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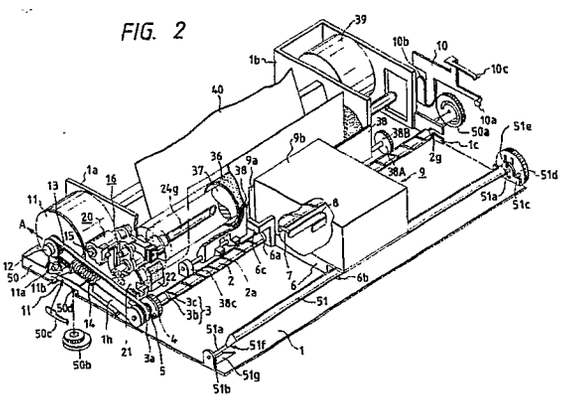
(54) Capping mechanism for an ink jet printer.

(57) A suction recovery device of ink jet recording apparatus comprises a cap which can contact with or separate from a face formed with discharge ports for recording by discharging the ink, said cap communicating to a suction system for performing the suction recovery through said discharge ports via said cap, said cap having a groove portion for guiding ink, and formed of an elastic material integrally with an ink communication member for communicating to said suction system via a suction port provided on an inner wall of said cap, and said suction system having a cylinder and a piston reciprocating within said cylinder, and having disposed ink absorbing member in an ink exhaust portion within said cylinder.

FIG. 2



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BACKGROUND OF THE INVENITON

Field of the Invention

The present invention relates to an ink jet recording apparatus, and more particularly to an ink jet recording apparatus having a suction recovery device.

Related Background Art

Conventionally, the recording apparatus for recording onto a recording medium such as a paper or OHP sheet (thereafter referred to as a recording sheet or simply as a paper) has been proposed in the form in which the recording head is mounted in accordance with any of various recording methods. The recording head is one in accordance with any of wire-dot, thermal, thermal imprint and ink jet recording methods.

Particularly, the ink jet recording method is one in which the ink is directly discharged onto a recording sheet, and has been noted by virtue of its inexpensive running cost and quiet recording method.

In a recording apparatus with such ink jet recording method, when some air bubbles or dusts have entered inwardly into discharge ports, or thickened ink inappropriate for discharging or recording has occurred owing to the evaporation of ink solvent, the processing (suction recovery processing) for removing improper discharge factors must be performed by refreshing the ink with the suction recovery device because the recording head has generality fine discharge ports arranged.

One form of such suction recovery means is provided with a cap for covering a discharge port formation face of recording head and a pump for exerting the suction force to the cap in communication therewith. Removal of improper discharge factors is accomplished in such a way of discharging ink by driving energy generation elements for discharging ink which are located inwardly of discharge ports, with the cap being opposed to the discharge port formation face, or forcedly discharging ink by suction through the discharge ports with the exertion of suction force, with the discharge port formation face being covered by the cap.

The present invention is to find out and resolve new technical problems in the aforementioned suction recovery device.

In order to perform the suction recovery processing smoothly, received ink within cap must be sucked smoothly into the waste ink tank. In this case, such a situation must not arise that received ink within cap remains without being sucked, or sucked ink leaks out of the equalizing mechanism for providing a stable contact between cap and discharge port face.

However, if the cap constitution is inadequate, received ink can not be exhausted completely from the cap, but may remain therein. That is, whereas such an exhaust processing is performed in such a manner that the cap is separated away from the recording head, and received ink is sucked through the suction port with the cap inner space opening to the atmosphere, if received ink is not adequately guided into the suction port, the air is only sucked recklessly.

Residual ink within the cap is apparently undesirable because it may leak out into the interior of apparatus for some reason, or stiffen within the cap to degrade the performance of cap remarkably.

Also, the equalizing mechanism had following problems. A constitution in which the cap member made of at least an elastic body is contacted with or directly supported by the support member was used excellently during early service period, because an ink exhaust passge of elastic cap member and an ink guide passage of support member are communicated each other. However, in a process for confirming the product reliability, observation of product condition indicated that a slight amount of ink leakage had occurred in the contact area as above described. This occurred even though sufficient measures had been considered in the design stage. The inventors found a following problem in pursuing that cause. That is, with a constitution in which the cap member is supported and equalized for the discharge port formation face of recording head so that a contact portion of the cap member is brought into stable contact with the discharge port formation face without gap, the face accuracy of cap with the discharge port formation face was sometimes decrease so that contact could be made rather unstably.

SUMMARY OF THE INVENTION

An object of the present invention is, in view of aforementioned conventional technical problems, to resolve those problems, and thus to provide a reliable ink jet recording apparatus with a suction recovery device for sucking waste ink smoothly.

A further object of the present invention is to provide a suction recovery device and an ink jet recording apparatus with said device, having support means for supporting a cap member which can provide securely both the cap face accuracy and the equalization ability for a discharge port formation face.

A further object of the present invention is to provide a suction recovery device and an ink jet recording apparatus with said device in which a cap member is adequately constructed so that received ink may not remain within cap.

Another object of the present invention is to provide a suction recovery device and an ink jet recording apparatus with said device in which in will not remain within a cap in whatever attitude the cap or apparatus is used.

Another object of the present invention is to provide a suction recovery device and an ink jet recording apparatus with said device in which waste ink produced during the recovery operation or received within suction recovery device in said operation can be surely introduced into a waste ink tank.

Another object of the present invention is to provide a suction recovery device and an ink jet recording apparatus with said device having a cap constitution in which ink within cap can be all removed surely after the suction recovery operation, and contamination on discharge port face due to residual ink or dusts such as paper dust accumulated within cap can be eliminated.

Another object of the present invention is to provide an ink jet recording apparatus comprising a cap which can contact with/separate from a face formed with discharge ports of recording head having discharge ports for recording by discharging the ink, and a suction system for performing the suction processing through said discharge ports via said cap, wherein an ink communication member for communicating to said suction system of said cap is formed of an elastic member integrally therewith.

Another object of the present invnetion is to provide an ink jet recording apparatus comprising a cap which can contact with/separate from a face formed with discharge ports of recording head having discharge ports for recording by discharging the ink, and a suction system for performing the suction processing through said discharge ports via said cap, wherein said cap has a channel portion for guiding ink associated with a suction port provided on its inner wall face to perform said suction.

Another object of the present invention is to provide an ink jet recording apparatus comprising a suction pump capable of making the ink discharge condition more excellent by sucking the ink through discharge ports of recording head for recording by discharging ink through said discharge ports, wherein said suction pump has a cylinder and a piston reciprocating within said cylinder, and having disposed absorbing member on an ink exhaust portion within said cylinder.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an external perspective view showing one example of an ink jet recording apparatus according to the present invention.

Fig. 2 is a perspective view showing a main portion of the apparatus as shown in Fig. 1, with a cover removed.

Fig. 3A is a perspective view mainly showing a paper exhaust system of the apparatus as shown in Fig. 1.

Fig. 3B is a side view of the apparatus as shown in Fig. 3A.

Figs. 4A and 4B are side views showing one example of a recording head corresponding to recording sheets, respectively.

Figs. 5A and 5B are rear views showing one example of a recording head at a home position in correspondence with recording sheets, respectively.

Fig. 6 is a partly broken perspective view showing one example of the engagement state of a base having mounted a recovery mechanism with a chassis.

Figs. 7A-7C are partial perspective views showing one example of a blade and an ink carrier unit for recording head.

Figs. 8A and 8B are an exploded perspective view showing one example of a recovery system for recording head and a cross-sectional view of a cap unit and its peripheral portion, respectively.

Figs. 8C and 8D are an upper view and a side view showing the equalizing state of cap, respectively.

Fig. 9 is a cross-sectional view of a suction pump and its peripheral portion in a suction circuit system according to the present invention.

Fig. 10 is a timing chart showing the operation timing of each portion according to the present invention.

Fig. 11 is a perspective view showing one example of a clutch mechanism for transmitting the driving force to recovery system.

Figs. 12A-12C are side views showing the engagement state of a clutch gear and a hook with a timing gear in the clutch mechanism as shown in Fig. 11.

Figs. 13A and 13B are front views similar to Fig. 12.

Figs. 14A-14D are side views for explaining sequential operations of a blade and an ink carrier unit.

Figs. 15A-15C are side views for explaining sequential operations of a cap unit.

Figs. 16A and 16B are side cross-sectional views for explaining the operation of a pump for performing the suction recovery.

Fig. 17 is a timing chart for explaining the sequence during predischarge and suction recovery according to the present invention.

Figs. 18A and 18B are side views showing one example of a pressing mechanism for paper presser plate.

Fig. 19 is a perspective view shoing one exam-

ple of a supporting state for spur in a paper exhaust system.

Fig. 20 is a front view showing one example of a paper exhaust roller.

Fig. 21 is a perspective view showing another embodiment of the service condition for the apparatus according to the example of the present invention.

Fig. 22 is a side cross-sectional view of the state as shown in Fig. 21.

Fig. 23A and 23B are a cross-sectional view and a perspective view showing one example of constitution for grounding a paper feed roller.

Figs. 24A and 24B are perspective views for explaining the ink residual state taking place in a cap according to a conventional constitution.

Fig. 24C is an explanation view for the effects in using a cap according to an example of the present invention.

Fig. 25 is a typical longitudinal cross-sectional view showing one example of another conventional head cap.

Fig. 26 is a typical longitudinal cross-sectional view showing a further constitutional example of conventional head cap.

Fig. 27 is a typical perspective view showing one example of a head cap according to the present invention.

Fig. 28 is a longitudinal cross-sectional view as shown in Fig. 27.

Fig. 29 is a typical longitudinal cross-sectional view showing an ink exhaust state within a head cap as shown in Fig. 27.

Fig. 30 is a typical longitudinal cross-sectional view corresponding to Fig. 29 when the ink is discharged downward with the attitude of apparatus changed.

Fig. 31 is a typical perspective view showing another example of a head cap according to the present invention.

Figs. 32A-32C are cross-sectional views showing other three examples of a pump in a suction circuit system.

Fig. 33 is a typical perspective view showing another example of an ink jet recording apparatus according to the present invention.

Fig. 34 is an external perspective view showing a vertical service condition of the ink jet recording as shown in Fig. 25.

Fig. 35 is an external perspective view showing a horizontal service condition of the ink jet recording apparatus as shown in Fig. 34.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An example of the present invention will be described in detail with reference to the drawings.

Fig. 1 is an external perspective view of an ink jet recording apparatus in accordance with one example of the present invention, Fig. 2 is a perspective view of the main portion of apparatus as shown in Fig. 1, with a case removed, and Figs. 3A and 3B are views mainly showing a paper exhaust system of apparatus as shown in Fig. 1.

In Fig. 1, 100 is an ink jet recording apparatus, in which the apparatus 100 is placed as shown in the same figure, or vertically placed as will be described later, during use, and is of a comparatively small size.

101 is an apparatus housing, 102 is an outer cover, and 103 is an inner cover; when not used, the outer cover 102 is overlapped on the inner cover 103 so that the apparatus 100 is made compact. Thereby, an user can transport the recording apparatus, for example, by containing it in a special bag.

The outer cover 102 can be also used as a paper feed guide for a recording sheet 40 as shown in the figure, in which 106 as indicated in the figure becomes a paper feed opening. Further, the outer cover 102 is also used as a paper exhaust tray as will be described later.

In either of the above cases, 107 as indicated in the figure becomes a paper exhaust opening.

105 is a position fixing hook for upper cover 102, and 104 is the operation key and display section.

Next, the constitution of essential parts for the apparatus will be described with reference to Fig. 2.

In Fig. 2, 1 is a chassis, backward of which are stood a left-hand plate 1a and a right-hand plate 1b which also serve as the guide for a recording medium such as a paper. The chassis 1 is provided with a motor mounting hole for rotatably supporting a carrier motor as will be described, but not shown.

1h is a lead arm for rotatably supporting a lead screw as will be described in the axial and radial directions, and supported in a bearing portion (not shown).

2 is the lead screw which is formed with a lead groove 2a at a predetermined pitch, corresponding to a range of recording. On a carrier home position side of the lead screw 2A, a position groove 3b for setting the position of capping and discharge recovery is formed around the periphery of cross section perpendicular to a screw axis. The lead groove 2a and the position groove 3b are smoothly continued via an introduction groove 3c.

A shank 2g is provided on a right end portion of the lead screw 2, and a shank is also provided on its left end portion, in which the shanks are fitted into bearing portions provided on a front side plate 1c and the lead arm 1b, respectively, and

rotatably supported therein. 3 is a lead pulley provided on the shaft of lead screw 2 and including the grooves 3b, 3c as above described, on an end portion of which is provided a pulley 3a. And the driving force is transmitted to the pulley 3a via a timing belt 13 from motor 11.

The shank 2g on right end portion of lead screw 2 engages slidably into a lateral slot of guide plate 1c connecting with a right side plate 1b of chassis and the chassis 1, and biased in a thrust direction by a presser portion 10a of leaf spring 10, and further engages into a cam groove of cam groove plate 50a rotatably supported in an axle provided on the guide plate 1c. Around the periphery of cam groove plate 50a, mating teeth are formed, in which its engagement with a ratchet pawl 10c of leaf spring 10 allows the cam groove plate 50a to be stopped at a predetermined position. As a result, the shank 2g engaging into the cam groove has its position fixed with respect to the lateral slot of guide plate 1c, and therefore, the position on the right end portion of the apparatus. This construction is used for the adjustment of recording head and platen as will be described later.

4 is a clutch gear supported slidably in the axial direction to the lead pulley 3, and engaged by a key provided on the lead pulley 3, as will be described, in the rotational direction, so as to transmit the rotation force of lead screw 2. 5 is a clutch spring, which is a compression spring urging the clutch gear 4 in the direction of lead groove. Note that member for restraining the clutch gear 4 within a predetermined range in the axial direction is formed between the clutch gear 4 and the lead pulley 3.

6 is a carrier slidingly mounted on the lead screw 2. 6a is a presser portion for pressing an end face of the clutch gear 4 and formed integrally on a left side of carrier. 7 is a lead pin engaging the lead groove 2a of lead screw 2 and guided in a guide hole (not shown) of carrier 6 with respect to the direction of pressing. 8 is a lead pin spring with its one end attached to the carrier 6, and the other end pressing on the lead pin 7.

9 is a recording head mounted on the carrier 6, in this example, in the form of a cartridge type made detachable by integrating a head element 9a for discharging ink and an ink tank 9b which is an ink supply source, i.e., a disposable type which is exchangeable when ink is used up. As discharge energy generation elements for acting the discharge energy onto the ink disposed in the head element 9a, electricity-heat or electromechanical converters are used, and preferably, the former is used because higher density packaging is possible and manufacturing process is simple.

6c is a hook secured to one portion of carrier 6 and used to stop stably in place such as a capping position of recording head 9 during the movement of carrier 6, as will be described later.

51 is a carrier guide shaft slidably engaged by a guide pin 6b provided on a rear end portion of carrier 6. The guide shaft 51 has an eccentric shaft 51a, as will be described later, which is rotatably carried by side plates 51b, 51c provided on end portions of chassis 1. Further, the end portion of shaft 51a carried by side plate 51c is fixed to a positioning knob 51d, and the engagement of projection on the knob 51d into a hole 51e on side plate 51c permits the rotation position.

As shown in Figs. 4A and 4B, the above constitution is intended to make appropriate the clearance between a recording plane of recording sheet 40 and discharge ports of head element 9a. That is, by rotating the knob 51d manually, the shaft 51 can be fixed to a position where the distance between the shaft 51a and the pin 6b is minimum, as shown in Fig. 4A, or a position where that distance is maximum, as shown in Fig. 4B. Correspondingly, the recording head 9 is rotated around a rotation axis of lead screw 2, and fixed to a position (Fig. 4A) corresponding to plain paper in which recording sheet 40 is comparatively thin, or a position (Fig. 4B) spaced in large clearance corresponding to comparatively thick recording sheet such as an envelope.

However, the above constitution is one corresponding to recording sheet during recording. That is, in the suction recovery processing, the recording head 9 is moved to a position for recovery processing as shown to the left in Fig. 2. At this time, the recording head 9 and the recovery system must be always placed in a predetermined positional relation. Accordingly, during the suction recovery processing, the recovery head 9 is required to take a predetermined position, irrespective of the position as shown in Fig. 4A or 4B. Such a constitution is shown in Figs. 5A and 5B.

Figs. 5A and 5B show views corresponding to those of Figs. 4A and 4B, respectively.

In Fig. 5A, the shaft 51a and the pin 6b are engageable without changing the height of engagement position of the shaft 51 with the pin 6b. At this time, in order to maintain the height of its engagement position, a parallel plane of trapezoidal cam 51g is caused to engage the pin 6b.

In Fig. 5B, when the recording head 9 moves and the pin 6b engages the shaft 51a, the height of engagement position of the pin 6b changes. Therefore, the shaft 51 is provided with a taper portion 51f, and correspondingly, the trapezoidal cam 51g is provided with a taper surface. Thereby, the height of engagement position of the pin 6b with the shaft 51 (taper portion 51f, shaft 51a) is changed, and then maintained.

With the above constitution, when the recording head 9 reaches the position of suction recovery system, a predetermined height, accordingly, a predetermined position relation with the recovery system can be always maintained.

