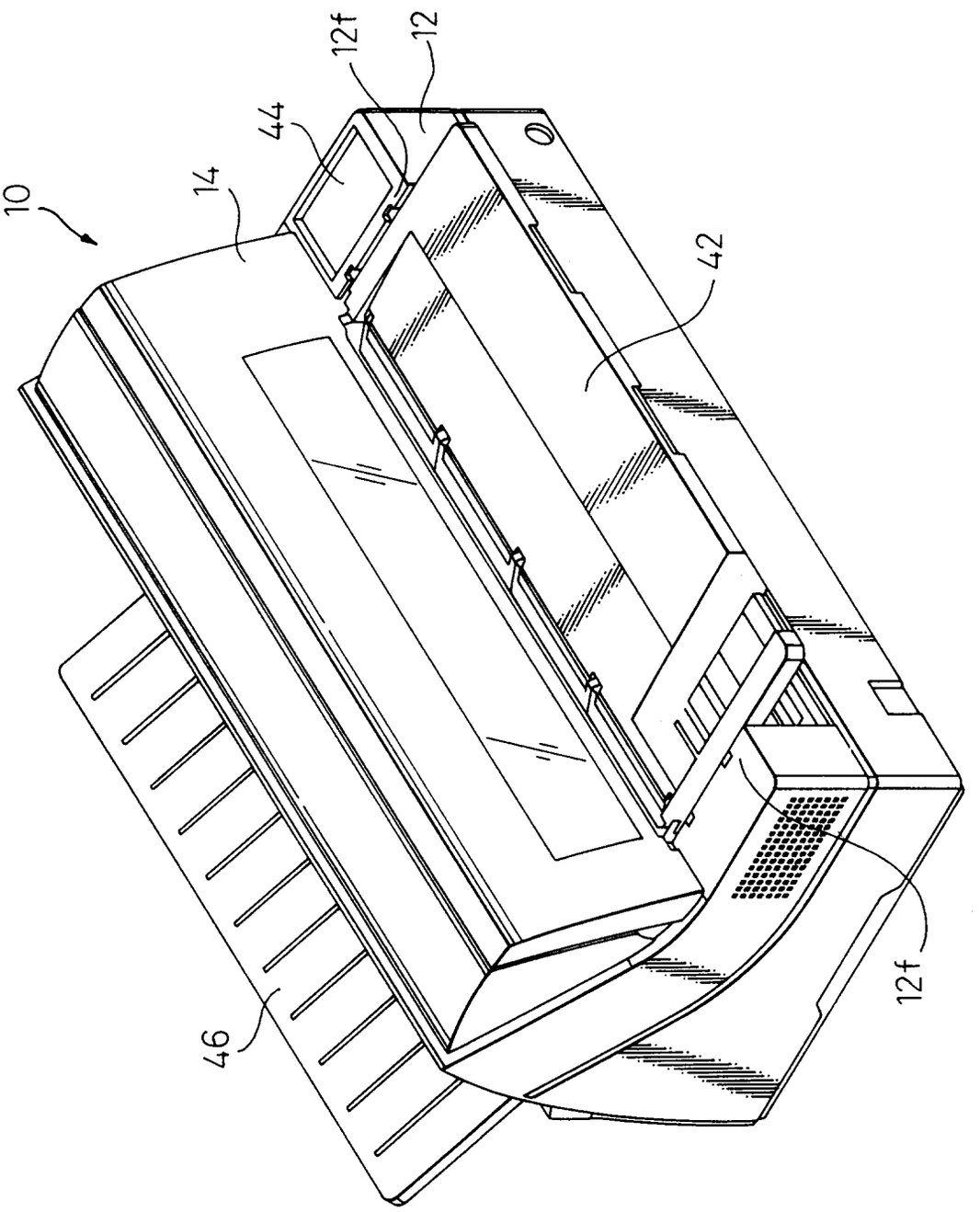


Fig.3

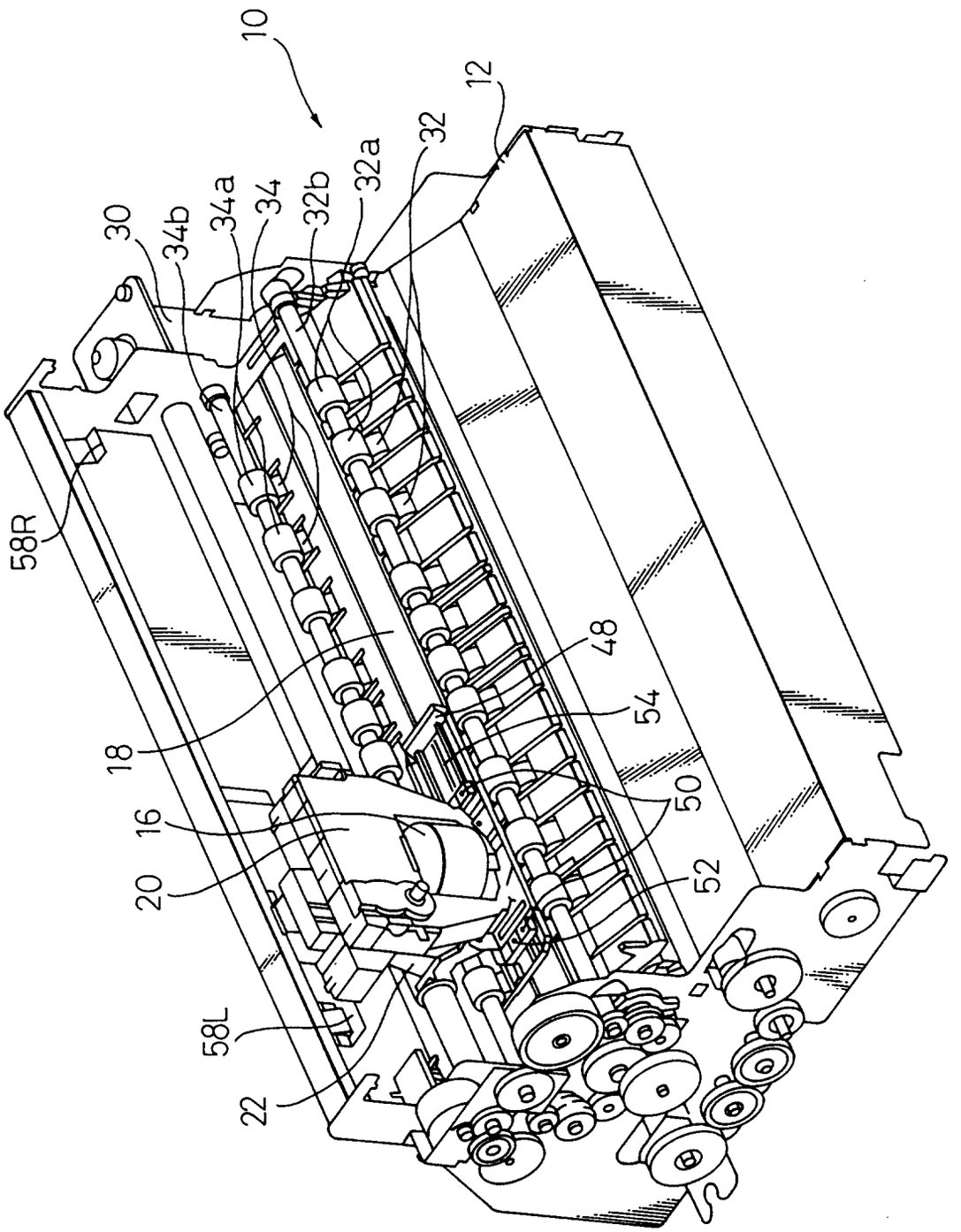


Fig. 4

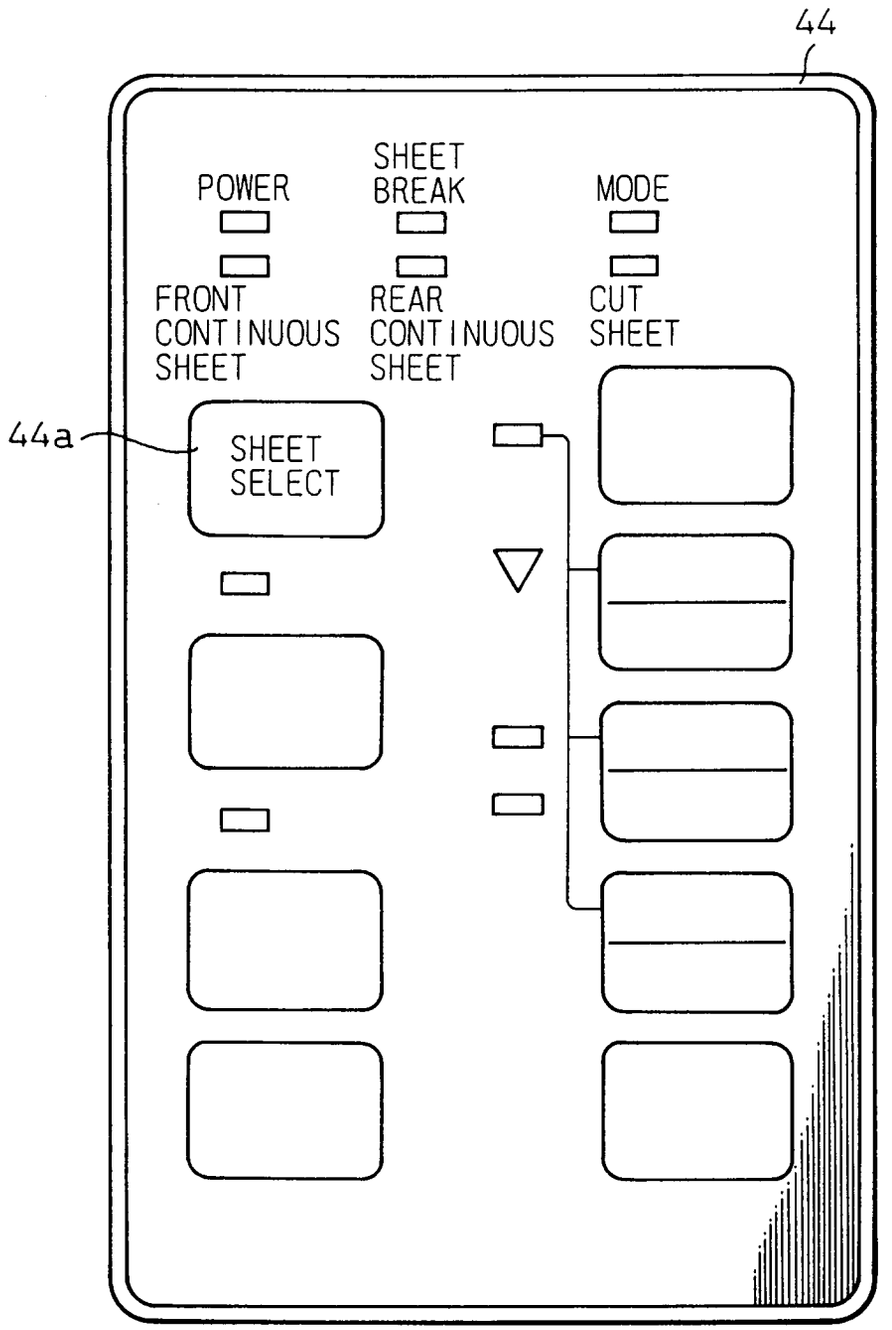

44
POWER
SHEET BREAK
MODE
FRONT CONTINUOUS SHEET
REAR CONTINUOUS SHEET
CUT SHEET
44a
SHEET SELECT

Fig.5

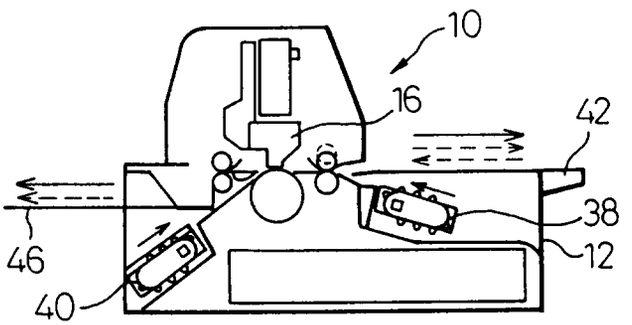


Fig.6

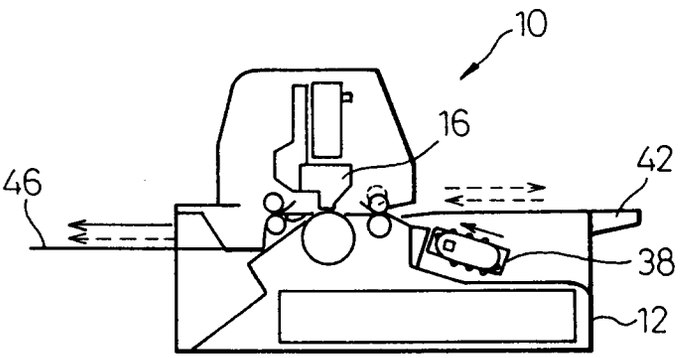


Fig.7

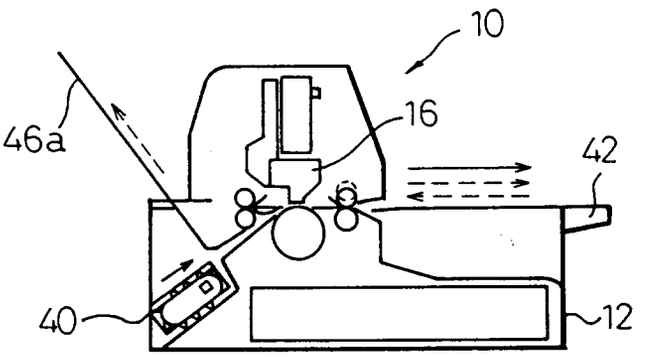