Note that the rotation fixed position of recording head 9 is not limited to two positions as above mentioned, but may take fixed intermediate position to cope with recording sheet of various thicknesses. In this case, engageable positions between the projection of knob 51d and the hole 51e of side plate 51c are needed to increase.

The rotation of knob 51d is not limited to manual operation, but the knob 51d may be rotated using the driving force of a paper feed motor or the like, in accordance with the key input corresponding to recording sheet for use, for example.

Referring to Fig. 2 again, 11 is a carrier motor consisting of a pulse motor, for example, on front and rear faces of which rotation pins 11a (that on rear side is not shown) are provided in lower portions in alignment therewith, and fitted for free rotation into motor mounting holes provided on a recovery system base 50 movable on the chassis 1. It is of course sufficient that the rotation pins are provided on the recovery system base 50 and the mounting holes are provided on the motor. And the carrier motor 11 is mounted for rotation around the rotation pins 11a. 11b is a spring shoe formed integrally with the carrier motor 11, and stood parallel to motor shaft for receiving a motor spring as will be described later. And the spring shoe is formed with a cylindrical projection to which an end portion of coiled motor spring 14 is fixed.

12 is a motor pulley secured on the motor shaft of carrier motor 11. 13 is a timing belt 13 extended under tension between the motor pulley 12 and the lead pulley 3a provided on the shaft of lead screw 2. The motor spring 14 is a compression spring in the constitution of this example, which is attached between one end of lead arm 1h and the spring shoe 11b of carrier motor 11, thereby urging the carrier motor 11 in the direction of arrow A as indicated in the figure, and giving a tensile force to the timing belt 13.

15 is a set shaft to which means for cleaning discharge port face stood on a side plate, not shown, fixed to the base 50, the cap and a so-called recovery mechanism involved in the suction recovery are mounted.

By the way, as previously described, the positional relation between the recovery mechanism and the recovery head 9 is important. For example, in order to exhibit excellently the feature of blade wiping over the discharge port face of recording head 9, the positional relation, the positional relation with respect to the discharge port face is important, and the spacing between the cap and the discharge port face is important to make excellent the capping function of discharge port face. Accordingly, the positional relation between the recovery mechanism and the recording head 9 is desirably maintained constant at all times.

On the other hand, the recording head 9 performs the recording while moving along the lead screw 2 by transmitting its driving force via the lead screw 2. At this time, it is clear that the distance between recording sheet 40 and the discharge ports of recording head 9 is desirably equal in any position of movement. Accordingly, an adjustment mechanism for adjusting the distance of the recording head 9 to recording sheet can be provided to let the recording head to move parallel to recording sheet, but this adjustment may destroy a certain positional relation with respect to the recovery system as above described.

Thus, in this example, the recovery system base 50 on which the carrier motor 11 and recovery mechanism as will be described are provided is made movable with respect to the chassis 1. The position of lead screw 2 can be adjusted on both end portions using the movement of the base 50 and the adjustment of cam groove plate 50a as previously described, so that the recording head 9 can move parallel to recording sheet 40. The detail of mechanism in the base 50 for such purpose is shown in Fig. 6.

Fig. 6 is a perspective view, partially broken away, of recovery system base 50 looked from the direction opposite to that of Fig. 2.

In the figure, 50e is a guide groove member fixed to a side face of groove provided on a back side of the base 50, wherein the engagement of a groove of the member 50e with a guide portion of hook-type guide member 1k can restrain the moving direction of the base 50, and prevent the lifting of base 50 from the chassis 1.

In the above mechanism, by rotating a cam plate 50b around an axis 50d attached to the base 50, its cam face is contacted with either of faces of cam groove 11 in the chassis 1, and pressed thereto, as shown in detail in Fig. 2. Then, the base 50 moves in a direction guided by the member 50e and member 1k due to a reaction against the pressing force.

Note that the above cam can be constituted such that the cam plate is rotated around a predetermined shaft by operating the shaft engageable with a predetermined cam groove formed on the cam plate.

Along with this movement, the carrier motor 11 and the driving system for driving the motor 11, i.e., timing belt 13, pulley 3, 12, lead screw 2, and the recovery mechanism mounted on the base 50 move so as to adjust the one end position of lead screw 2.

On the other hand, the position adjustment for other end of lead screw 2 is performed by rotating the cam groove plate 50a.

With the above adjustment, the lead screw 2 can be made parallel to recording sheet, and accordingly, the recording head can move parallel to recording sheet.

Note that this adjustment is carried out by assembler robot in a manufacturing process for recording apparatus, whereas this adjustment can be made in the user side, for example, in the repair after long-term service of apparatus.

Next, means for making excellent the discharge port formation face which is one of the recovery mechanisms will be described with reference to Fig. 2 and Figs. 7A-7C.

16 is a blade lever (see Fig. 7A), a boss portion 16a of which is rotatably mounted on a set shaft 15. 16b is an arm portion and 16c is a hook portion. 17 is a blade for wiping over the discharge port formation face, and formed of an elastic member such as silicone rubber or chloroprene (CR) rubber. 18 is a blade shaft for clamping the blade 17 on central portion parallel to the rotation axis, and rotatably attached to the blade lever 16. 18a is a rotation tab integrally formed with the blade shaft 18. 19 is an ink carrier formed of hydrophilic porous material (plastic sintered body, urethane foams) and secured to the blade lever 16. Note that the blade 17 and the ink carrier 19 are disposed at places where they are overlapped by cap as will be described later.

20 is a set lever rotatably mounted on the set shaft 15. 20a, 20b are stop teeth provided on the set lever 20, 20c is a start tooth, and 20d is a rotation tooth, the tooth thickness of start tooth 20c being about one half that of other teeth. 20e is an arm portion, including a set plane 20f and a reset plane 20g formed by cutting away its part in a direction of plate thickness, to which the rotation tab 18a of the blade shaft 18 mounted on the blade lever 16 is fitted for the driving.

21 is a timing gear rotatably mounted on the base 50 by a support member, not shown.

The timing gear 21 is formed with a stop cam 21a for engaging the stop teeth 20a, 20b of set lever 20 on a part of its external periphery, as shown in Fig. 7B. Also, three types of driving teeth $21b_1$, $21b_2$, $21b_3$, partially omitted, are formed, and further, a cap cam 21c for swinging cap lever as will be described later is formed. In addition, a piston set cam 21f for pressing a piston of pump as will be described later is formed as a face cam, and a piston reset cam 21g is integrally formed corresponding to the piston set cam 21f and spaced by a predetermined distance.

22 is an ink absorbing spring fixed to a predetermined position of base 50, and having an absorbing member holding portion 22a and a spring portion 22b for rotating the pump as will be described later, as shown in Fig. 7C. 23 is an ink absorbing member formed of a hydrophilic porous material like the ink carrier 19 as previously described. The ink absorbing member 23 is formed with a wipe-over portion 23a with which the blade 17 as previously described is brought into contact, and an absorbing face 23b contacted by the ink carrier 19 to pass and receive ink in a lower portion thereof. Note that the absorbing member holding portion of ink absorbing member spring 22 is urged upward with a slight elasticity, and stopped at a predetermined position by a stopper, not shown. Therefore, when the ink carrier 19 as previously mentioned is contacted, the ink absorbing member 23 is displaced downward by the flexing of ink absorbing member spring 22 so as to secure the contact state.

Next, a recovery unit, which is one of the recovery mechanisms, will be described mainly with reference to Figs. 8 and 9.

In Figs. 8A, 8B and 9, 24 is a cylinder having a cylindrical cylinder section 24a, a piston absorbing member 241 as will described later, and a cylinder flow passage 24b for carrying a flow passage absorbing member 242, wherein a portion into which the flow passage absorbing member 242 as will be described is fitted has partially formed a projection 24c extending in the axial direction so as to provide a void in the axial direction between an external periphery of flow passage absorbing member and a bore of cylinder flow passage. 24d is a cap lever carrier formed to be fitted thereinto by a lever seal, as will be described. 24e is an ink flow passage which opens at a predetermined position within the cylinder 24a. 24f is a rotation lever formed integrally with the cylinder 24, and having the rotation force applied by a spring portion 22b of ink absorbing member spring 22 as previously described. Note that an extension spring may be also used to apply the rotation force.

241 is an absorbing member provided on an ink exhaust portion within the cylinder on the right hand of piston as shown in Fig. 9, wherein it is formed of a hydrophilic porous material (sintered compact from fine grains of polyolefine, or urethane foams) and fitted into the cylinder flow passage 24b of cylinder 24 as previously described. This piston absorbing member 241 may be secured to the cylinder 24, or conversely, fitted loosely with a play. The piston absorbing member 241 is formed with a substantially conical opening portion 241a slightly larger than an edge contour of piston shaft as will be described, a support portion 241b fitted into the cylinder flow passage 24b as previously described, and an air bleed 241c.

242 is a flow passage absorbing member fitted

into the cylinder flow passage 24b as previously described, wherein the total length is set so that its one end is in contact with an end face of piston absorbing member 241, and the other end projects by a slight amount from an edge of the cylinder 24 to come into contact with a waste ink absorbing member as will be described. The flow passage absorbing member 242 is formed of a porous material containing communication pores with the elasticity such as melamine or urethane foam.

25 is a cylinder cap secured to an end portion of cylinder 24 with a press fitting or adhesive. 25a is a lever guide disposed at a position opposed to the cap lever carrier 24d of cylinder 24 as previously described. 26 is a piston seal fitted into cylinder 241, wherein its inner diameter is made slightly smaller to obtain a predetermined pressure welding force with the piston shaft as will be described. Also, lubrication coating may be applied on its surface to reduce the sliding force of piston shaft 27.

27 is piston shaft, which is formed with an operation shaft 27a, a piston presser 27b, a piston carrier 27c, a connecting shaft 27d, and a channel 27f serving as an ink flow passage along the connecting shaft 27d. 27g is a rotation stop formed as a groove in the operation shaft 27a. And a bearing portion 27h is provided on an end face of operation shaft 27a.

28 is piston, formed in a cylindrical shape and larger by a predetermined amount than an inner diameter of the cylinder 24, using a rubber such as NBR or CR, wherein it is adequately compressed when inserted into the cylinder 24. A surface where an external circumferential surface and a piston presser 27b for piston shaft 27 are in contact is desirably made smooth, but may be provided with one or more ribs to secure the sealing property. The total length of piston 28 is formed shorter by a predetermined amount than the connecting shaft 27d of piston shaft 27, so as to yield a slight amount of play in the axial direction.

42 is a pump chamber. 29 is a piston presser roller rotatably mounted on an end portion of piston shaft 27. 30 is a piston return roller, which is also rotatably mounted on the end portion of the piston shaft 27.

32 is a cap lever formed with a rotation shaft 32a, an ink guide 32b and a lever guide 32c. And on its top portion, a cylindrical portion 32d inserted into a tube portion of cap as will be described is provided, with an hole for ink flow passage formed centrally therein, and a convex spherical guide face 32e which is brought into contact with a spherical recess of cap holder as will be described is formed on its front face. Further, on its side face, a partially cylindrical horizontal stop face 32f and a vertical stop face 32g which is substantially semicircular step portion are provided in a pair with opposed side face.

The ink flow passage 32f is formed to pass from the cylindrical portion 32d as previously described through the inside of the lever 32, bent at right angles midway, passing through a center of the ink guide 32b, and open to its end face.

33 is a lever seal into which the ink guide 32b is fitted and which is fitted under pressure into the cap lever carrier 24d. 33a is a communication aperture which communicates a notch 32i of the ink guide 32b with an ink flow passage 24e.

34 is a cap holder provided with a hook 34a engageable with the horizontal stop face 32f and the vertical stop face 32g of cap lever 32 on opposed positions. Also, a holder guide portion 34b having a spherical recess to make contact with the guide face 32e of cap lever 32 is formed. 34c is an opening portion for mounting cap as will be described.

35 is a cap on the lower portion of which is provided a seal face 35a, a slit-shaped channel 35b (thereafter called as a slit) for collecting residual ink within the cap, and a suction port 35c for sucking, and on its back portion is formed a tube portion 35d having internal ink passage. Note that in this example, the slit 35b is provided substantially over the entire length of area in the upward and downward directions on a central portion in inner wall of cap, and the suction port 35c is formed elliptically in the same width as the slit width. On the inner wall face provided with the slit, a taper face is formed in a portion ranging from a boundary with a side wall portion where the seal face 35a is provided to the slit 35b. However, as long as received ink can be collected well, any number of slits or any shape can be taken. For example, the slit may be formed radially from the suction port. Also, the suction port does not need reside within the slit.

35e is a flange portion which serves as a stop member when attached to the cap holder 34. The tube portion 35d is inserted into the cylindrical portion 32d of cap lever 32 as previously described. Note that if the cap 35 housed in the cap holder 34 is attached to the cap lever 32, it is communicated to the ink flow passage 32h of cap lever 32 via the tube portion 35d, wherein the cap holder 34 serves as an equalizer through the holder guide portion 34b, and the hook portion 34a engages the vertical engagement face 32g of cap lever 32 to serve as a stop. Note that when the cap equalizes the head discharge port formation face, the equalization can be performed smoothly with the deformation of tube portion 35d or the relative movement of the cap lever 32 with respect to the cylindrical portion 32d.

Figs. 8C and 8D are views showing the equalization from the above and the side of cap 35.

Note that in this example, the tube portion 35d which is an ink communication portion of cap has the elasticity, while the cylindrical portion 32d which is an ink communicating portion of cap lever is formed of a material considered as the rigid body compared with the elasticity of the tube portion 35d. Accordingly, the holding accuracy of cap 35 against the head discharge port formation face, i.e., the face accuracy of cap 35 against the head discharge port formation face can be secured by the cylindrical portion 32 of cap lever, and the equalization of cap 35 against the head discharge port formation face during the capping is permitted by the deformation of the tube portion 35d.

On the contrary, when the communication portion of both the cap and cap lever is made of an elastic member, it is necessary to take into consideration the elasticity of the communication portion to satisfy sufficiently both the holding property and equalization, so that the selection of material is inconveniently limited on the design. On the other hand, when the cap communication portion is made of a rigid body, and the cap lever communication portion is made of an elastic material, the cap communication portion and the cap body are separate members, so that it is inconvenient to manufacture the cap as it is constructed by coupling them, and a problem may arise in respect of the holding accuracy as the lever communication portion for holding the cap and exerting the capping force on the cap has the elasticity.

Further, in this example, the holding accuracy and equalization are made more excellent in connection with the constitution of cap holder 34 and cap lever 32. This is because with a spherical recess of holder guide portion 34b and a convex spherical guide face 32e of lever 32 being in contact, when the cap 35 comes into contact with the discharge port formation face, the holder 34 and the cap 35 are displaced along a sphere, and the hook portion 34a of holder 34 and vertical and horizontal stop faces 32g, 32f of lever 32 permits the displacement along the sphere as above mentioned, while serving as stops. When the stopper feature is only given to the mounting portion holder lever, it is apprehended that the face accuracy of cap on the discharge port face becomes improper owing to the dimension precision or aging of the mounting portion (especially, further worse when the lubricant is applied to the above-mentioned spherical contact face in view of the equalization), and the equalization becomes incomplete, but in this example, such an disadvantage will not occur.

Referring now to Fig. 2 again, 36 is a paper feed roller for conveying a recording medium such as a paper, which is formed by applying an elastic coating (e.g., urethane or acrylic resin) on a surface of aluminum drawn tube, for example. Also, this roller 36 has its interior as a reservoir of waste ink, as well as serving as the platen for restraining the record surface of recording medium on its external face. 37 is a waste ink absorbing member provided within the roller 36, which is made by filling an absorbing material of polyester cotton or the like into a thin tube formed of a plastic such as vinyl chloride so as to have better ink absorbency in the axial direction. Note that waste ink tube 24g of the cylinder 24 is inserted into the waste ink absorbing member 37 and fixed therein, because the movement of base 50 causes the recovery mechanism to move. The fiber itself of absorbing material is preferably a liquid non-absorbing material such as a resin or metal, but may be slightly absorbent for liquid.

Here, while the paper feed roller 36 is charged with the static electricity generated by the friction with paper, to prevent the discharge from breaking circuit devices, a method of grounding the paper feed roller 36 (thereafter referred to as a PF roller) via a chassis (made of metal) of printer will be described with reference to Figs. 23A and 23B.

In Figs. 23A and 23B, 361 is a PF roller cap with a gear 361a and a shaft 361b integrally formed of a plastic material, fitted under pressure into the PF roller 36 made of aluminum, and secured therein by means of a caulking or adhesive. 361c is stopper, wherein more than one stopper are provided on inner periphery so that waste ink absorbing member 37 will not move from a predetermined position to the PF roller cap 361, and formed integrally with the PF roller cap 361.

Moreover, the PF roller cap 361 is formed with two bores 361d for mounting a PF roller ground member (PF roller earth) as will be described, on an intermediate portion of which a projecting portion 361e is formed by projecting a predetermined amount from an end portion of shaft 361b. 361f is a hole for opening to the atmosphere to promote the evaporation from the waste ink absorbing member 37. 362 is a PF roller earth formed of a metallic wire with the elasticity such as SUS, with its U-shape portion 362a inserted into the hole 361d of PF roller cap 361 as above described, in which a predetermined flexed portion is provided midway so that its tip portion comes into contact with an inner face of PF roller 36 at a predetermined pressure.

Note that the projection portion 361e of PF roller cap 361 is provided to fix the PF roller earth 362 at a projecting position so that a thrust pressing portion 10b of leaf spring 10 as previously described and the PF roller earth 362 are easily placed into contact.

38 is a paper presser plate made of a fluorocarbon resin or carbon fiber blended material, and mounted on the chassis 1 by being divided

into four sections, as detailed in Fig. 3. A gear 38B is fixed at one end of shaft 38A for releasing the pressing force of paper pressing plate 38, its other end engaging a bearing 38C for supporting the shaft 38A therein. The bearing 38C is fixed to the chassis 1. Note that the gear 38B is mated with a gear portion of release lever, not shown. 39 is a paper feed motor connecting to the paper feed roller 36 via reduction gear with a predetermined gear ratio.

40m is a recording sheet such as a paper or film.

Next, the operation in connection with the above constitution will be described.

First, in normal recording operation, as the rotation of shaft of carrier motor 11 causes the lead screw 2 to be rotated via the timing belt 13, the carrier 6 is moved for the scan in the printing direction along the recording sheet 40 with the lead pin 7 engaging the lead groove 2a. Here, as the carrier motor 11 is urged by the motor spring 14, the timing belt 13 is tensioned at all times to enable the suitable transmission.

In moving the carrier 6, though inertial force is exerted at the starting or stopping, the load applied on the motor spring 14 may be smaller because the weight of carrier motor 11 absorbs that inertial force, and thereby the load for motor rotation may be also smaller. If an air or hydraulic damper is provided in connection with this spring, noise owing to the vibration of rotor of motor 11 in starting or stopping the carrier 6 can be reduced. The overshoot of rotor can be reduced by appropriately selecting the weights of motor and carrier, and the damping coefficient of motor spring, so that the noise can be lowered.

Next, the operation of apparatus of this example during non-recording will be described with reference to Figs. 10 - 16.

Fig. 10 is a timing chart showing the operation timing of each portion, wherein the operation timing of each portion can be determined, as shown, in accordance with the number of pulses.

Fig. 11 is a perspective view showing the detailed construction of clutch gear 4 and timing gear 21 as above described, in which the clutch gear 4 can slide on the lead screw 2, and rotate together with the key groove 4d engaging the key portion 2h of lead screw 2. Also, the clutch gear 4 is urged toward the carrier 6 by the spring 5, and normally, is placed at a predetermined position by a slot 2i of lead screw 2 and rotated together with the lead screw 2 during recording. When the recording head 9 is moved to a home position, the clutch gear 4 is pressed by the carrier 6 correspondingly, and begins to engage the timing gear 21.

The clutch gear 4 has a start tooth $4c_1$ and a normal driving tooth $4c_2$, which are formed at different positions in the direction of width of clutch gear. The driving gear $4c_2$ is not formed over the entire periphery of gear, but partially has a curved surface 4b. Further, on an edge portion of clutch gear 4, a collar 4a is formed over the entire periphery.

The timing gear 21 has a start tooth $21b_1$, and two driving teeth $21b_2$, $21b_3$ at different positions, the teeth $21b_1$, $21b_2$, $21b_3$ being formed at different positions in the direction of width.

Figs. 12A - 12C and Figs. 13A - 13B are views showing the engagement state between the clutch gear 4 and the timing gear 21.

During normal recording, the engagement state is as shown in Figs. 12A and 13A. However, in Fig. 13A, the lead pin 7 is not located at the position as shown, and the blade 17 and the ink carrier 19, not shown, are located on the upper portion of ink absorbing member 23.

At this time, the clutch gear 4 is rotated along with the rotation of lead screw 2, but is not located at a position where the start tooth $4c_1$ and the start tooth $21b_1$ are in engagement (see Fig. 13A). Thereby, the timing gear 21 is not rotated, and the driving tooth $21b_2$ at the left end of timing gear 21 and the collar 21h are in the positional relation of being spaced a slight clearance from the collar 4a of clutch gear 4 and able to come into contact therewith, the timing gear 21 can not be rotated in any of the directions.

Thereby, some rotational force or human power is exerted on the timing gear 21, it is not rotated inadvertently, so that errors at the operational position of the recovery mechanism can be prevented.

If the recording head 9 moves to the home position, and the carrier 6 presses the clutch gear 4, the positional relation between the clutch gear 4 and the timing gear 21 is finally as shown in Fig. 13B. In this process, the start teeth $4c_1$ and $21b_1$ are placed in engageable positional relation (however, the lead pin 7 has not been located at this position).

Next, when the lead pin 7 moves fro groove 3c to groove 3b, the clutch gear 4 is rotated clockwise in Fig. 12, in which the positional relation sequentially changes from the state of Fig. 12A to that of Fig. 12C. Then, as the curve portion 4b as non-tooth portion as shown in Fig. 11 is located in closest proximity to the timing gear 21 until the start teeth $4c_1$ and $21b_1$ are placed in engagement, the timing gear does not move inadvertently to cause other driving teeth to be first engaged with each other.

Thereby, the mating between the clutch gear 4 and the timing gear 21 is always started by that between respective start teeth, so that the rotation of timing gear 21 is always started at a correct position.

Consequently, the operation of recovery mechanism driven via the timing gear 21 is made correctly.

Also, some advantages can be obtained such that the attachment precision of clutch gear 4 and timing gear 21 are not necessary to be very high.

Note that the driving teeth $21b_3$ located differently among the driving teeth of timing gear 21 is one engageable when the above-mentioned curve portion 4b is confronted with the timing gear 21 again, as shown in Fig. 7B. That is, if the driving teeth is located at the same side as that for normal driving teeth $21b_2$, they may be brought into contact with the curve portion 4b, and thereby, that driving teeth are displaced for the engagement between respective driving teeth.

Also, while the timing gear is rotating with driving teeth in engagement, the hook 6c attached to the carrier 6 slides on the side face of timing gear 21.

Thereby, separation of the recording head 9 from the home position can be prevented, for example, by separating the lead pin 7 from the groove 3b before predetermined teeth are mated. This is because when the recording head 9 performs a series of recovery processings at the home position, the lead screw is rotated twice, and so the lead pin 7 may be moved to the groove 3c.

Note that in the previous example, a series of recovery processings are made by two revolutions of the lead screw, whereas they are not limited to such an operation, and any number of revolutions can be set, whereby the degree of freedom in designing the clutch mechanism can be decreased.

Figs. 14A - 14D are explanation views showing sequential operation states of mechanism associated with the blade 17, Figs. 15A - 15C are explanation views showing sequential operation states of mechanism associated with the cap 35, and Figs. 16A - 16B are explanation views showing the operation of mechanism for introducing waste ink into waste ink receiver 37 within the roller 36. With reference to those figures and Figs. 12 and 13 as above described, the operation will be described.

Firstly, the carrier 6 is moved in the direction to the home position (direction as indicated by an arrow B). At this time, as shown in Fig. 13A, the lead pin 7 still engages the lead groove 2a, with discharge ports 9c of head element 9a being opposed to the ink carrier 19 (see Fig. 14A). Here, the discharge operation (thereafter referred to as predischarge) is carried out by driving all the discharge energy generation elements of head element 9a at this position to remove some thickened ink with the discharge force, and thereby, the recovery operation with predischarge is terminated. Also, periodical predischarges performed during normal recording to prevent thickened ink around discharge ports not used are also carried out at this position. Note that Fig. 14A is a side view around the periphery of the same position.

Further, as shown in Fig. 13B, if the carrier 6 is moved in the direction of arrow B by rotating the lead screw 2, the clutch gear 4 is pressed by the presser portion 6a, and thus is moved in the same direction of arrow B, so that the start tooth $4c_1$ is positioned to be engageable with the start tooth $21b_1$ of timing gear 21. Then, the clutch gear 4 is rotated synchronously with the lead screw 2, the timing gear 21 is rotated in the direction of arrow D as shown in Figs. 14B with the engagement between respective start teeth. On the other hand, as the lead pin 7 enters through the lead-in groove 3c into the position groove 3b, the rotation of lead screw 2 does not cause the carrier 6 to move.

If the timing gear 21 is rotated in the direction of arrow D, the set lever 20 is rotated in the direction of arrow E, because its gear portion and the gear portion of set lever 20 are mated. By this time, as the hook portion 16c of blade lever 16 engages a click portion of chassis 1, the set lever 20 only is rotated and the blade lever 16 is stopped, and in a short time, the set face 20f of set lever 20 is rotated in the direction of arrow F while depressing the rotation tab 18a of blade shaft 18, so that the blade 17 is rotated in the direction of arrow G to be set in a state of being engageable with the discharge port face.

With a further rotation of timing gear 21 in the D direction, the hook portion 16c of blade lever 16 is disengaged from the click portion of chassis, and the set lever 20 and the blade lever 16 are further rotated to wipe over the discharge port face of head 9 with the wiper 17. At this time, ink liquid and others removed by the wiping of blade 17 are eliminated in only one direction, i.e., only downward in this case, whereby ink liquid and others eliminated are absorbed and carried in the upper portion of ink carrier 19. Then, the ink carrier 19 comes into contact with the ink absorbing member 23. With a further rotation of the set lever 20, as the ink carrier 19 and the blade 17 slide on a wipe-over face 23a of ink absorbing member 23, ink received into the ink carrier 19 at the predischarge, or dusts wiped from the discharge port face by the blade 17 are accepted by the wipe-over portion 23a, and ink droplets adhering to the discharge port face is also absorbed. Thereby, the ink absorption ability of ink carrier 19 can be retained for a long term.

If the timing gear 21 is further rotated in the direction of arrow D, the stop teeth 20a, 20b of set lever 20 and the stop cam 21a of timing gear 21 are made opposed and contact, so that the rotation of set lever 20 is restrained, and at the same time,

the driving gear of timing gear 21 becomes an omitted tooth portion, thereby not exerting the rotation force.

As above described, since the blade and the absorbing member for carrying ink liquid or others removed from the blade are made integrally with the ink receiver at the predischarge, the apparatus can be miniaturized, and the time necessary for the recovery operation can be shortened.

With a further rotation of the timing gear 21, the cap 35 is stopped at a position away from the discharge port face of head element 9a, as shown in Fig. 15A, because the cap cam 21c of timing gear 21 first restricts the rotation shaft 32a of cap lever 32c as shown in Fig. 8. Subsequently, with a further rotation of the timing gear 21 in the direction of arrow D, as the cap cam 21c is disengaged from the cap cam 21c, thereby releasing the restraint state, the cylinder 24 is rotated in the F direction with the rotation lever 24f urged by the spring portion 22b of ink absorbing member spring 22, as shown in Fig. 15B, so that the cap portion 35a of cap 35 is welded under pressure against the discharge port formation face, and the capping operation is terminated. Note that Fig. 13B shows an upper view at this time.

The above operations are cleaning and capping operations, and normally, the operation stops here, whereby in accordance with a next recording signal, the above operations are inversely performed to enter the recording operation.

Next, the suction recovery operation, which is performed when the discharge condition has not been made excellent with the predischarge, will be described.

When this operation is activated, the timing gear 21 is further rotated from the cap position to depress the cap lever 32 with the cap cam 21f, so that the cap 35 is separated a little from the discharge port formation face, as shown in Fig. 15C.

If the timing gear 21 is further rotated in the D direction, the cap portion 35a is welded under pressure against the discharge port face as it is disengaged from the cap cam 21f again.

Next, the pump operation will be explained. It should be note that the entry of the recovery operation after termination of sealing cap as previously described involves entering the suction operation.

First, with a rotation of timing gear 21, as the piston set cam 21g presses the piston presser roller 29 mounted on the piston shaft 27, the piston shaft 27 moves in the H direction as shown in Fig. 16A. And the piston 28 is also pressed by the piston presser 27b, thereby moving in the H direction and placing the pump chamber 42 in a negative pressure.

At the ink flow passage 24e of cylinder 24 is being closed by the piston 28, the negative pressure of pump chamber 42 only increases, with the piston 28 being movable. On the other hand, after being capped again as previously described, the ink flow passage 24e opens, and the ink from the recording head 9 is sucked via the suction port 35b of cap 35. The ink sucked hereby passes through the ink flow passage 32f formed within the cap lever 32, through the communicating aperture 33a of lever seal 33 and further through the ink flow path 24e of cylinder 24 into the pump chamber 42.

At this time, conventionally, the ink sometimes remains in a lower portion of cap 35, as shown in Fig. 24A. Though it is also conceived that the suction port is biased on a lower end portion of cap, the ink may remain on the upper portion of suction port, as shown in Fig. 24B, when the printer is vertically placed.

Fig. 25 is a typical longitudinal cross-sectional view showing one constitution example of conventional another head cap, and Fig. 26 is a typical longitudinal cross-sectional view showing a further constitution example of conventional head cap.

However, in a conventional head cap as shown in Fig. 25, as cap 551 is formed like a U -shape, and an ink exhaust port 552 connectable to suction pump is provided on a central portion thereof, the ink 553 within cap at a lower level than the ink exhaust port 552 can not be sucked with the suction pump, and so remains within the cap, as shown.

As another conventional example, one constitution has been proposed in which an ink exhaust port 552 is provided on an end portion of head cap 551, as shown in Fig. 26, so that the ink does not remain within cap.

In the head cap as shown in Fig. 26, when recording head is used in a lateral orientation (horizontally), accordingly, the head cap 551 is stood from the illustrated orientation and used in the U attitude with its concave side directed laterally, the ink can be exhausted without remaining, while when recording head is used in a downward directed orientation, accordingly, it is used with the concave side of head cap 551 directed upward, as shown in Fig. 26, the ink 553 may remain within cap 551.

On the contrary, in a cap of this example, as a suction port 35c is biased to a lower edge side and has associated therewith a slit 35b for collecting ink (see Fig. 8A), the ink can be collected into the slit with the surface tension, and sucked through the suction port located downwardly, as shown in Fig. 24C. Accordingly, irrespective of whether the printer is used in a horizontal orientation, or vertical orientation, the performance of cap is not degraded. Note that the thinner the width of slit 35b, the stronger the tensile force of ink, whereby an

excellent result could be obtained with 0.4 - 0.7 mm.

Fig. 27 is a perspective view from the front side of another example of a cap according to the present invention, and Fig. 28 is a longitudinal cross-sectional view of Fig. 29.

In Figs. 27 and 28, 721 is a sealing portion which is made contact with a discharge port faoe 501 of head cartridge (recording head) 601, 722 is an ink exhaust port provided on an end portion of inner plane (cavity portion) in head cap 522, and 723 is an ink exhaust passage connecting the ink exhaust port 722 to suction recovery means 515 such as a suction pump.

On the inner plane of head cap 522, the cavity portion 724 tapered in a direction of converging toward the ink exhaust port 722 is provided.

The above-mentioned portions 721, 722, 723 and 724 are all integrally formed.

Next, the operation of head cap 522 as shown in Figs. 27 and 28 will be described.

First, the sealing portion 721 of cap 522 is closely affixed to the discharge port face 501 of recording head 601, so that the interior of cap is placed in an enclosed state. And a suction pump 515 is activated to place the interior of cap in a negative pressure state, and thereby the ink is sucked through discharge ports of recording head 601, filling the cap 522, so that the ink passes through the ink exhaust port 722 and ink exhaust passage 523 into the suction pump 515.

Next, the head cap 522 is separated from the discharge port face of recording head, wherein the cap has remaining ink within its interior.

Therefore, the ink within cap 522 is sucked and exhausted by activating the suction pump 515 again.

Fig. 29 is a typical longitudinal cross-sectional view showing a state in which the pump suction for exhausting ink within the head cap is being performed, with the head cap 522 separated from the discharge port face 501, after the suction recovery for the discharge port face 501 of recording head 601 is performed with the head cap 522.

Fig. 29 shows an instance where an ink jet recording head 601 is attached in a horizontal attitude, and the discharge direction of the recording head is directed horizontally, accordingly, a concave side of head cap 522 is directed horizontally.

In Fig. 29, the ink 725 within head cap 522 flows in a gravitational direction along tapered slant face (cavity portion) 724 as shown, and all ink 725 is exhausted through the ink exhaust port 722 toward the suction pump 515.

Fig. 30 shows an instance where an ink jet recording apparatus using a head cap 522 as shown in Figs. 27 - 29 is placed in a vertical attitude, i.e., the discharge direction of recording head 601 is directed downward, and a concave side of head cap 522 is directed upward.

In Fig. 30, as an inner plane 724 of cap 522 is tapered in the direction of converging toward an ink exhaust port 722, the ink 725 remaining within a head cap 522 flows along a slant face 724 to the ink exhaust port 722, and all ink is exhausted from the ink exhaust port 722 through an ink exhaust passage 723 into a pump 515.

Fig. 31 is a typical perspective view showing another example of a head cap 522 according to the present invention.

In the head cap 522 as shown in Figs. 27 - 30, corner portions of cap inner plane are angled, while in this example, these corner portions are curved with a certain roundness.

The head cap 522 of this example and the ink jet recording apparatus using that head cap are different in the above-described respect from those of the previous example, but other portions have substantially the same construction.

Generally, if any angled portion exists within the cap 522, remaining ink is liable to stay on that portion.