Fig.8

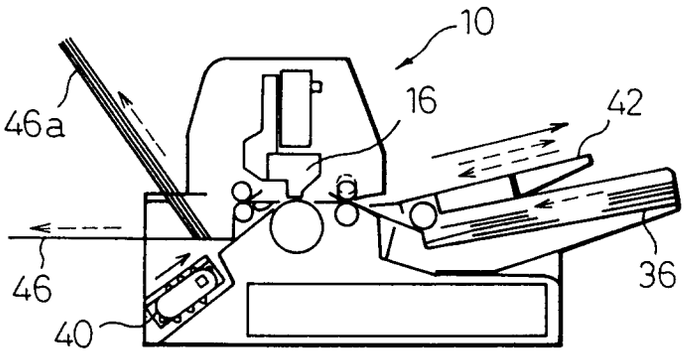


Fig.9

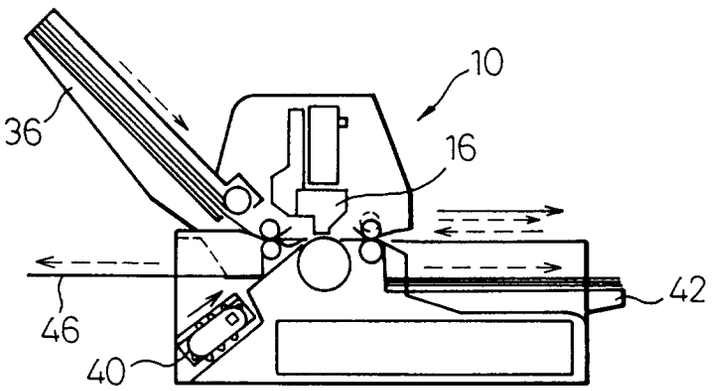


Fig.10

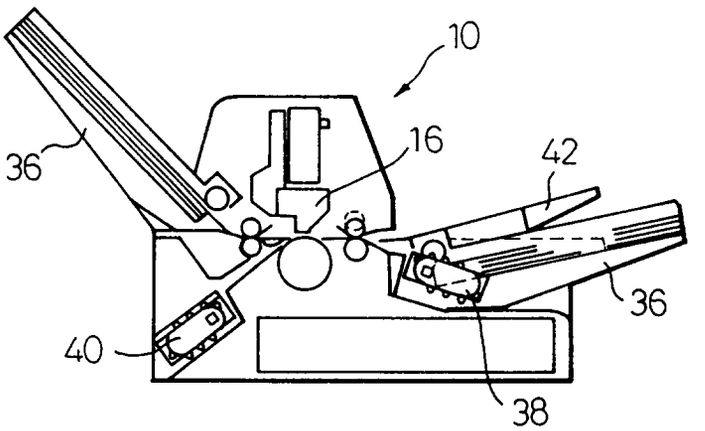


Fig.11

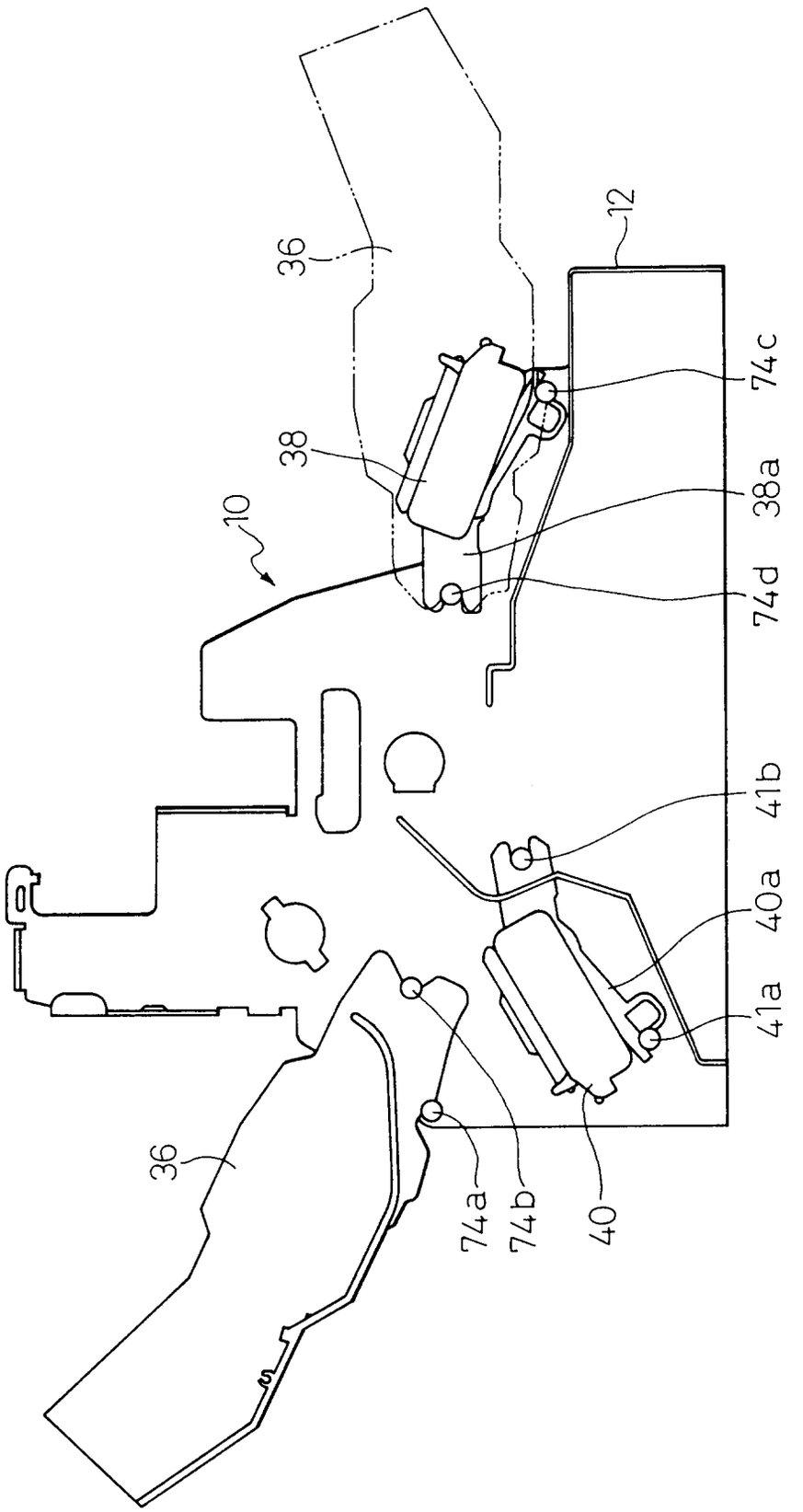


Fig.12A

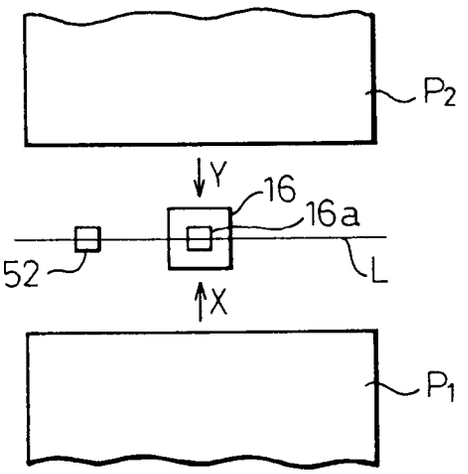


Fig.12B

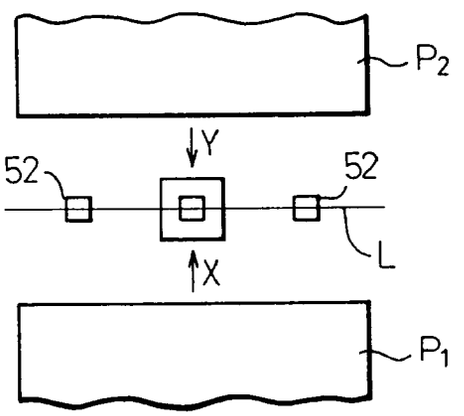


Fig.13

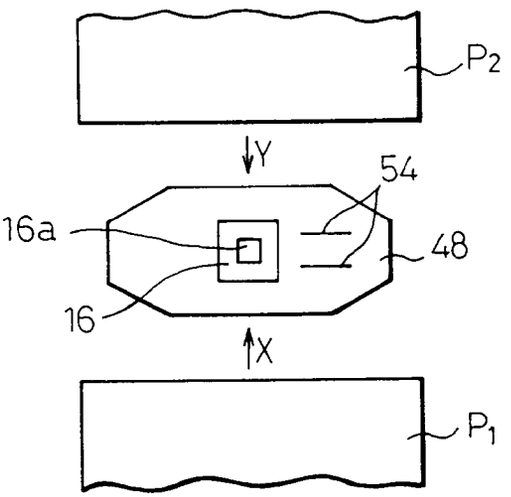


Fig.14A

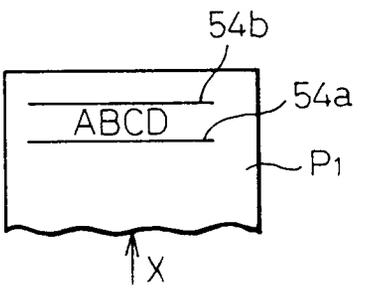