Thus, in the cap as shown in Figs. 27 and 28, as corner portions within cap 522 are all curved and tapered in the direction of converging toward the ink exhaust port 722, the ink within the cap can be passed into the ink exhaust port 722 more securely, and accordingly, all ink 725 (Fig. 29) can be exhausted through the ink exhaust port 722 into suction means 515 rapidly and securely.

Here, the operation of the timing gear 21 in the aforementioned suction recovery operation will be described again.

If the timing gear 21 is further rotated, the cap 35 is separated a little from the discharge port face by the cap cam 21h, and then the ink on the discharge port face and within the cap 35a is sucked owing to a residual negative pressure, so that remaining ink is eliminated from those portions.

Next, if the timing gear 21 is rotated reversely (in a direction as indicated by the arrow I in Fig. 14D), the piston reset cam 21i pulls the piston return roller 30, thereby moving the piston shaft 27 is a direction of arrow J as shown in Fig. 16B. At this time, since the piston 28 can move after the piston carrier 27c of piston shaft 27 comes into contact therewith, a clearance $\Delta 1$ is generated between an end face 28h of piston 28 and the piston presser 27b.

With the mcvement of piston shaft 27 and piston 28, waste ink sucked within the pump chamber 42 passes through the clearance $\Delta 1$ as described, further passing through the groove 27f of piston shaft, ink flow passage 24c of cylinder 24

and waste ink tube 24g, and exhausted into a near central portion of waste ink absorbing member 37. Note that the ink flow passage 24e of cylinder 24 is enclosed by the piston at the early time of the operation of piston 28, waste ink does not flow backward toward the cap.

Note that after termination of the pump operation, the piston 28 further moves and comes not to enclose the ink flow passage 24e of cylinder 24, wherein as the waste ink absorbing member 37 exists in the communication passage from the cap 35 to the atmosphere, the interior of cap is maintained in moist atmosphere, and almost any evaporation of ink does not occur, so that the discharge ports and liquid channels are not dried.

The ink remaining within the cylinder 24 is collected by the piston absorbing member 241 to be passed via the flow passage absorbing member 242 to the waste ink absorbing member 37, and thereby prevented from flowing backward toward the cap.

It should be noted that the constitution for preventing such back flow is not limited to that as shown in Fig. 9, but may be made as shown in Figs. 32A - 32C.

First, Fig. 32A shows a constitution in which the piston absorbing member 241 is extended to come into direct contact with the waste ink absorbing member 37, i.e., the flow passage absorbing member 242 is integrally formed.

Next, Fig. 32B shows a constitution in which an inward directed click 24g is provided on an end face of cylinder 24 to restrict the drift of piston absorbing member in the axial direction, whereby the piston absorbing member 241 is inserted, the click is snapped into place to serve as a draft stop. Also, Fig. 32C shows a constitution in which a fastener 24m consisting of more than one click provided on a thin plate formed from an elastic material for preventing the drift of piston absorbing member 241 is inserted into the piston ring afterwards and fixed therein.

Fig. 17 shows generically the sequence of predischarge and suction recovery as above described. Particularly, the figure shows the sequence in which the blade 17 waits in a wiping ready state (set state, see Fig. 14B), and after wiping, is inclined to the absorbing member 23 (reset state, see Fig. 14A), and then, set in the wiping ready state immediately before the set lever 20 returns to its original position.

Note that the recovery operation is performed once again immediately after the power is turned on, for example, when the power has not been turned on for three or more days. Also, it can be appropriately performed in accordance with the operation of start switch.

The wiping of blade is performed in a direction of discharge port array (longitudinal direction) once per about 60 seconds during the printing, as well as immediately before the closing of cap and the start of printing.

The predischarge is performed such that, for example,

(1) When the power is turned on.
50 times x 64 discharge ports (500 Hz)
(2) Immediately before the start of printing.
50 times x 64 discharge ports (500 Hz)
(3) During the printing.
15 times for every about 12 seconds x 64 discharge ports (500 Hz)

Note that it is assumed that the penetrating amount of blade into head is 0.7 ± 0.3 [mm], and the penetrating amount of blade into absorbing member is 1.15 ± 0.6 [mm]. However, in the wait state, it is preferred that the blade is placed in a free state where it is not in contact with the absorbing member.

The suction pressure minus 4 is approximately -6 [mAq] (the cap pressure welding force is above 60 [g]), and the amount of ink suction is approximately 0.1 (+0.04, -0.025) [cc].

Next, the recording sheet conveying mechanism will be described from the recording to the paper exhaust in the apparatus of this example, with reference to Figs. 3A and 3B.

In these figures, 38 is a paper presser plate formed of fluorocarbon resin or carbon fiber blended material as previously described, serving to exert the pressing force against a recording sheet fed thereto so that the discharge port face of recording head 9 and the recording sheet are spaced a predetermined interval. The pressing force of paper presser plate 38 relies on the elastic force of spring 38D. That mechanism is shown in detail in Figs. 18A and 18B.

Fig. 18A is a view showing a state where the paper presser plate 38 exerts a pressing force against the paper feed roller. In this case, a cutaway portion of shaft 38A, which is formed as D shape by cutting away a part of circle linearly and is slidable with the paper presser plate 38 in a rotational direction, is at a position confronted to an end portion 38F of spring plate 38D, whereby an end portion 38E of paper presser plate is urged upward in the figure by the spring plate 38D. Thereby, the paper presser plate 38 attempts to rotate in a clockwise direction around the shaft 38A, thus exerting the pressing force against the paper feed roller 36.

On the other hand, Fig. 18B shows a state where the action of pressing force with the paper presser plate 38 is released. In this case, the shaft 38A rotates, and a circular arc portion of shaft 38A presses on the end portion 38F. Then, the spring plate 38D is wholly depressed downward in the

figure. As a result, the end portion 38E is not urged by the spring plate 38D.

In this state with the urging force released, as the shaft 38A and the paper presser plate 38 are engaged with a certain friction force, the paper presser plate 38 does not change its rotation position greatly. Thereby, even when the pressing force of paper presser plate 38 is required to release, the movement of recording head can not be prevented by the paper presser plate.

Also, the above paper presser mechanism is one in which the pressing force enough not to prevent the appropriate conveyance of recording sheet with the paper feed roller 36 in a limited space can be provided.

That is, since elastic member is not used for the paper presser plate itself, and the pressing force is generated by a leaf spring disposed along and on a bottom portion of chassis 1 which is normally a dead space, the degree of freedom for setting the pressing force with the adjustment of length of leaf spring is increased, and the paper presser member can be miniaturized.

Note that the leaf spring 38D is attached to the chassis 1 by a securing member, not shown.

Referring to Figs. 3A and 3B again, 60 is a paper exhaust roller for exhausting recording sheet that has been recorded, and 61 is a spur for giving the pressing force to recording sheet to be conveyed by the paper exhaust roller 60, restraining the exhausting direction of recording sheet, and generating the conveying force.

62 is a transmission roller for transmitting the rotation of paper feed roller 36 to the paper exhaust roller 60, and which is disposed in an intermediate portion between the paper exhaust roller 60 and the paper feed roller 36. The transmission of rotation is performed with the friction force between both rollers placed in contact. The paper exhaust roller 60 is of a cylindrical shape having different radii on both end portions and its intermediate portion, wherein the transmission roller 62 is made in contact with the intermediate portion of paper exhaust roller 60 with smaller radius. Accordingly, both end portions with larger radius are rotated at slightly higher peripheral speed than that of paper feed roller 36. Consequently, in exhausting, recording sheet is pulled slightly and conveyed, so that record face is excellently formed.

Note that the rotation shafts of transmission roller 62 and spur 61 are formed using coil springs with appropriate elastic coefficients, respectively. The mechanism will be detailed with reference to Fig. 19, and using an instance of spur 61.

In Fig. 19, 61A is a shaft formed of a coil spring, which extends through a central portion of spur 61 to both sides thereof and rotatably engages the spur 61. 103B is a shaft support member in which both end portions of rotation shaft 61A are supported, and which is formed as a part of inner cover 103 as shown in Fig. 1. The shaft support member 103B supports the shaft 61A slidably in the axial direction. 103C is restraint member for restraining the movement of spur 61 in a rotational axis direction and a direction perpendicular thereto and provided on both sides of spur 61. The restraint member 103C is formed as a part of inner cover 103, like the shaft support member 103B.

With the above constitution, the shaft 61A can obtain the pressing force of spur 61 against the paper exhaust roller 60 with its bending elastic force, as well as supporting the spur 61.

The inner cover 103 has a spring member 103A on its rear end portion, as shown in Fig. 3A, which receives the pressing force in a direction toward the paper exhaust roller owing to the reaction against a case 101. The interaction between this pressing force and the elastic force of rotation shaft 61A allows the spur 61 to exert an appropriate pressing force to the paper exhaust roller 60.

Also, by the inner cover 103 receiving the pressing force as above indicated, the engagement between the securing member 103D of inner cover 103 and the rotation shaft 60C of paper exhaust roller 60 is made more secure, as shown in Fig. 3A. As a result, the positional relation between the spur 61 and the paper exhaust roller 60 can be always maintained constant, or otherwise, can be maintained in high precision by securing in abutment with a member for stopping the rotation shaft 60C, irrespective of the precision of inner cover.

Also, in the transmission roller 62, the feature of rotation shaft 62A consisting of a coil spring is the same, wherein the abutting force onto the paper feed roller 36 and the paper exhaust roller 60 is obtained with the elastic force of shaft 62A.

The paper exhaust roller 60 is of a shape with the radius of its intermediate portion being smaller than the radii of both end portions, as previously described. The detail of this constitution is shown in Fig. 20.

In Fig. 20, 60A is a cover member made of a rubber material, and 60D is a core member with the radius of intermediate portion being made smaller than the radii of both end portions. The paper exhaust roller 60 is formed by covering the cover member 60A of pipe shape onto the core member 60D.

As a result, the paper exhaust roller can be obtained comparatively easily and inexpensively without integrally forming such a shape with rubber material.

Note that a groove 60B provided continuously on one end portion of paper exhaust roller 60 serves to stop a terminal portion of recording sheet

exhausted by the paper exhaust roller 60, whereby the exhaust of recording sheet can be made more secure, even when recording sheet is deviated out of place.

Note that the shape of core member 60D is not limited to the above-described one, but may be such a shape in which the groove portion 60B is extended in original shape with intermediate portion made smaller, whereby cylindrical shape can be obtained by covering a rubber member thereon.

Next, the vertical service of an ink jet recording apparatus of this example will be described with reference to Figs. 21 and 22.

The vertical service condition of apparatus is used in cases where an automatic feeder 200 is used, and a thick paper such as an envelope is fed through a paper feed opening on the back side of apparatus, as shown in those figures.

When the automatic feeder is used with normal recording sheet, an upper cover 102 can be used as a stacker for recording sheets exhausted. In this case, the upper cover 102 is fixed at a different angle from that when used as a paper guide for feeding paper.

The condition where the upper cover 102 is used as stacker is as follows.

A position where an exhausted recording sheet itself, which is conveyed in the air with its nervy characteristic, will come into contact with the upper cover 102 or recording sheet already stacked is set near an upper edge portion 102A of the upper cover 102. Thereby, The portion where exhausted recording sheet may slide on recording sheet already stacked is limited to only a leading portion of recording sheet, so that the sliding can be avoided to the utmost, and the stain of recording sheet due to unfixed ink can be prevented.

Such a constitution requires that the upper end portion 102A is located near a common tangential line for the paper feed roller 36 and the paper exhaust roller 60, in a direction for exhausting sheet, and the lower end portion 102B is lowered.

Further, it is constituted that when a trailing end portion of recording sheet which is stopped at the upper end portion 102A is completely exhausted, it descends at the same position and is stacked without sliding.

With such constitution the length of upper cover 102 in the direction for exhausting sheet (the length from upper end 102A to lower end 102B) is essential, wherein when recording sheet ordinarily used is exhausted almost horizontally like this example, its length is 60%-90% the length of recording sheet, and more preferably, 70%-80%.

Note that when the paper exhaust direction is different from the above-described one with different constitution or service condition of recording apparatus, the length of stacker should be determined, taking into consideration the first factor as above described.

108 as shown in Figs. 21 and 22 is an entrainment prevention piece for preventing recording sheet to be stacked from entering into the paper feed opening.

Moreover, another example of an ink jet recording apparatus to which this example is preferably applied will be described.

In Fig. 33, a head cartridge 1101 is mounted on a carriage 1102 reciprocating along a recording medium (sheet-like recording medium such as a paper or plastic thin plate) P.

The head cartridge 1101 has a recording head (ink jet recording head) and an ink tank integrally formed, wherein a discharge port face 1001 having formed discharge ports is provided on an opposed face to the recording medium P.

The recording head 1101 is an ink jet recording head for discharging ink by the use of the heat energy, comprising electricity-heat converters for generating the heat energy.

Also, the ink jet recording head 1101 performs the recording by discharging the ink through discharge ports by growth of bubbles due to film boiling caused by the heat energy applied by the electricity-heat converters.

A lead screw 1005 constituting a guide shaft of carriage 1102 is driven and rotated via transmission gears 1011, 1009 for the driving force in accordance with the positive or reverse rotation of driving motor 1013.

The carriage 1102 engaged with a spiral groove 1004 of the lead screw 1005 is driven for reciprocating motion in the direction of the arrow P or R in accordance with the rotation of the lead screw 1005.

The recording medium P is pressed against a platen 1024 disposed along the moving direction of carriage.

On a left end portion of recording apparatus, photo coupler 1007, 1008 as home position detection means are installed, and are constituted to sense the existence of a lever 106 of the carriage when the carriage 1102 reaches a home position at the left end, and then switch the rotation direction of driving motor 1013.

Between a recording area (substantially an area of platen 1024) and the home position, a head cap 1022 for capping the discharge port face of recording head 1101 is provided.

The head cap 1022 is supported by a cap holder 1016.

The interior of head cap 1022 is connected via an opening 1023 to suction means 1015 such as a suction pump, in which the suction recovery of recording head (head cartridge) is performed by activating suction means 1015 with the discharge

port face 1001 being capped.

Between the head cap 1022 and the platen 1024, a cleaning blade 1017 for wiping the discharge port face of recording head 1101 is disposed.

The cleaning blade 1017 is carried by a holder 1019 movable in the forward and backward directions, and the holder 1019 is attached to a support member 1018 movable in the forward and backward directions.

Note that the cleaning member 1017 can use well known various forms, besides the form as shown.

Numeral 1020 is a cam for switching the driving force of the driving motor 1013 with a clutch, wherein when the carriage 1102 reaches the home position, the carriage engages and moves the cam 1020, thereby moving the lever 1021 for starting the suction for the suction recovery, so that the state in which the suction recovery operation can be performed for the discharge ports of recording head at the home position is set.

Capping means 1022, cleaning means 1017, and suction recovery means 1015 as above described are constituted to perform desired processings at a desired timing at their corresponding positions, with the action of lead screw 1005, when the carriage 1102 reaches the home position area.

Figs. 34 and 35 are external perspective views showing an ink jet recording apparatus comprising a head cap according to the present invention, which can record in two forms of vertical and horizontal conditions.

In the vertical condition as shown in Fig. 34, a main body is supported by a support saddle 156, wherein as the ink from the recording head is discharged downward as indicated by the arrow X, the head cap 1022 placed in opposed relation to the recording head is attached with its concave portion directed upward, as shown in Fig. 30.

Note that in Fig. 34, 1151 is an insertion opening for recording medium (e.g., paper) 1152 when used in the vertical condition, the recording medium conveying passage within apparatus is formed almost horizontally.

Thus, an ink jet recording apparatus can be obtained in which it is capable of recording in both forms of vertical and horizontal conditions and comprises a head cap 1022 having tapered surface for guiding ink to ink exhaust port 1222 within cap 1222 easily and securely.

The present invention brings about excellent effects particularly in an ink jet recording apparatus having an ink jet recording head of the ink jet system for recording by forming fine liquid droplets with the heat energy among the various ink jet recording systems.

As to its representative constitution and principle, for example, one practiced by use of the basic principle disclosed in, for example, U.S. Patents 4,723,129 and 4,740,796 is preferred. This system is applicable to either of the so-called on-demand type and the continuous type. Particularly, the case of the on-demand type is effective because, by applying at least one driving signal which gives rapid temperature elevation exceeding nucleus boiling corresponding to the recording information on electricity-heat converters arranged corresponding to the sheets or liquid channels holding a liquid (ink), heat energy is generated at the electricity-heat converters to effect film boiling at the heat acting surface of the recording head, and consequently the bubbles within the liquid (ink) can be formed corresponding one by one to the driving signals. By discharging the liquid (ink) though an opening for discharging by growth and shrinkage of the bubble, at least one droplet is formed. By making the driving signals into pulse shapes, growth and shrinkage of the bubble can be effected instantly and adequately to accomplish more preferably discharging of the liquid (ink) particularly excellent in response characteristic.

As the driving signals of such pulse shape, those as disclosed in U.S. Patents 4,463,359 and 4,345,262 are suitable. Further excellent recording can be performed by employment of the conditions described in U.S. Patent 4,313,124 of the invention concerning the temperature elevation rate of the above-mentioned heat acting surface.

As the constitution of the recording head, in addition to the combination of the discharging orifice, liquid channel, and electricity-heat converter (linear liquid channel or right-angled liquid channel) as disclosed in the above-mentioned respective specifications, the constitution by use of U.S. Patent 4,558,333, or 4,459,600 disclosing the constitution having the heat acting portion arranged in the flexed region is also included in the present invention.

In addition, the present invention can be also effectively made the constitution as disclosed in Japanese Laid-Open Patent Application No. 59-123670 which discloses the constitution using a slit common to a plurality of electricity-heat converters as the discharging portion of the electricity-heat converter or Japanese Laid-Open patent Application No. 59-138461 which discloses the constitution having the opening for absorbing pressure wave of heat energy correspondent to the discharging portion.

Further, as the recording head of the full line type having a length corresponding to the maximum width of a recording medium which can be recorded by the recording device, either the constitution which satisfies its length by a combination of a plurality of recording heads as disclosed in the

above-mentioned specifications or the constitution as one recording head integrally formed may be used, and the present invention can exhibit the effects as described above further effectively.

In addition, the present invention is effective for a recording head of the freely exchangeable chip type which enables electrical connection to the main device or supply of ink from the main device by being mounted on the main device, or a recording head of the cartridge type having an ink tank integrally provided on the recording head itself.

Also, addition of a restoration means for the recording head, a preliminary auxiliary means, etc. provided as the constitution of the recording device of the present invention is preferable, because the effect of the present invention can be further stabilized. Specific examples of these may include, for recording head, capping means, cleaning means, pressurization or suction means, electricity-heat converters or another type of heating elements, or preliminary heating means according to a combination of these, and it is also effective for performing stable recording to perform preliminary mode which performs discharging separate from recording.

Further, as the recording mode of the recording device, the present invention is extremely effective for not only the recording mode only of a primary color such as black etc., but also a device equipped with at least one of plural different colors or full color by color mixing, whether the recording head may be either integrally constituted or combined in plural number.

Further, a recording apparatus according to the present invention is provided integrally or separately as an image output terminal for the information processing equipment such as a word processor or computer, a copying machine in combination with a reader, or a facsimile terminal equipment having the transmission and reception feature.

As clearly seen from the above description, according to the present invention, a suction recovery device capable of sucking waste ink smoothly and a reliable ink jet recording apparatus using that device can be obtained.

According to the present invention, by comprising a cap made of an elastic member formed integrally with an ink communication member having formed suction passage, and connecting a rigid ink communication member of main body of suction system to the elastic ink communication member of cap, high face accuracy for the discharge port formation face of recording head in the non-capping state can be retained, and the equalization of cap for the discharge port formation face in the capping state can be achieved excellently.

According to the present invention, as a channel portion for guiding ink is provided in connection with a suction port on the inner wall of cap, the ink received in the discharge recovery operation can be efficiently conducted into the suction port and exhausted therefrom, so that ink remaining within cap can be eliminated. Further, in whatever attitude the cap or apparatus is used, the exhaust can be performed excellently.

According to the present invention, it is possible to concentrate the suction force when suction recovery means is operated, and to achieve an excellent recording performance in any form of vertical and horizontal conditions as the ink is sucked and received in any attitude with above constitution.

A suction recovery device of ink jet recording apparatus comprises a cap which can contact with or separate from a face formed with discharge ports for recording by discharging the ink, said cap communicating to a suction system for performing the suction recovery through said discharge ports via said cap, said cap having a groove portion for guiding ink, and formed of an elastic material integrally with an ink communication member for communicating to said suction system via a suction port provided on an inner wall of said cap, and said suction system having a cylinder and a piston reciprocating within said cylinder, and having disposed ink absorbing member in an ink exhaust portion within said cylinder.

Claims

1. A suction recovery device of ink jet recording apparatus comprising:

   a cap which can contact with or separate from a face formed with discharge ports for recording by discharging the ink, said cap communicating to a suction system for performing the suction recovery through said discharge ports via said cap;

   said cap having a groove portion for guiding ink, and formed of an elastic material integrally with an ink communication member for communicating to said suction system via a suction port provided on an inner wall of said cap; and

   said suction system having a cylinder and a piston reciprocating within said cylinder, and having disposed ink absorbing member in an ink exhaust portion within said cylinder.

2. A suction recovery device of ink jet recording apparatus according to claim 1, wherein

   said groove portion of said cap is provided on said inner wall face recessed from a contact surface of said cap placed into contact with said face, and wherein said inner wall face leading from said contact face to said groove

portion is formed with decreasing tapered continuous face.

3. A suction recovery device of ink jet recording apparatus according to claim 1, wherein

said inner wall face of said cap is formed with a tapered cavity which decreases toward said suction port.

4. A suction recovery device of ink jet recording apparatus comprising:

a cap which can contact with or separate from a face formed with discharge ports for recording by discharging the ink, said cap communicating to a suction system for performing the suction recovery through said discharge ports via said cap;

said cap having a groove portion for guiding ink, and formed of an elastic material integrally with an ink communication member for communicating to said suction system via a suction port provided on an inner wall of said cap;

a cap holder for holding said cap, said cap holder having a concave spherical portion for equalizing; a pair of stop portions provided on an outer confronted face portion of said cap holder, said stop portion having a disk-like portion on its end portion;

a cap lever for allowing said cap to contact with or separated from said face via said cap holder, said cap lever having a convex spherical portion and a stop portion engaged by said stop clicks;

said cap lever having a mating portion for mating with said ink communication portion of said cap; and

said suction system having a cylinder and a piston reciprocating within said cylinder, and having disposed ink absorbing member in an ink exhaust portion within said cylinder.

5. A suction recovery device of ink jet recording apparatus according to claim 4, wherein

said groove portion of said cap is provided on said inner wall face recessed from a contact surface of said cap placed into contact with said face, and wherein said inner wall face leading from said contact face to said groove portion is formed with decreasing tapered continuous face.

6. A suction recovery device of ink jet recording apparatus according to claim 4, wherein

said inner wall face of said cap is formed with a tapered cavity which decreases toward said suction port.

7. An ink jet recording apparatus comprising:

a recording head having discharge ports for recording onto recording medium by discharging the ink;

a cap which can contact with or separate from a face formed with said discharge ports of said recording head, said cap communicating to a suction system for performing the suction recovery through said discharge ports via said cap;

said cap having a groove portion for guiding ink, and formed of an elastic material integrally with an ink communication member for communicating to said suction system via a suction port provided on an inner wall of said cap;

a cap holder for holding said cap, said cap holder having a concave spherical portion for equalizing; a pair of stop portions provided on an outer confronted face portion of said cap holder, said stop portion having a disk-like portion on its end portion;

a cap lever for allowing said cap to contact with or separated from said face via said cap holder, said cap lever having a convex spherical portion and a stop portion engaged by said stop clicks;

said cap lever having a mating portion for mating with said ink communication portion of said cap; and

said suction system having a cylinder and a piston reciprocating within said cylinder, and having disposed ink absorbing member in an ink exhaust portion within said cylinder.

8. An ink jet recording apparatus according to claim 7, wherein

said groove portion of said cap is provided on said inner wall face recessed from a contact surface of said cap placed into contact with said face, and wherein said inner wall face leading from said contact face to said groove portion is formed with decreasing tapered continuous face.

9. An ink jet recording apparatus according to claim 7, wherein said inner wall face of said cap is formed with a tapered cavity which decreases toward said suction port.

10. An ink jet recording apparatus according to claim 7, wherein

said recording head has electricity-heat converters, and discharges the ink through said discharge ports by growth of bubbles due to film boiling caused by the heat energy generated by said electricity-heat converters.

11. An ink jet recording apparatus comprising a suction pump for making the ink discharge condition more excellent by sucking the ink through discharge ports of recording head for recording by discharging the ink through said discharge ports,

wherein said suction pump has a cylinder and a piston reciprocating within said cylinder, and has an absorbing member disposed on an ink exhaust portion.

12. An ink jet recording apparatus according to claim 10,

wherein said absorbing member is formed of polyolefine sintered body.

13. An ink jet recording apparatus comprising a cap which can contact with or separate from a face formed with discharge ports of recording head having said discharge ports for recording by discharging the ink, and a suction system for performing the suction processing through said discharge ports via said cap,

wherein said cap is formed of an elastic material integrally with an ink communication member for communicating to said suction system.

14. An ink jet recording apparatus according to claim 13, characterized by comprising:

a cap holder for holding said cap;

a cap lever provided on said suction system for allowing said cap to contact with or separated from said face via said cap holder;

said cap holder having a concave spherical portion for equalizing, and a pair of stop clicks having disks on end portions provided on opposed side portions;

said cap lever having a convex spherical portion and stop apertures engaged by said stop clicks of said cap holder, and having a rigid ink communication portion having a larger outer diameter than an inner diameter of said ink communication portion of said cap on a central portion of front face of said cap lever and for mating with said ink communication portion of said cap.

15. An ink jet recording apparatus comprising a cap which can contact with or separate from a face formed with discharge ports of recording head having said discharge ports for recording by discharging the ink, and a suction system for performing the suction processing through said discharge ports via said cap,

wherein said cap has a groove portion for guiding ink in connection with a suction port provided on an inner wall face for performing said suction.

16. An ink jet recording apparatus according to claim 15,

wherein said groove portion is provided on a place of said inner wall face recessed from a side wall portion of said cap placed into contact with said face, and wherein an area leading to said place is formed with tapered continuous face.

FIG. 1

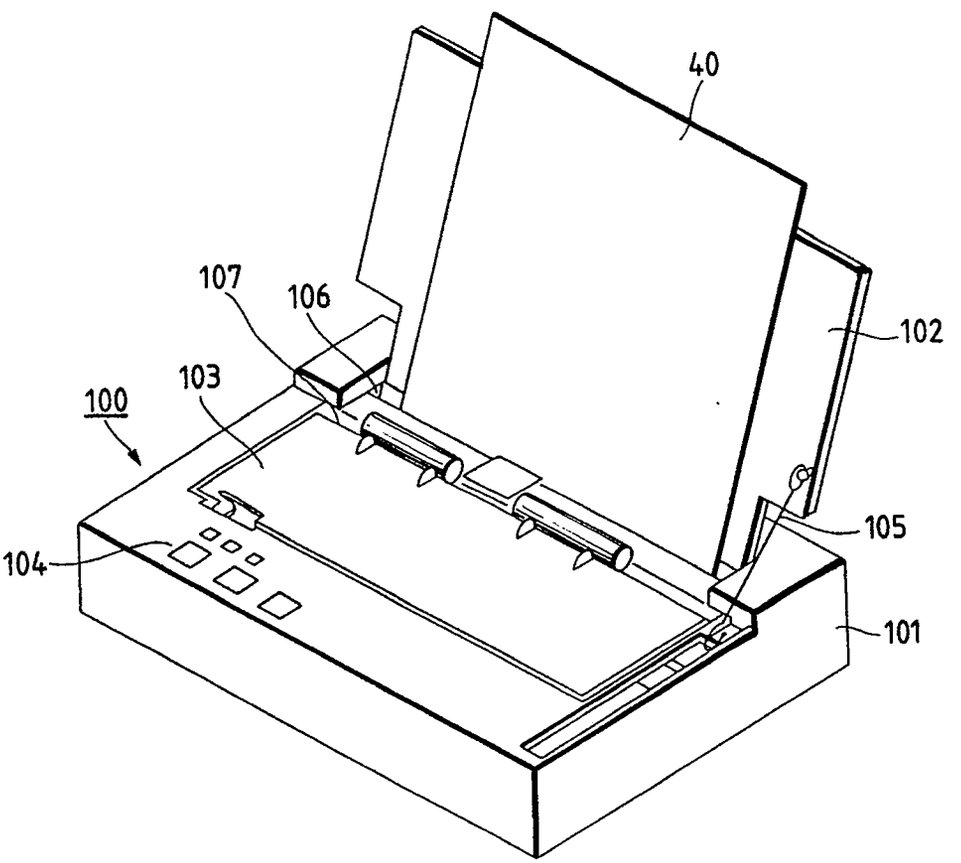
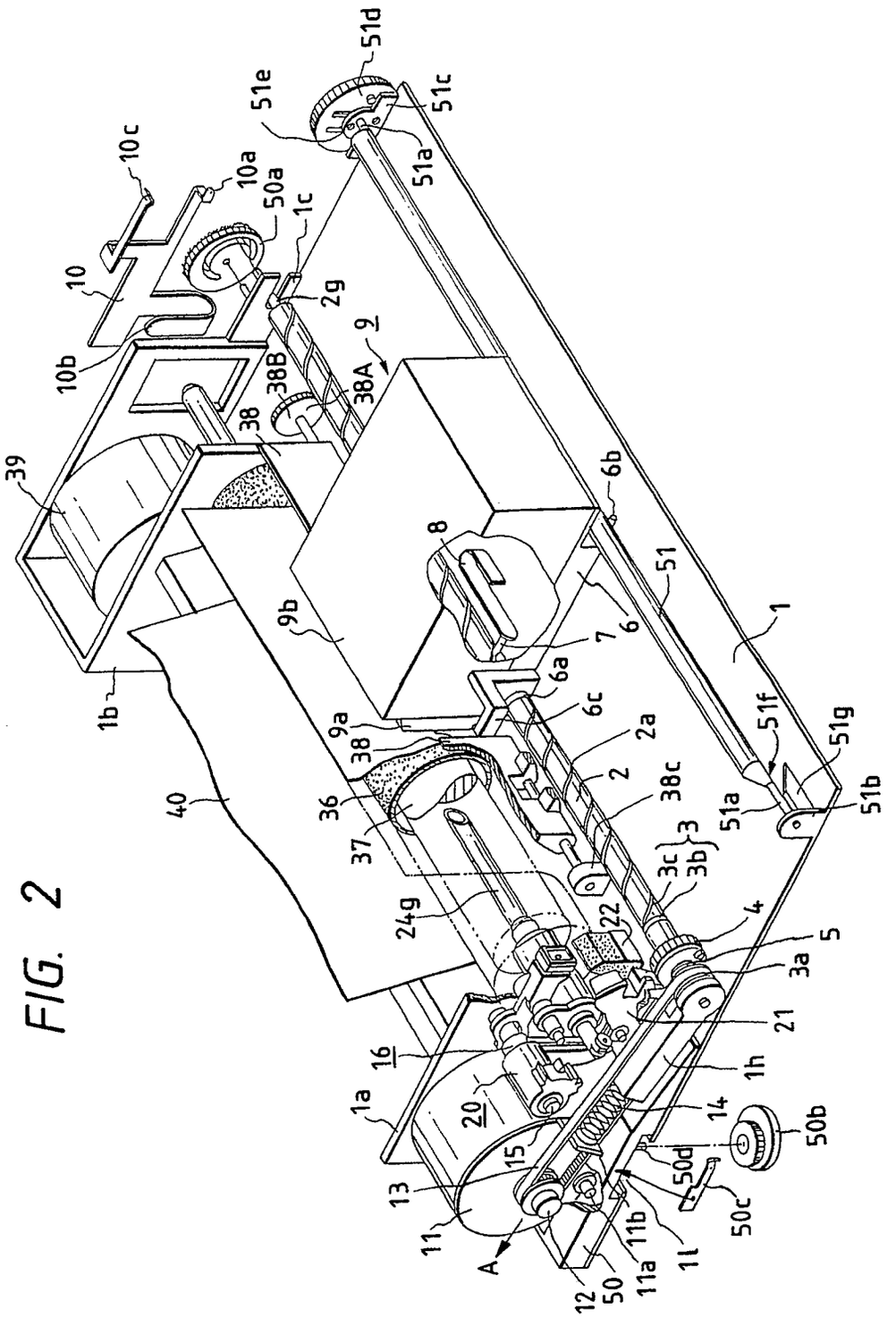