Fig.14B

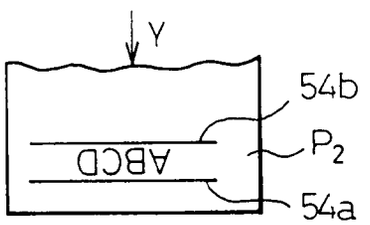


Fig.15

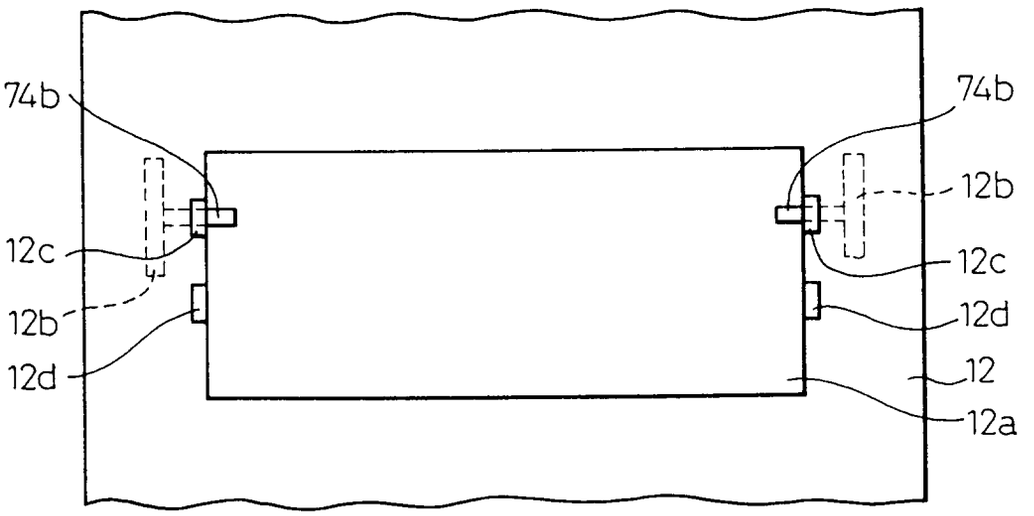


Fig.16

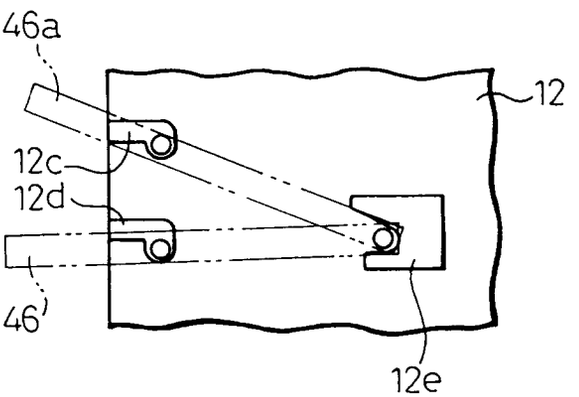


Fig.17

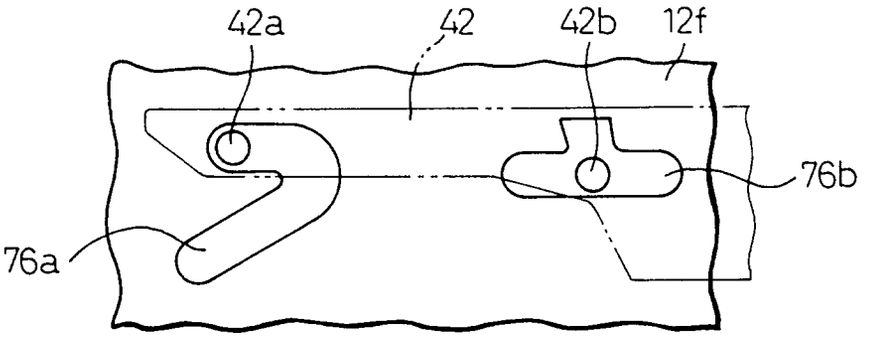


Fig.18

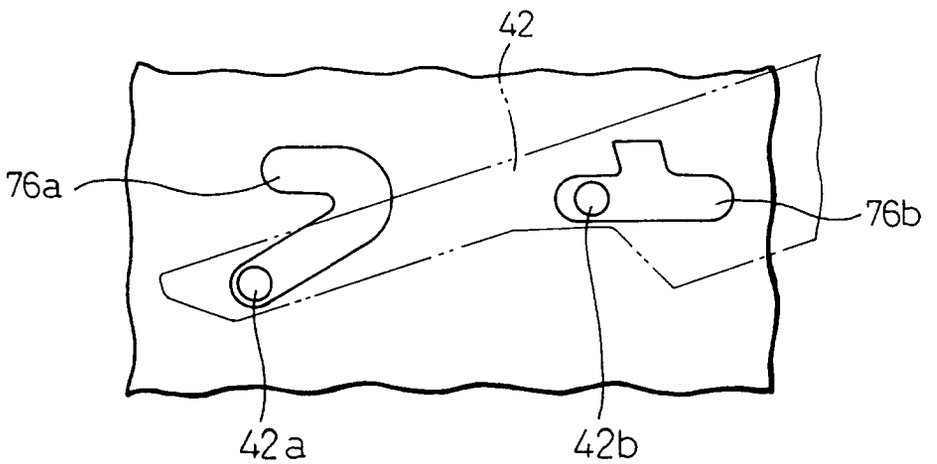


Fig.19

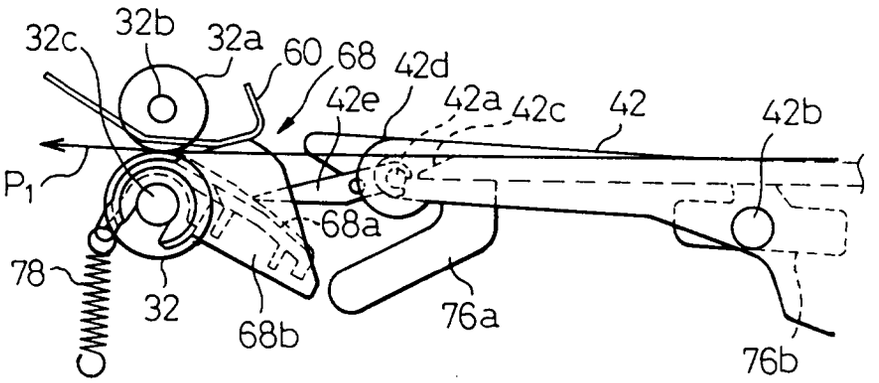

32c
32b
32a
60
68
42d
42e
42a
42c
42
42b
P1
68a
78
32
68b
76a
76b

Fig.20