FIG. 2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51c
51a
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10a
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2g
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10b
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8
51
9b
7
6
1
6a
1b
9a
6c
2a
38
51f
51g
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36
2
38c
51a
51b
37
3
3c
3b
24g
22
4
5
3a
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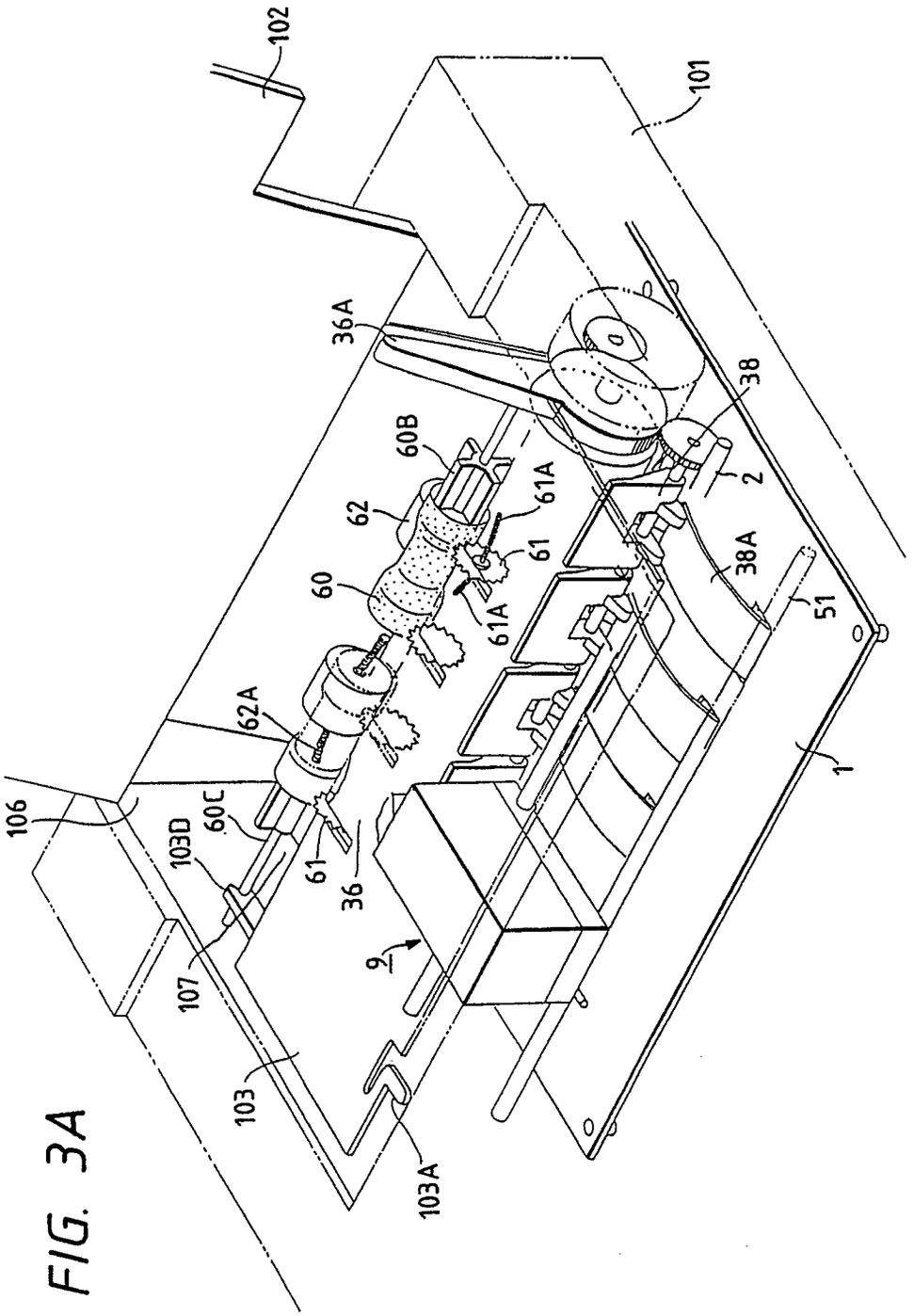

102
101
36A
38
60B
61A
62
2
61
38A
60
61A
51
62A
1
106
60C
103D
61
36
9
107
103
103A

FIG. 3A

FIG. 3B

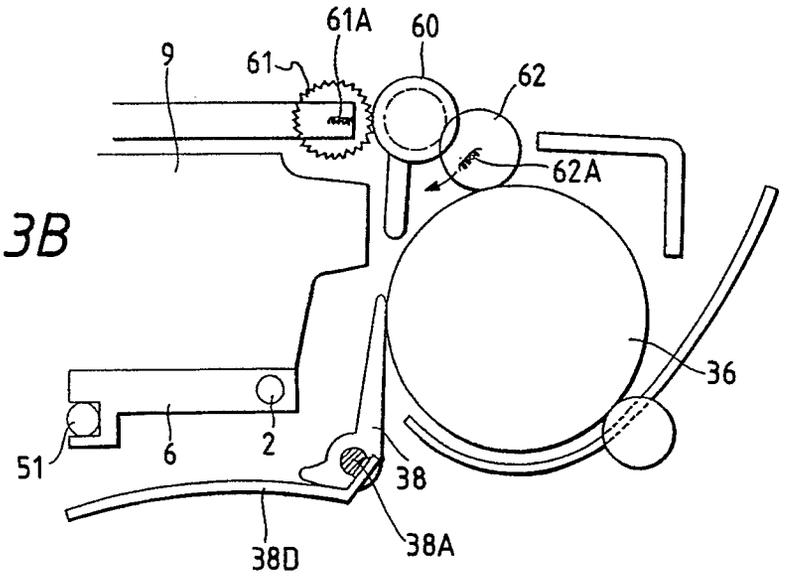


FIG. 4A

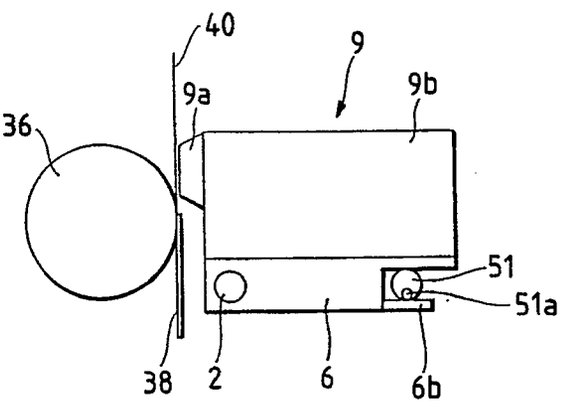


FIG. 4B

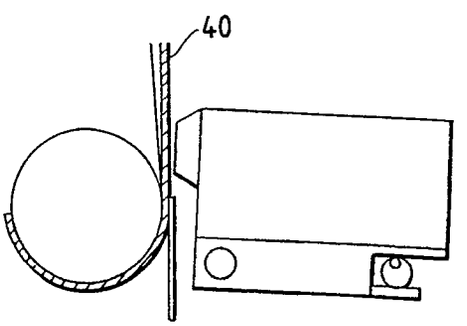


FIG. 5A

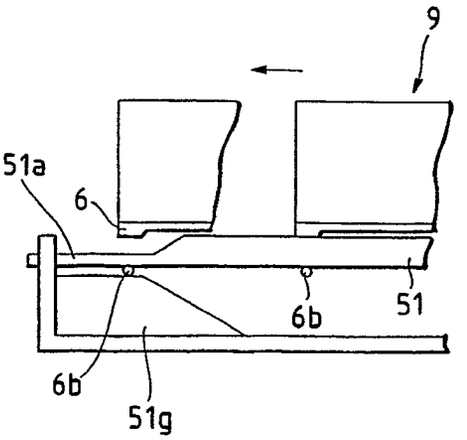


FIG. 5B

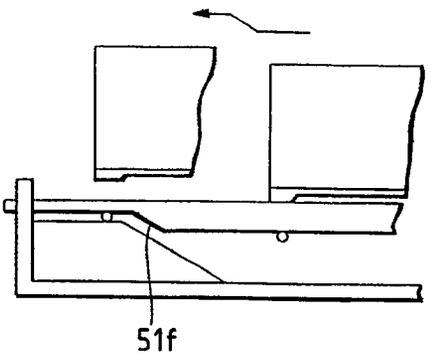


FIG. 6

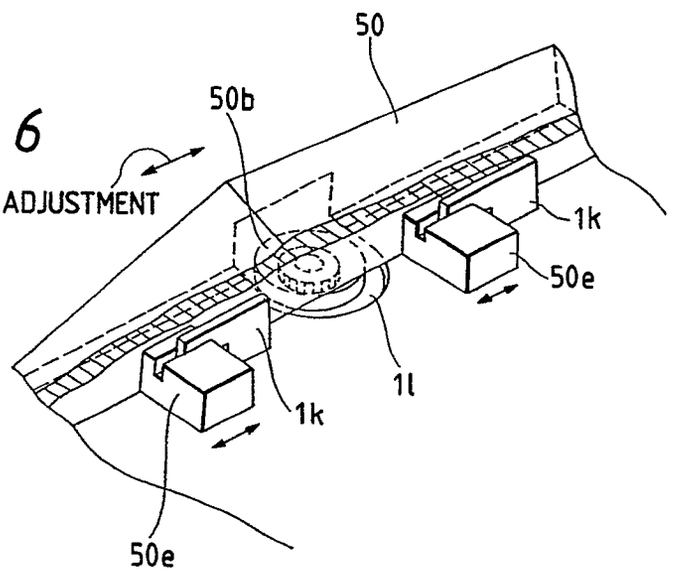


FIG. 7A

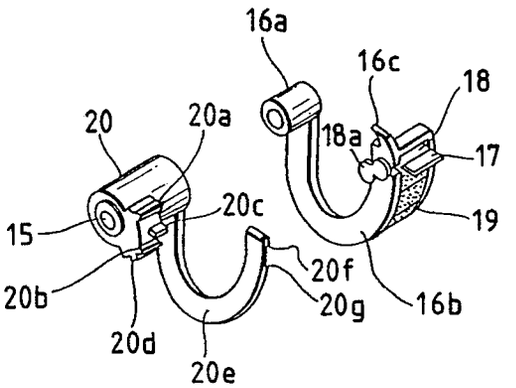


FIG. 7B

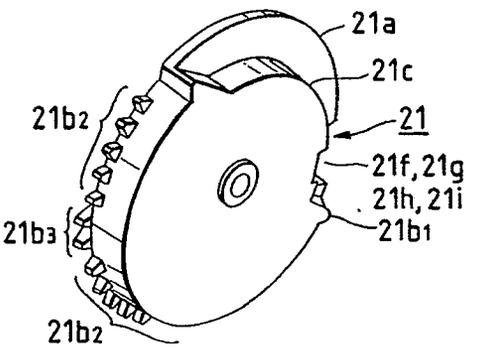


FIG. 7C

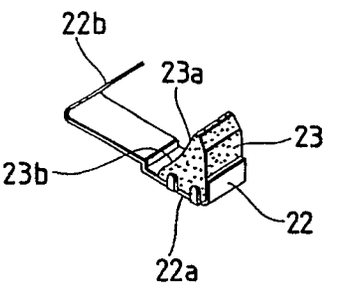
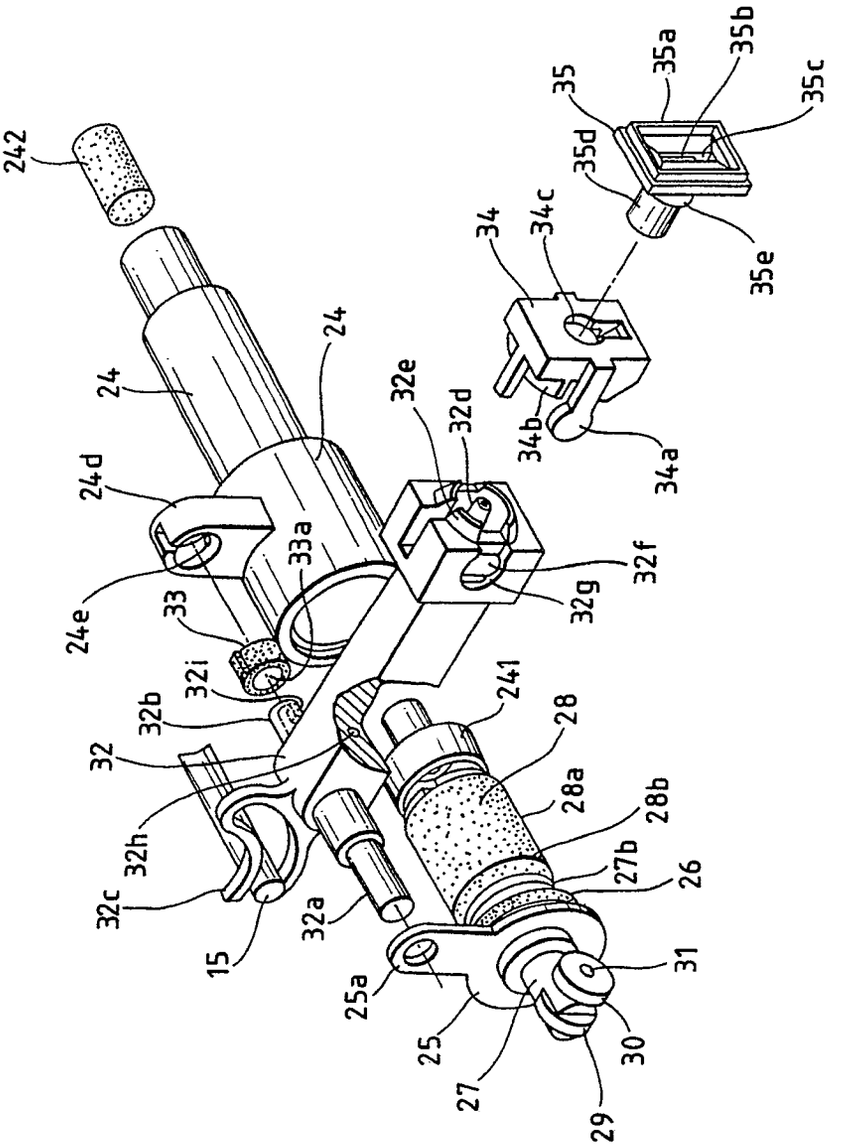


FIG. 8A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35c
35d
35e
32i
32b
32
32h
32c
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27b
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31
25a
25
27
30
29

FIG. 8B

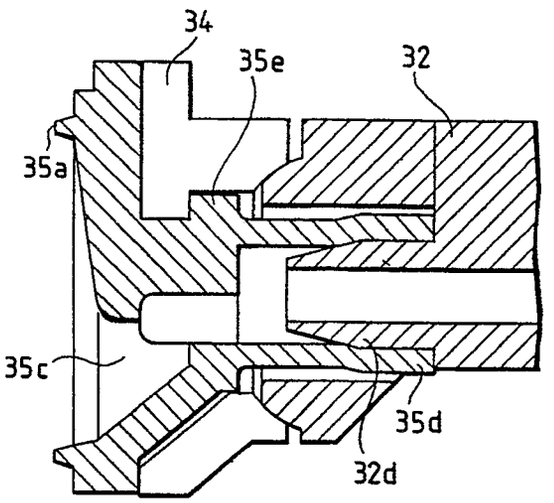


FIG. 8C

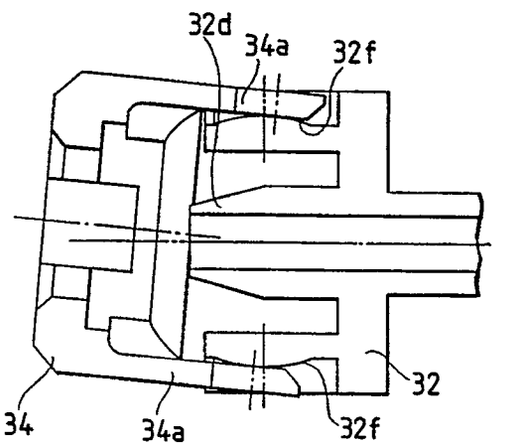
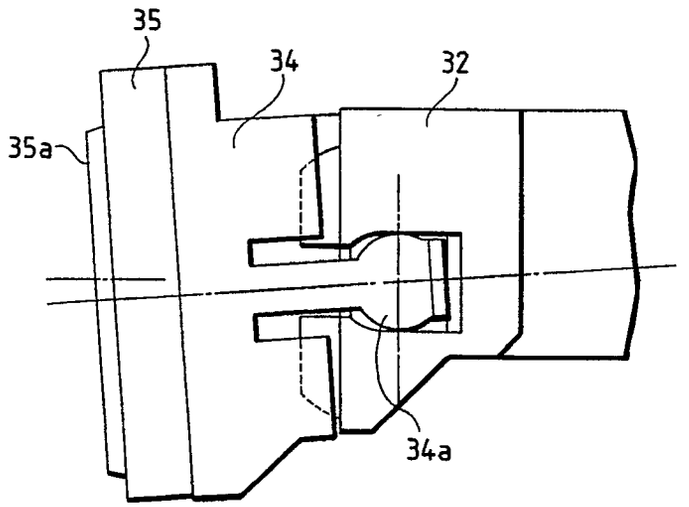


FIG. 8D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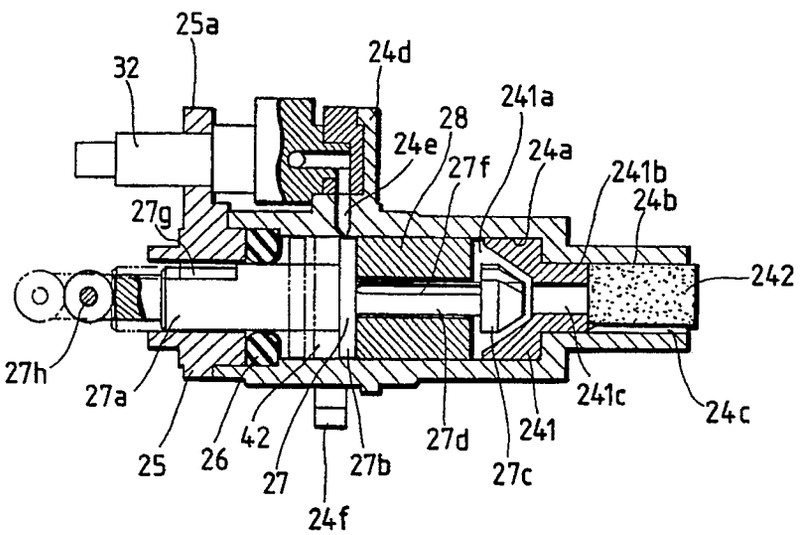
34a

FIG. 9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27b
27d
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27c
24f