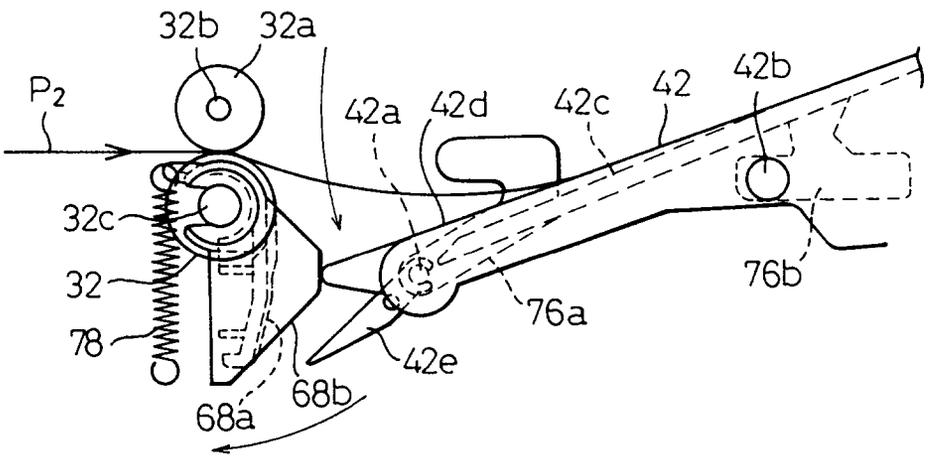

32b
32a
P2
42a
42d
42c
42
42b
32c
32
78
76a
76b
42e
68b
68a

Fig. 21

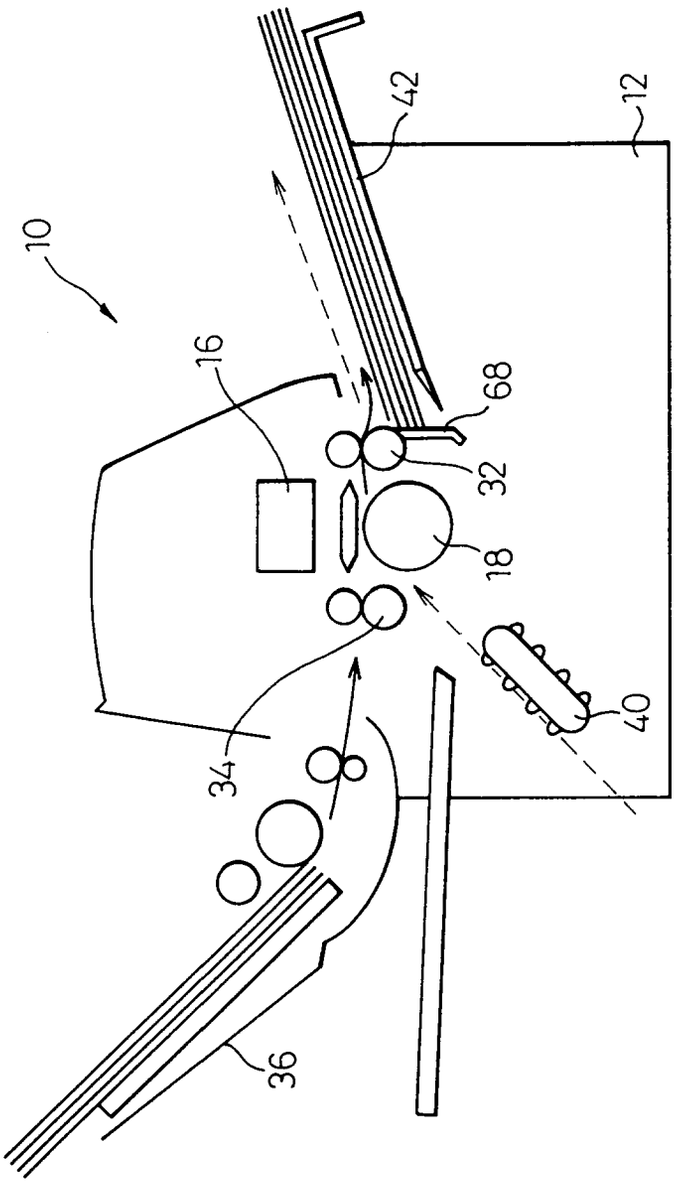


Fig.22

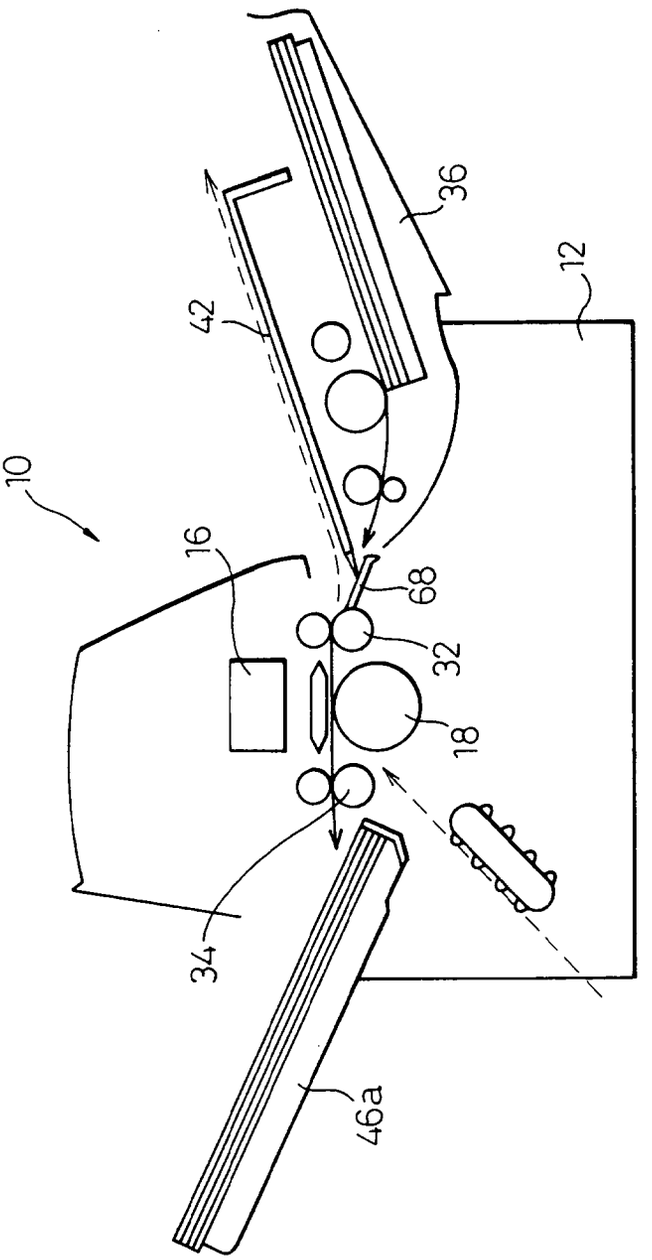


Fig.23

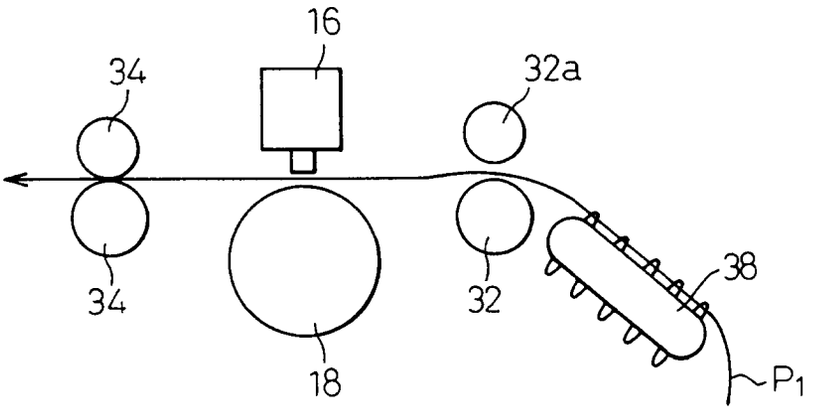


Fig.24

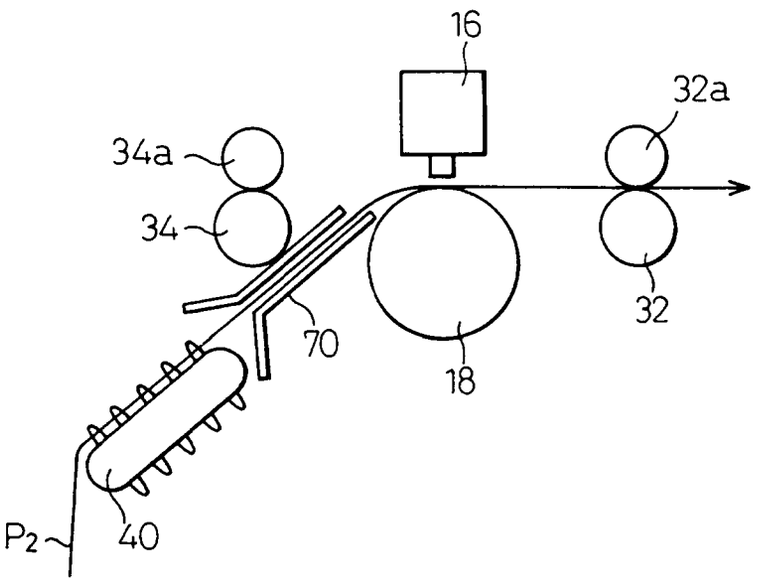


Fig.25

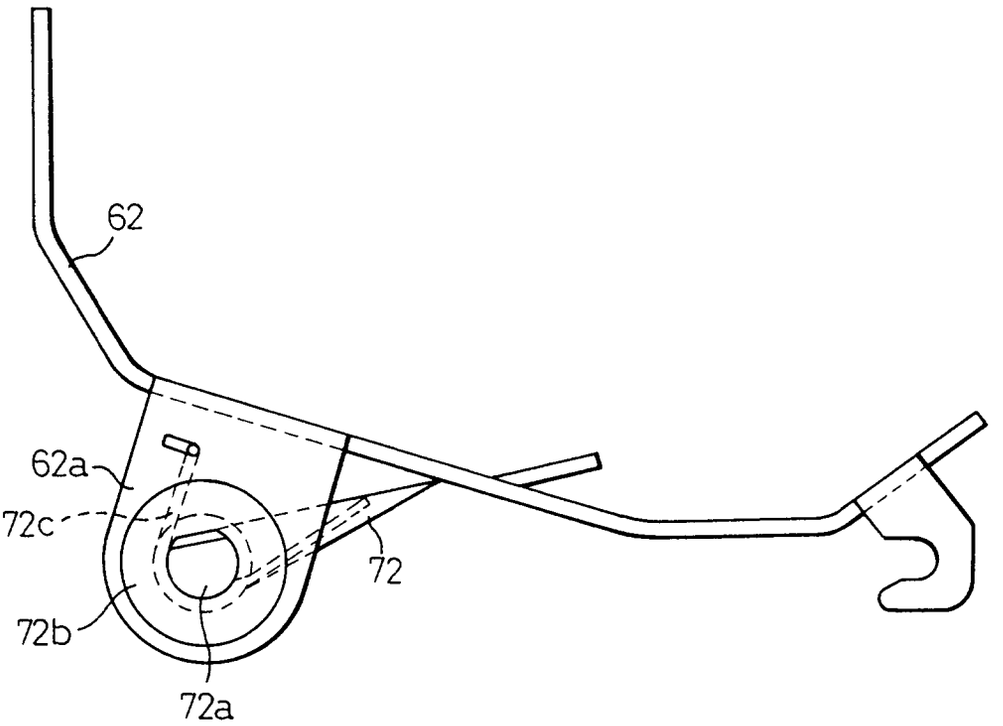


Fig.26

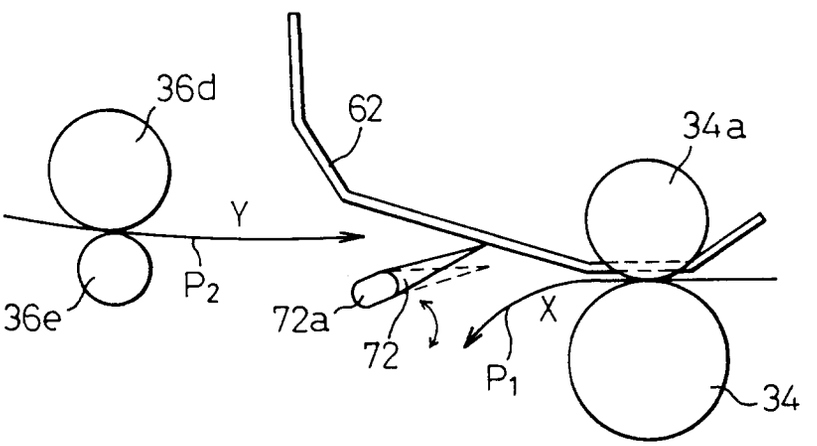