FIG. 10

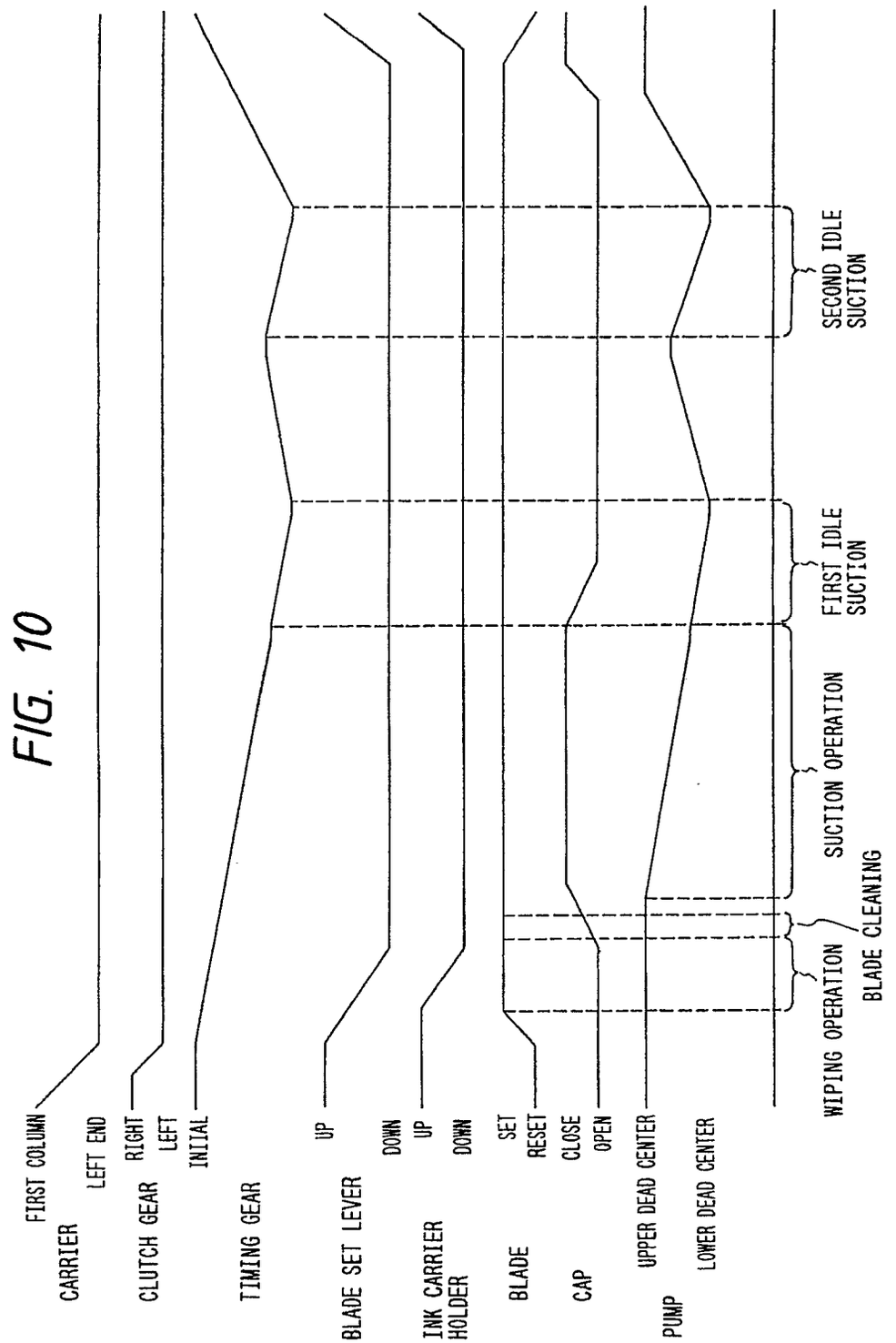

FIRST COLUMN
CARRIER
LEFT END
CLUTCH GEAR
RIGHT
LEFT
INIAL
TIMING GEAR
UP
BLADE SET LEVER
DOWN
UP
INK CARRIER HOLDER
DOWN
SET
BLADE
RESET
CLOSE
CAP
OPEN
UPPER DEAD CENTER
PUMP
LOWER DEAD CENTER
WIPING OPERATION
BLADE CLEANING
SUCTION OPERATION
FIRST IDLE SUCTION
SECOND IDLE SUCTION