Fig.27

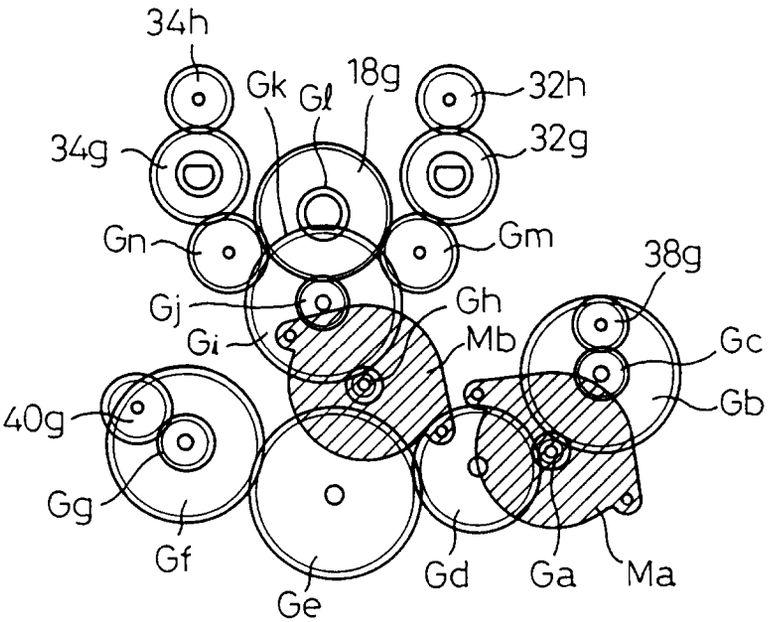

34h
Gk
Gl
18g
32h
34g
32g
Gn
Gm
38g
Gj
Gh
Gi
Mb
Gc
Gb
40g
Gg
Gf
Ge
Gd
Ga
Ma

Fig.28

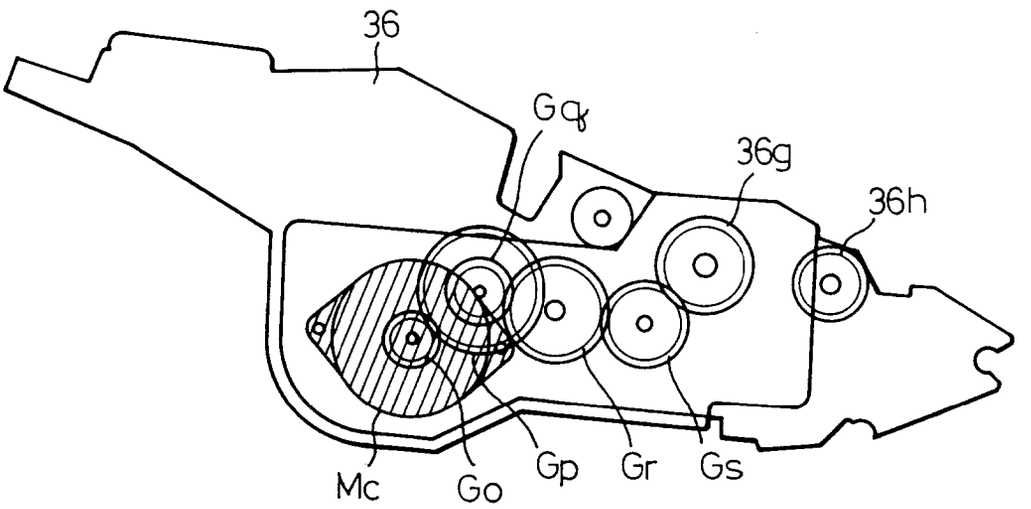
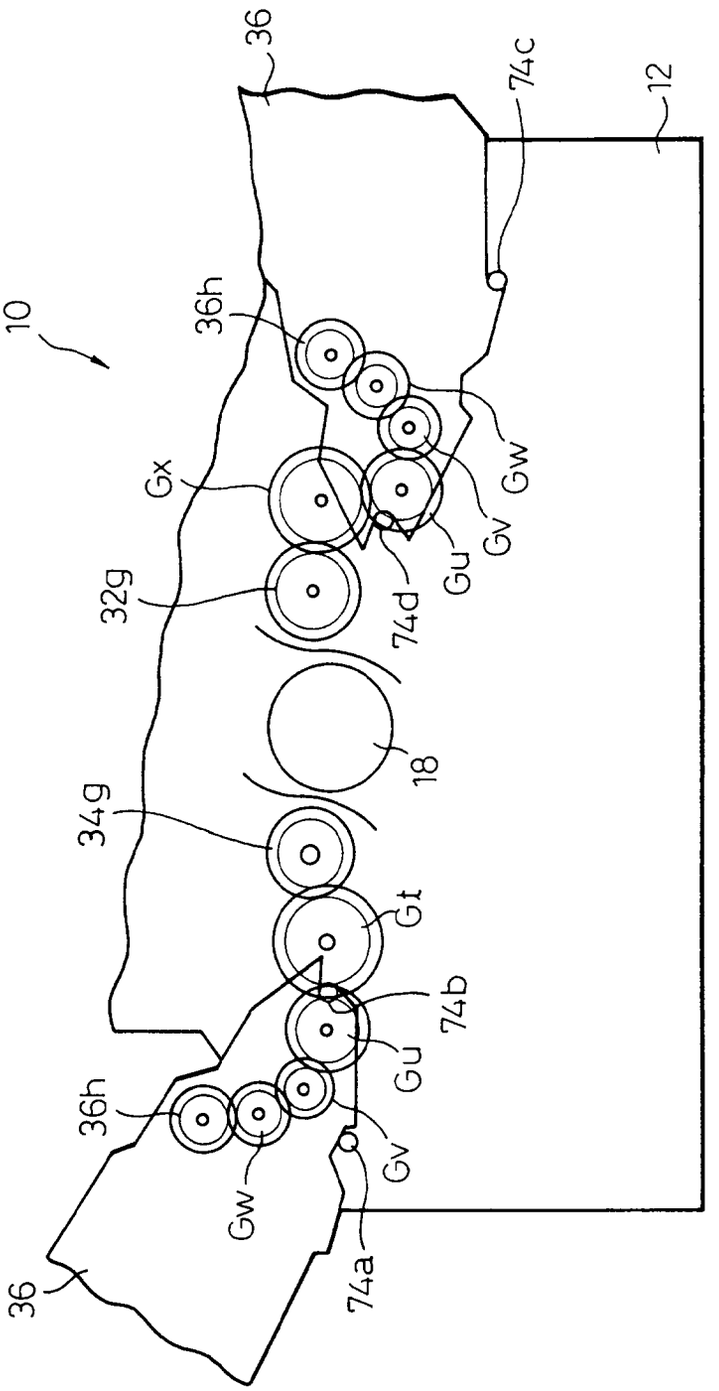

36
Gq
36g
36h
Mc
Go
Gp
Gr
Gs

Fig.29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36
74c
12
36h
Gx
Gw
Gv
Gu
32g
74d
18
34g
Gt
74b
36h
Gu
Gv
Gw
74a
36

Fig.30

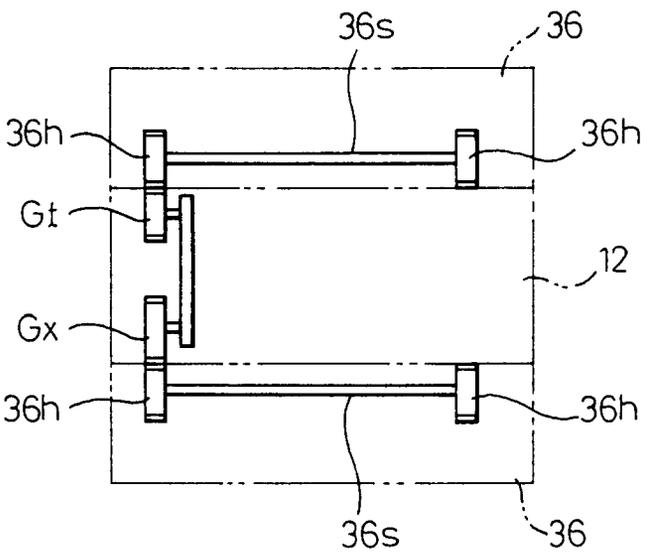

Fig.31

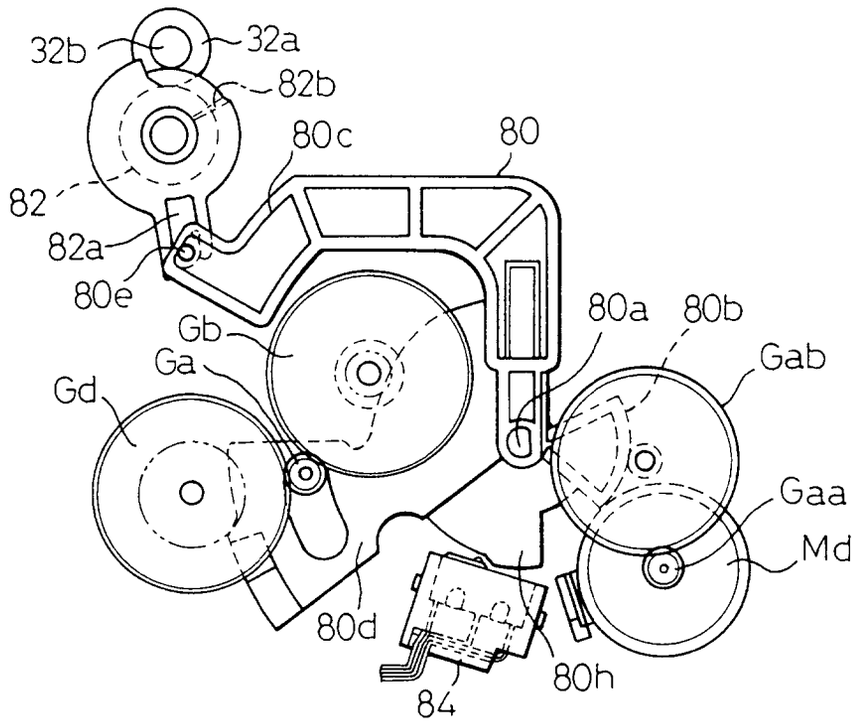
32b
32a
82b
80c
80
82
82a
80e
Gb
Ga
Gd
80a
80b
Gab
Gaa
Md
80d
80h
84

Fig.32

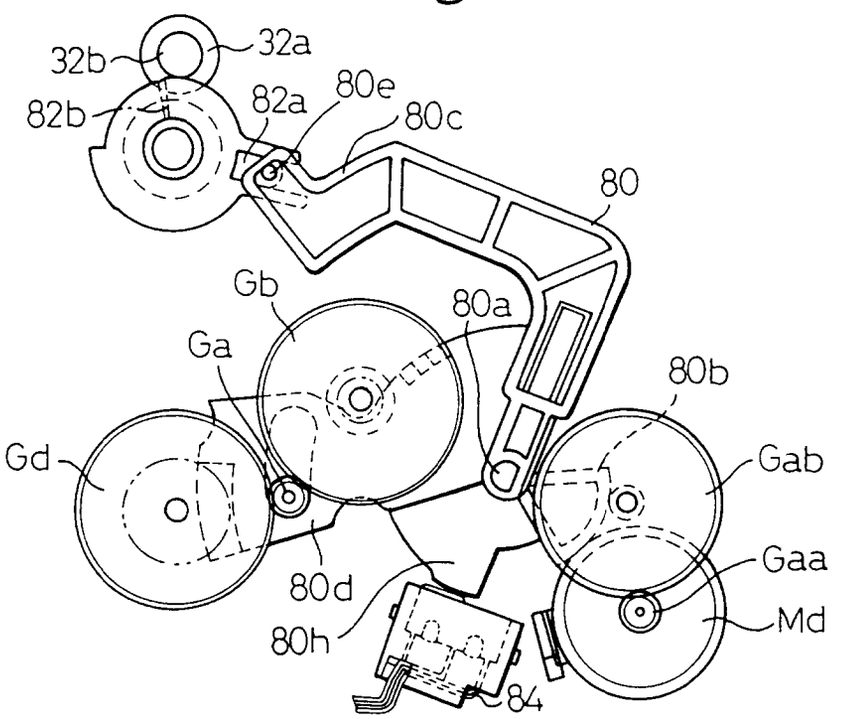
32b
32a
82b
82a
80e
80c
80
Gb
80a
Ga
80b
Gd
Gab
Gaa
Md
80d
80h
84

Fig.33

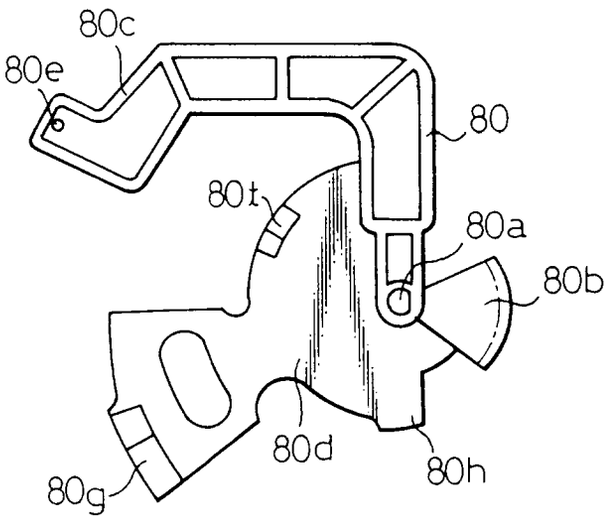

Fig.34

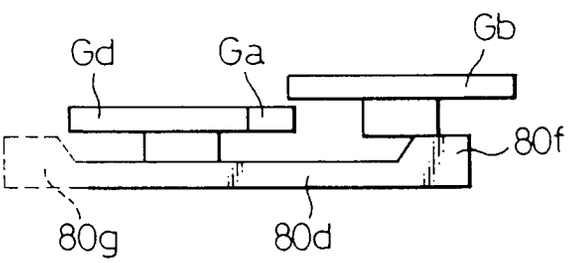

Fig.35

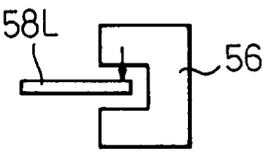

Fig.36

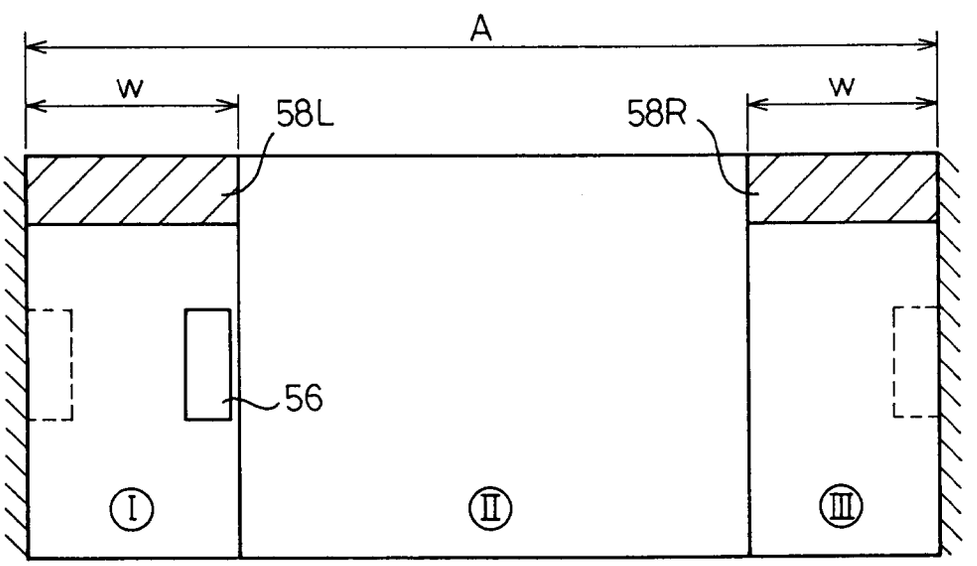

Fig.37

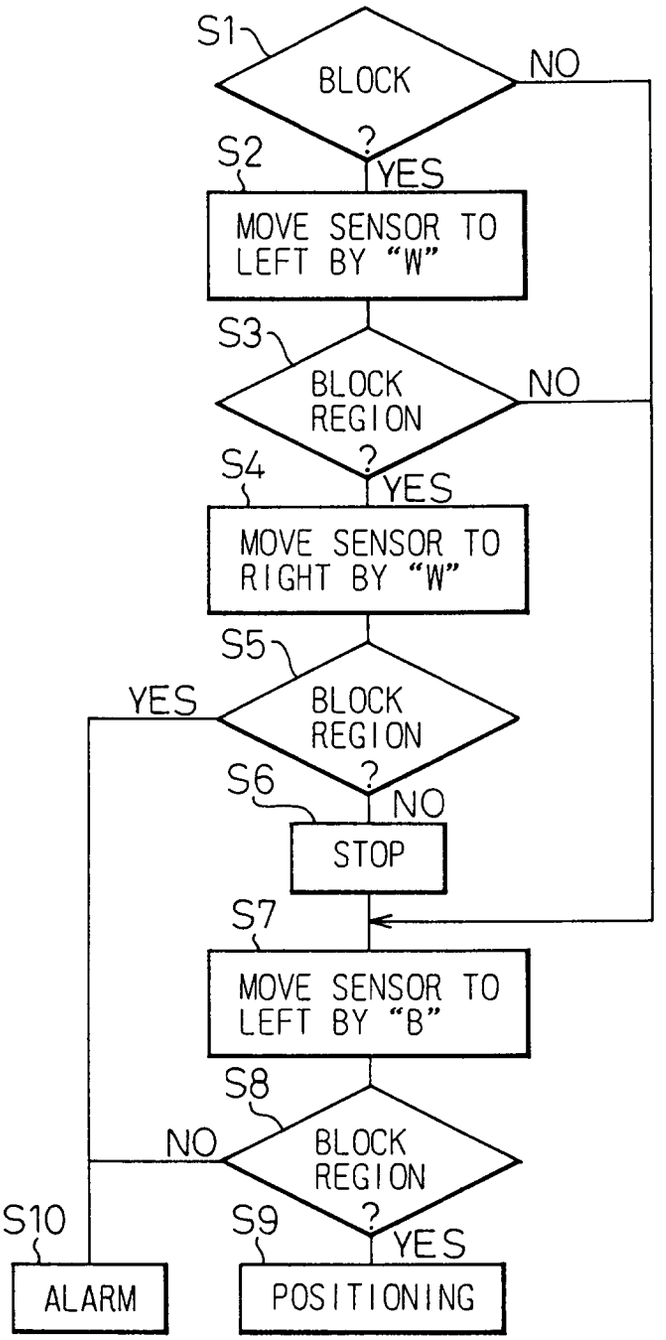
S1
BLOCK
?
NO
YES
S2
MOVE SENSOR TO LEFT BY "W"
S3
BLOCK REGION
?
NO
YES
S4
MOVE SENSOR TO RIGHT BY "W"
S5
BLOCK REGION
?
YES
NO
S6
STOP
S7
MOVE SENSOR TO LEFT BY "B"
S8
BLOCK REGION
?
NO
YES
S9
POSITIONING
S10
ALARM

Fig.38

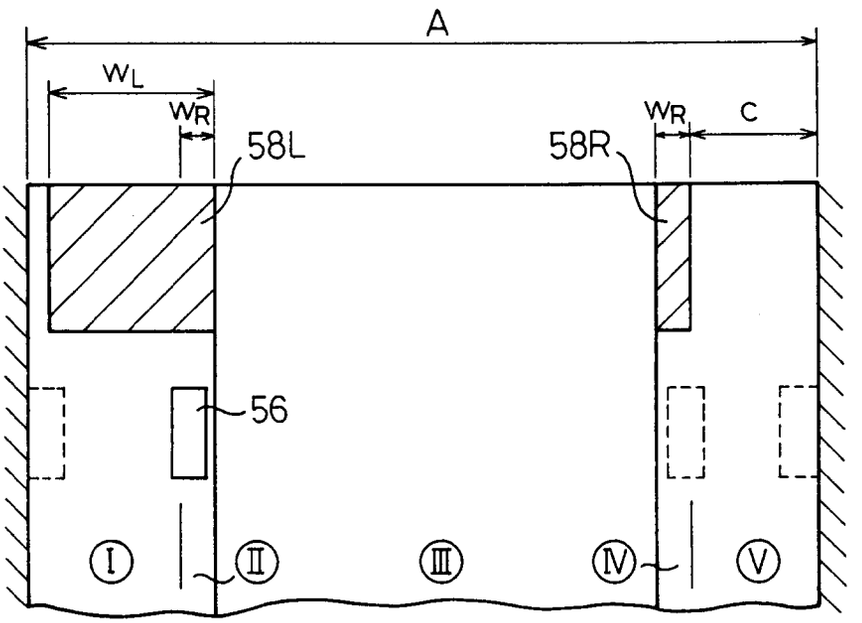

Fig.39

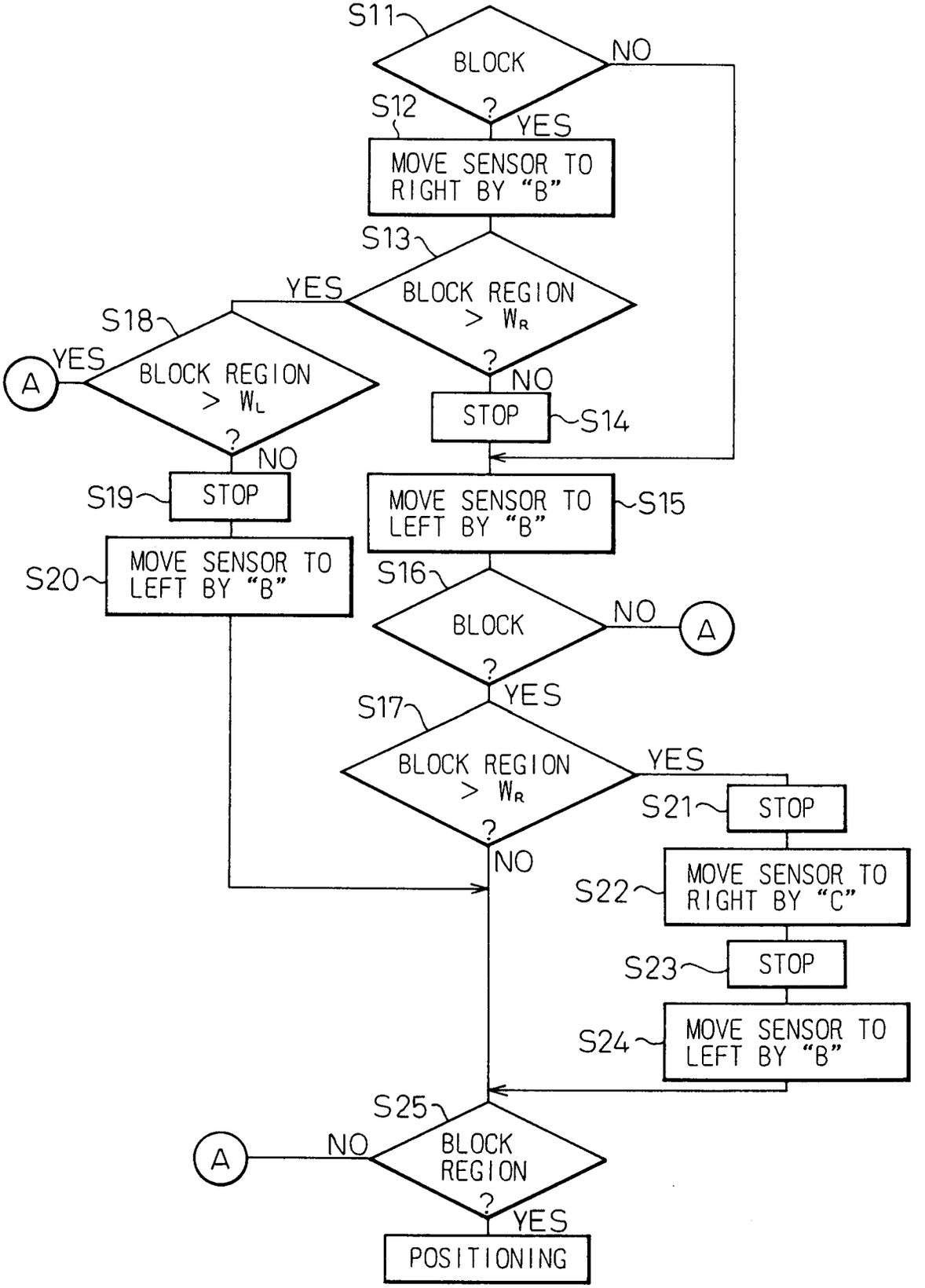
S11
BLOCK
?
NO
YES
S12
MOVE SENSOR TO RIGHT BY "B"
S13
BLOCK REGION > W_R
?
YES
NO
S14
STOP
S15
MOVE SENSOR TO LEFT BY "B"
S16
BLOCK
?
NO
A
YES
S17
BLOCK REGION > W_R
?
YES
S21
STOP
S22
MOVE SENSOR TO RIGHT BY "C"
S23
STOP
S24
MOVE SENSOR TO LEFT BY "B"
NO
S18
BLOCK REGION > W_L
?
YES
A
NO
S19
STOP
S20
MOVE SENSOR TO LEFT BY "B"
S25
BLOCK REGION
?
NO
A
YES
POSITIONING

Fig.40

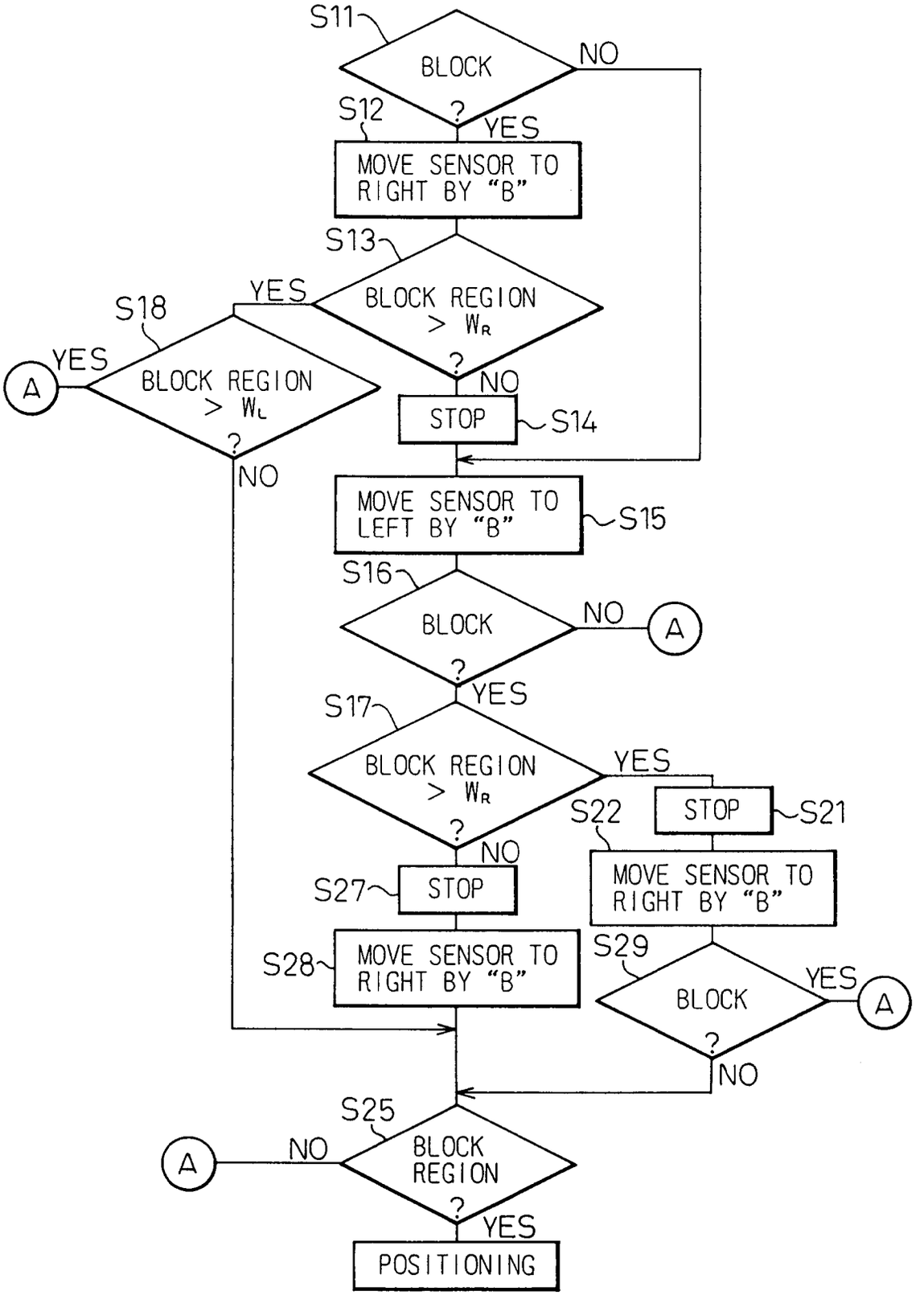
S11
BLOCK
?
NO
YES
S12
MOVE SENSOR TO RIGHT BY "B"
S13
BLOCK REGION > W_R
?
YES
NO
S18
BLOCK REGION > W_L
?
YES
NO
A
STOP
S14
MOVE SENSOR TO LEFT BY "B"
S15
S16
BLOCK
?
NO
A
YES
S17
BLOCK REGION > W_R
?
YES
NO
S22
STOP
S21
MOVE SENSOR TO RIGHT BY "B"
S27
STOP
S28
MOVE SENSOR TO RIGHT BY "B"
S29
BLOCK
?
YES
A
NO
S25
BLOCK REGION
?
NO
A
YES
POSITIONING

Fig.41

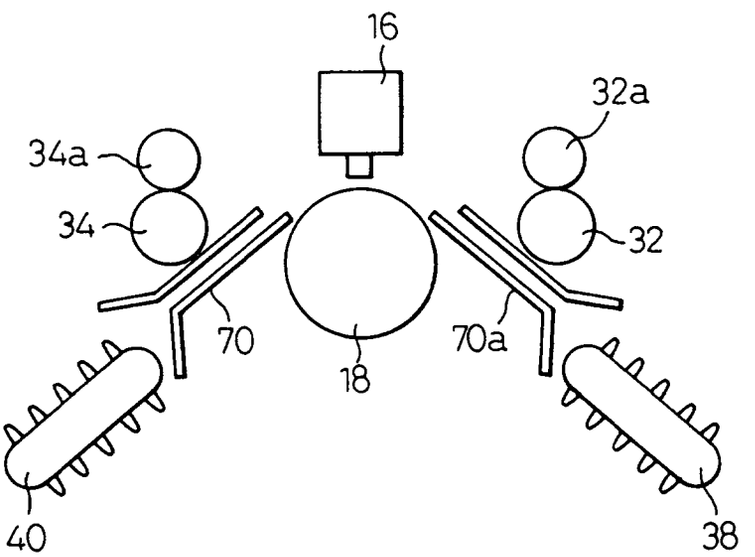

Fig.42

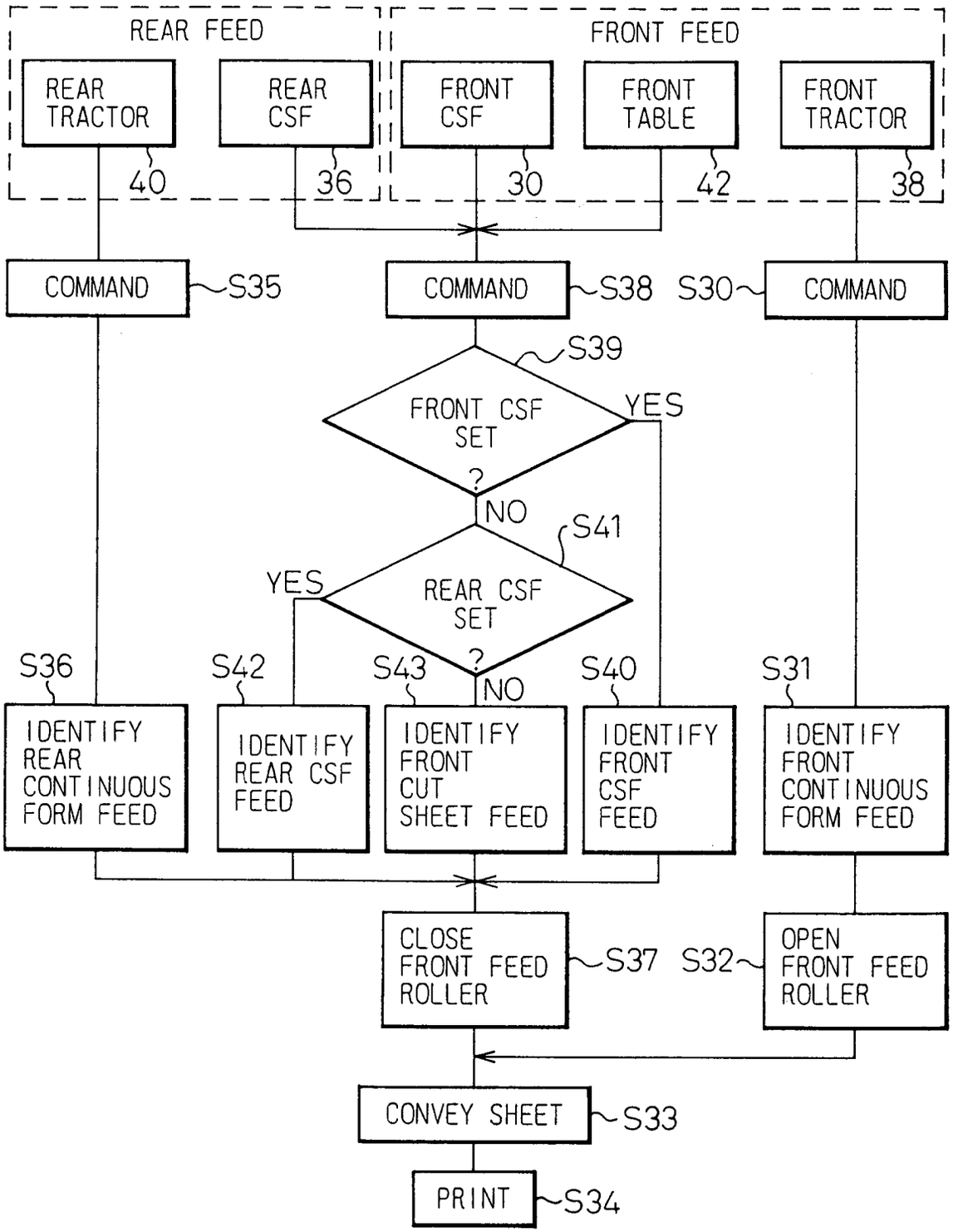
REAR FEED
FRONT FEED
REAR TRACTOR
REAR CSF
FRONT CSF
FRONT TABLE
FRONT TRACTOR
40
36
30
42
38
COMMAND
S35
COMMAND
S38
S30
COMMAND
S39
FRONT CSF SET ?
YES
NO
S41
REAR CSF SET ?
YES
NO
S36
S42
S43
S40
S31
IDENTIFY REAR CONTINUOUS FORM FEED
IDENTIFY REAR CSF FEED
IDENTIFY FRONT CUT SHEET FEED
IDENTIFY FRONT CSF FEED
IDENTIFY FRONT CONTINUOUS FORM FEED
CLOSE FRONT FEED ROLLER
S37
S32
OPEN FRONT FEED ROLLER
CONVEY SHEET
S33
PRINT
S34

Fig.43

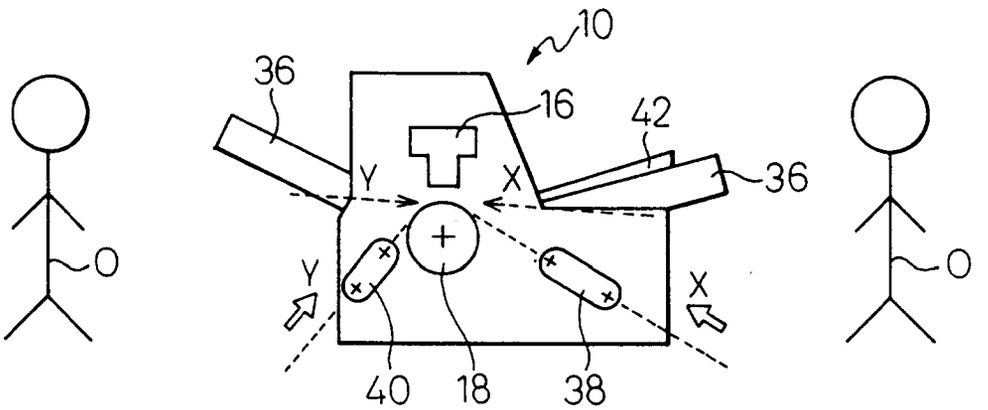

Fig.44