FIG. 11

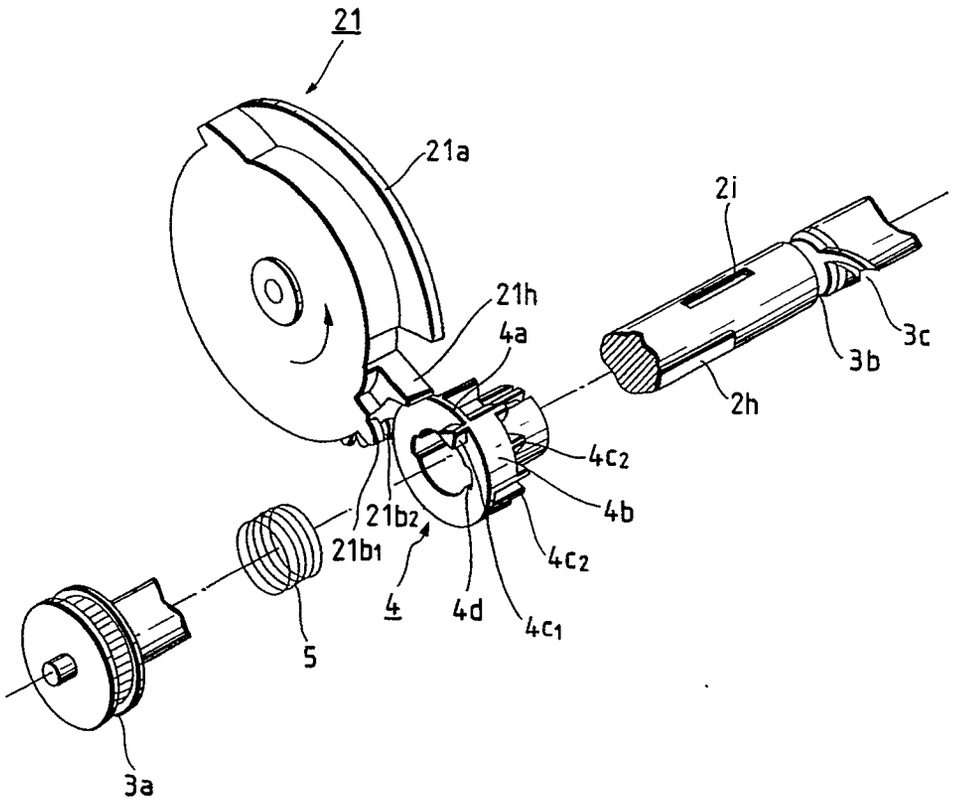


FIG. 13A

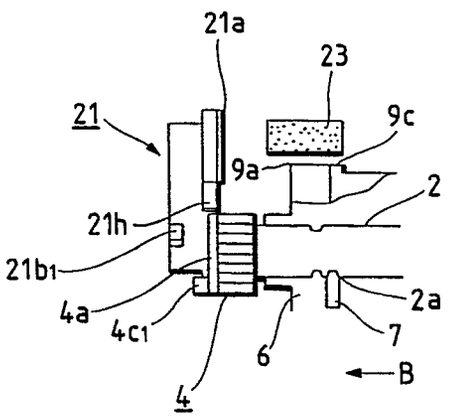


FIG. 13B

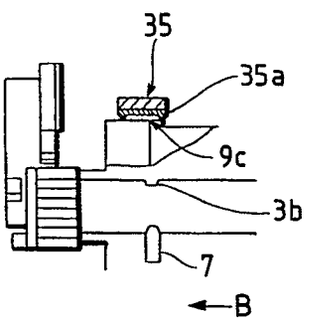


FIG. 12A

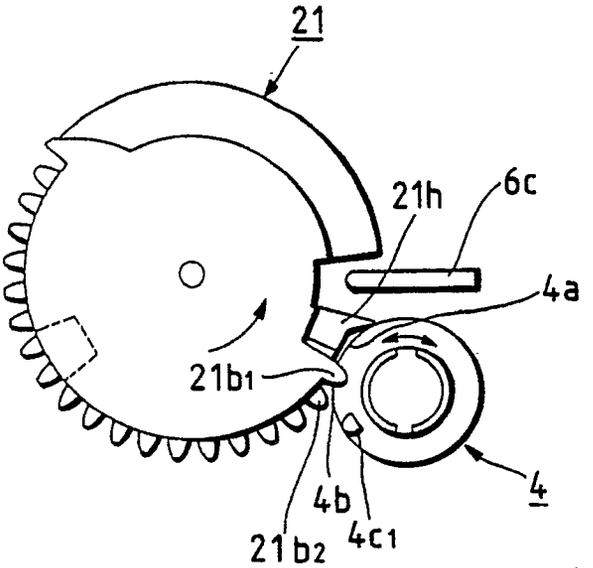


FIG. 12B

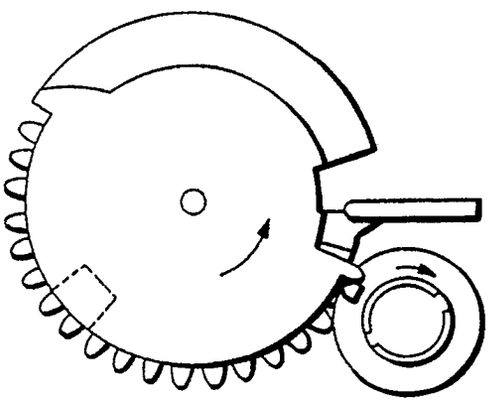


FIG. 12C

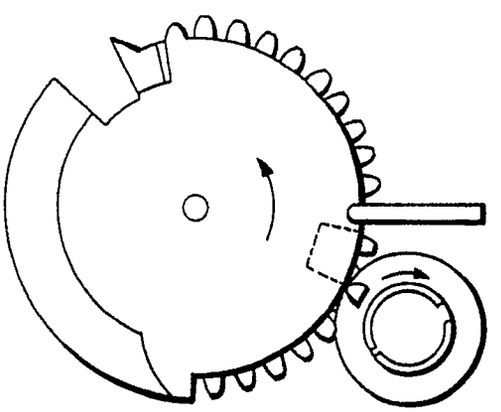


FIG. 14A

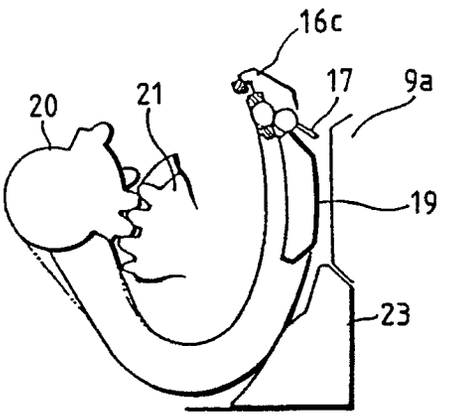


FIG. 14B

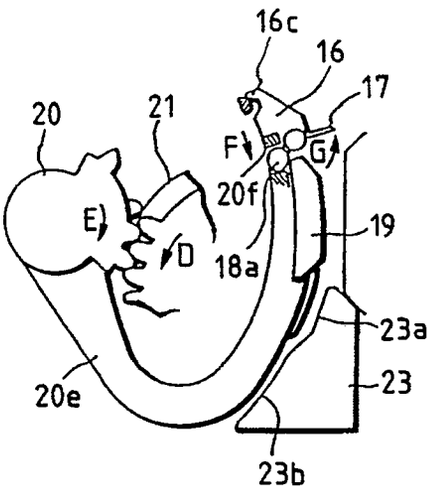


FIG. 14C

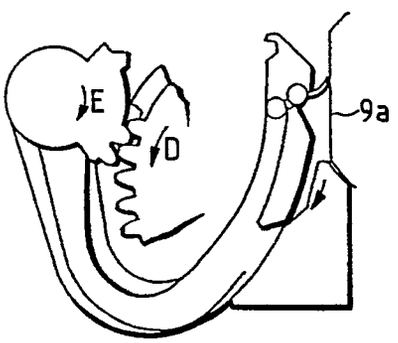


FIG. 14D

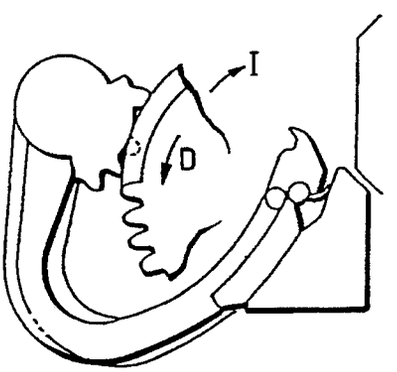


FIG. 15A

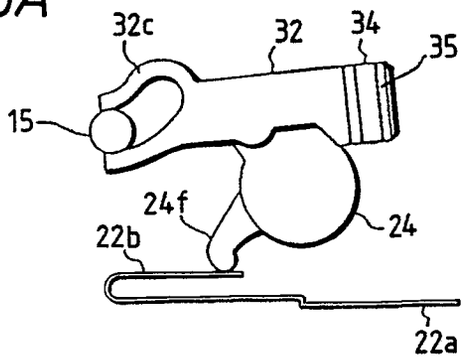


FIG. 15B

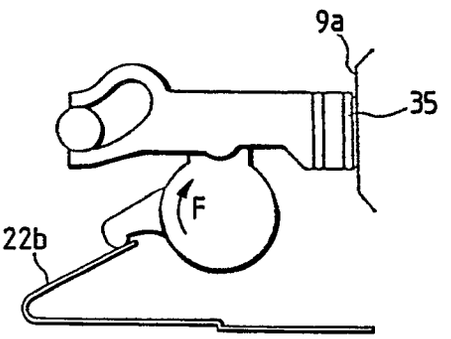


FIG. 15C

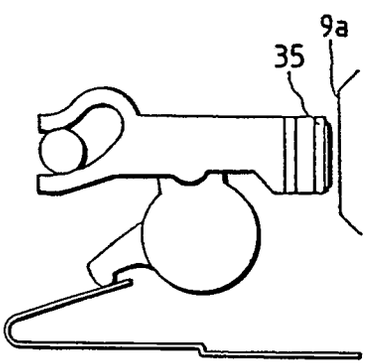


FIG. 16A

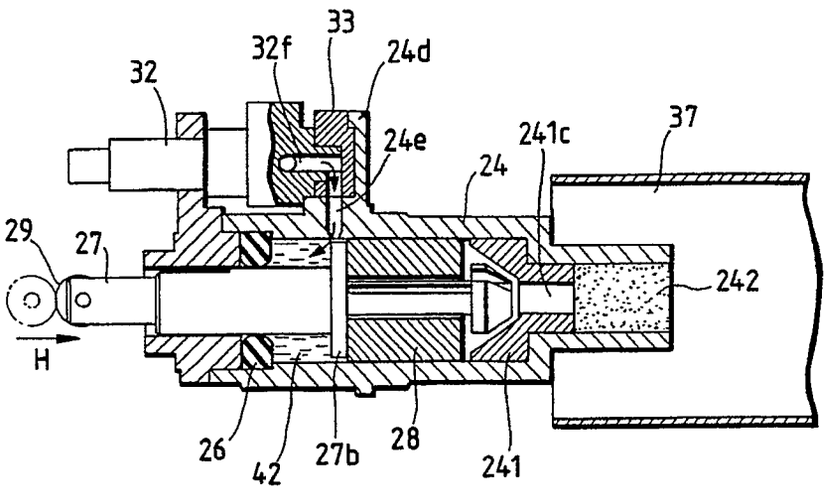


FIG. 16B

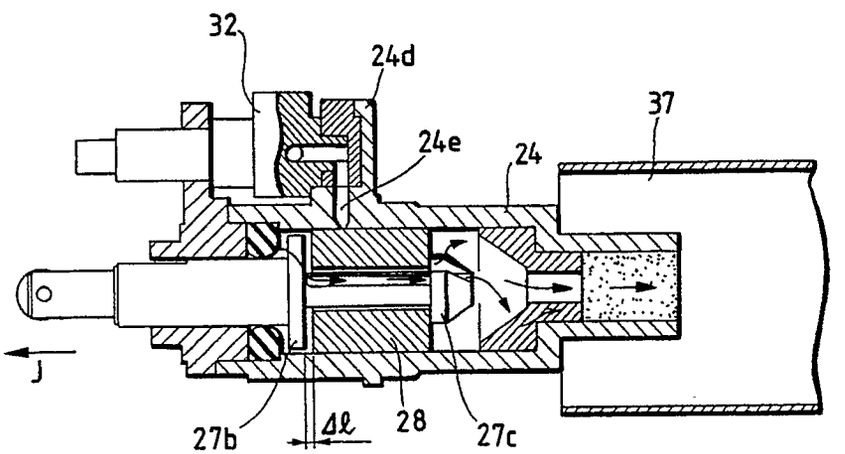


FIG. 17

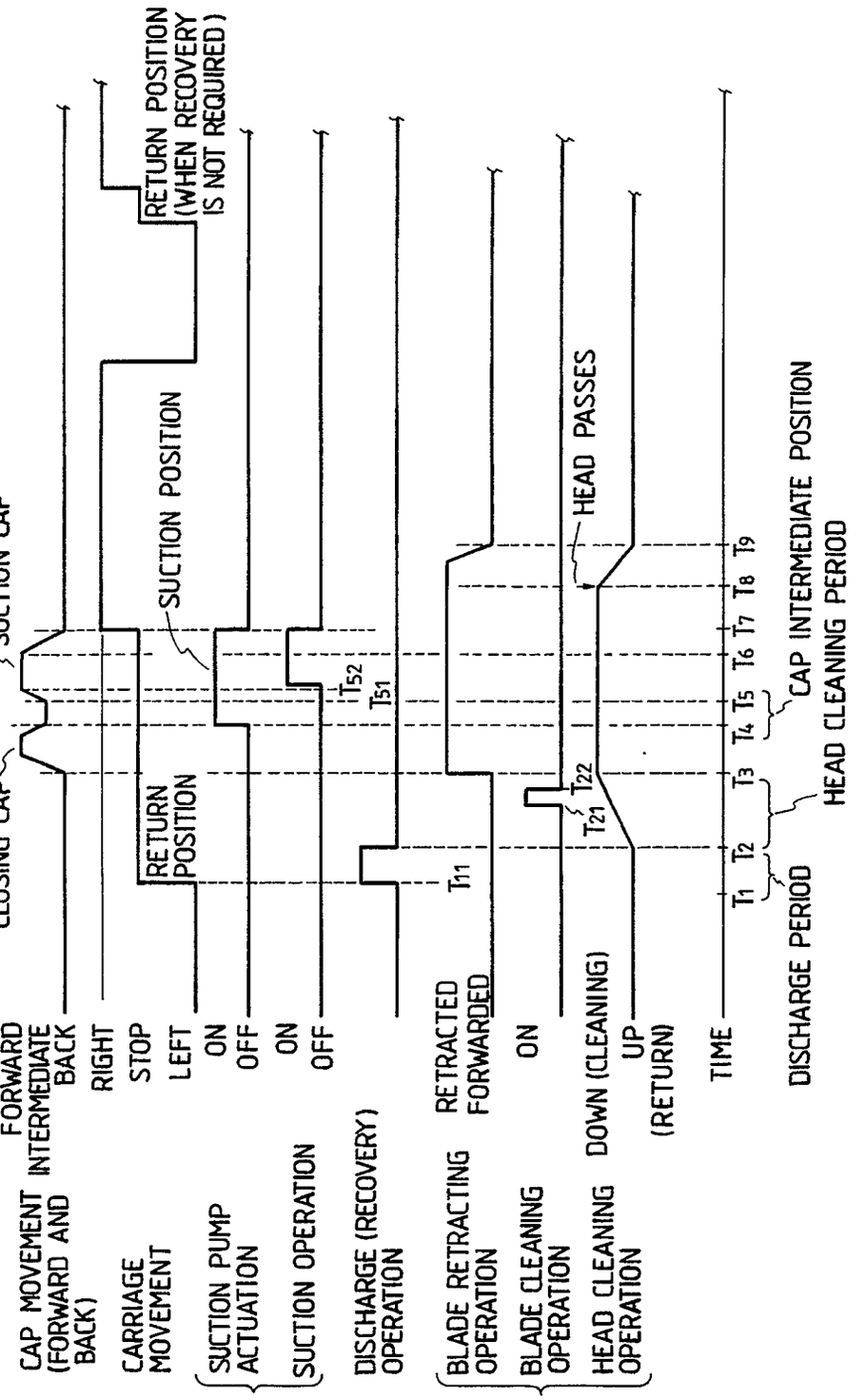

CAP MOVEMENT (FORWARD AND BACK)
FORWARD
INTERMEDIATE
BACK
CARRIAGE MOVEMENT
RIGHT
STOP
LEFT
SUCTION PUMP ACTUATION
ON
OFF
SUCTION OPERATION
ON
OFF
DISCHARGE (RECOVERY) OPERATION
BLADE RETRACTING OPERATION
RETRACTED
FORWARDED
BLADE CLEANING OPERATION
ON
HEAD CLEANING OPERATION
DOWN (CLEANING)
UP
(RETURN)
TIME
CLOSING CAP
SUCTION CAP
RETURN POSITION
SUCTION POSITION
RETURN POSITION (WHEN RECOVERY IS NOT REQUIRED)
HEAD PASSES
T1 T2 T3 T4 T5 T6 T7 T8 T9
T11
T21 T22
T51 T52
DISCHARGE PERIOD
HEAD CLEANING PERIOD
CAP INTERMEDIATE POSITION

FIG. 18A

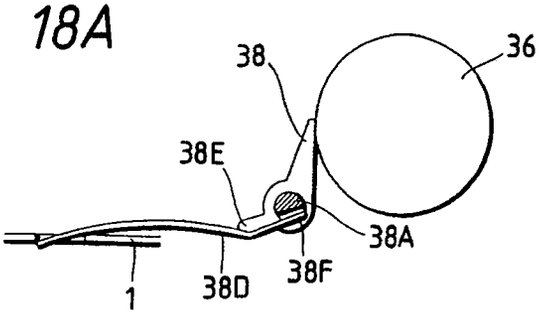


FIG. 18B

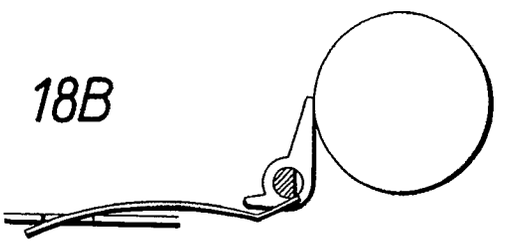


FIG. 19

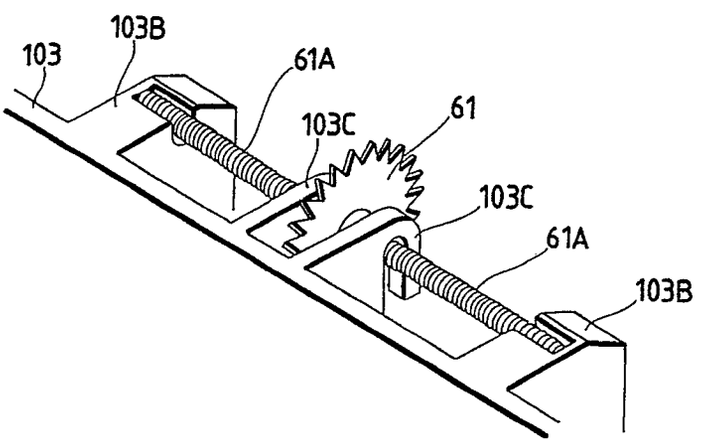


FIG. 20

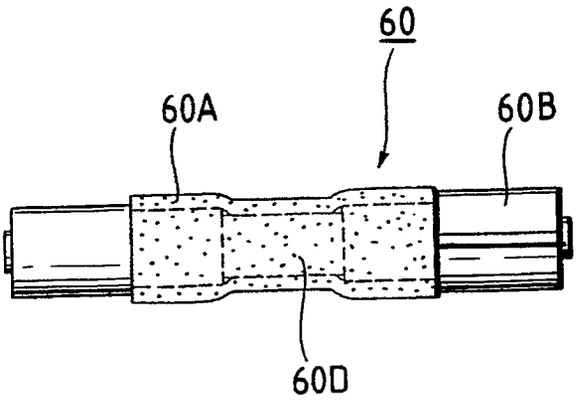


FIG. 21

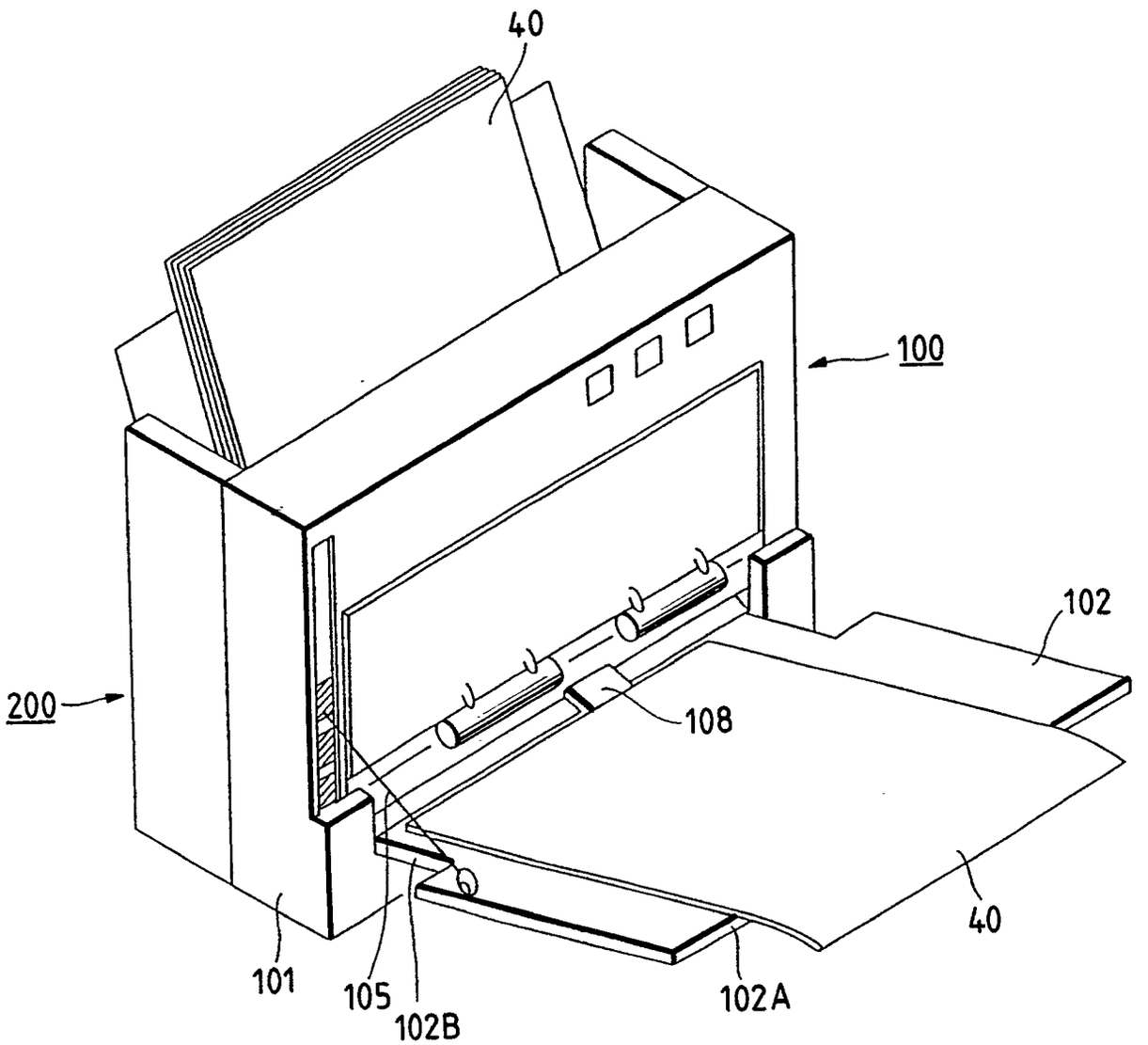


FIG. 22

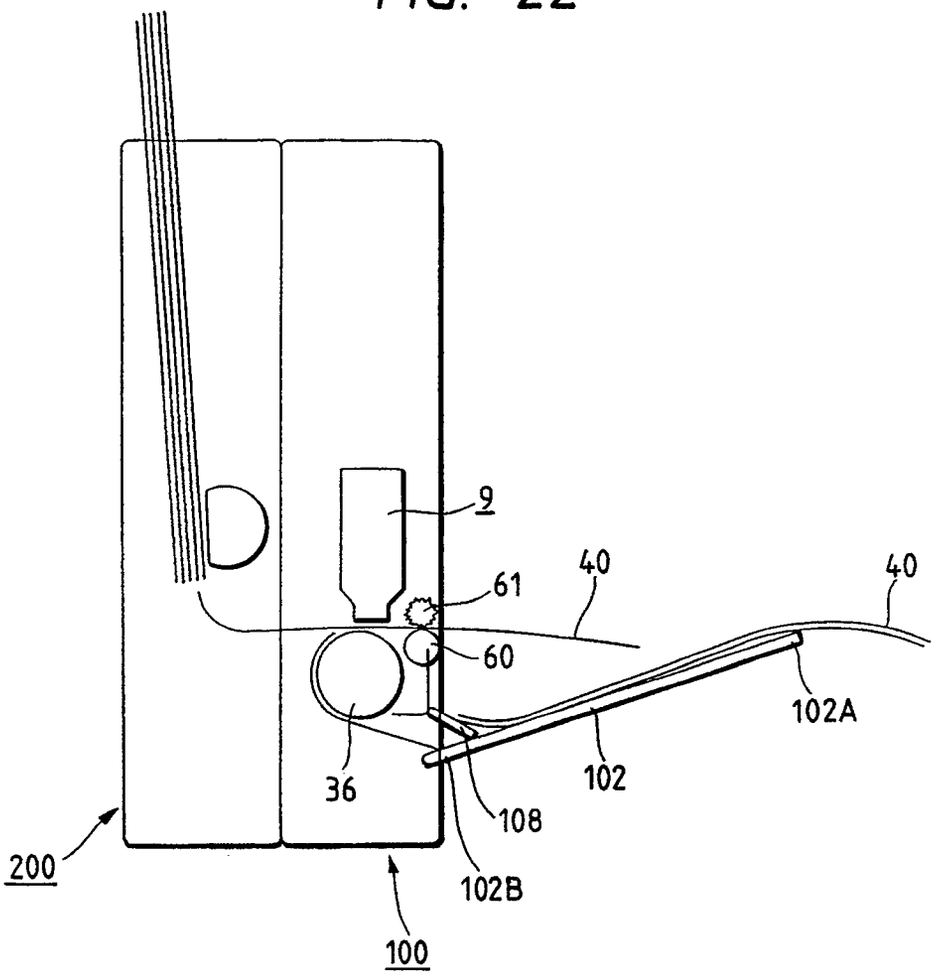


FIG. 23A

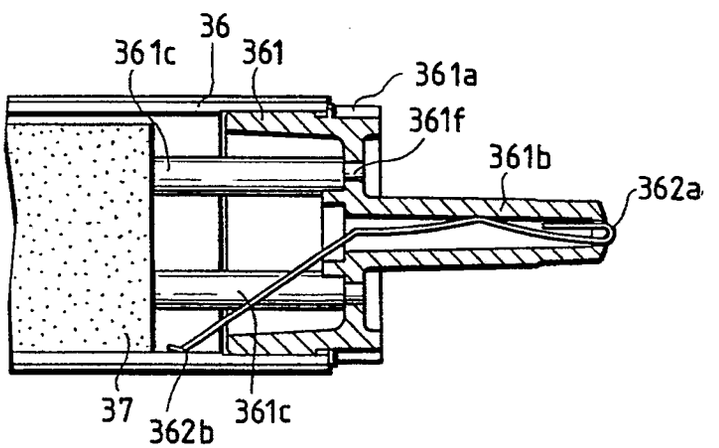


FIG. 23B

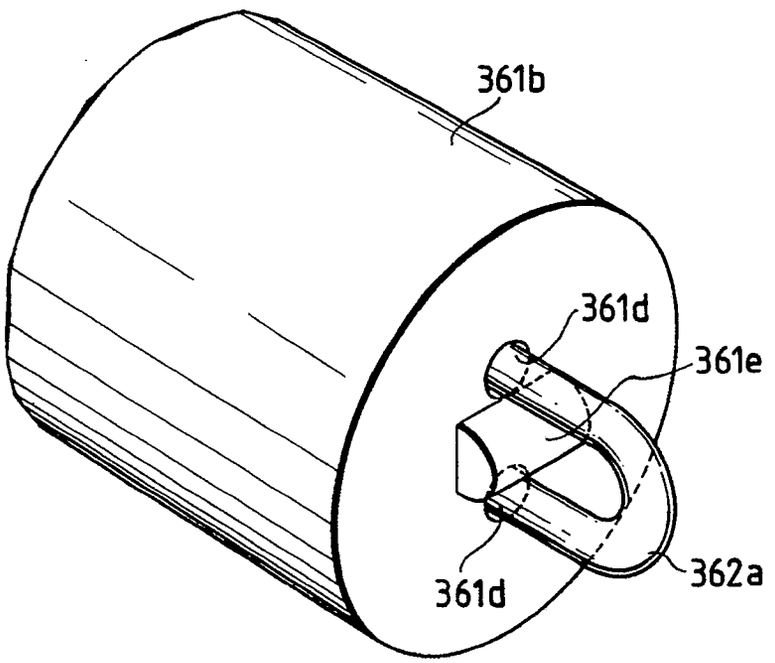


FIG. 24A

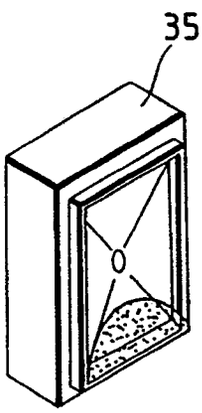


FIG. 24B

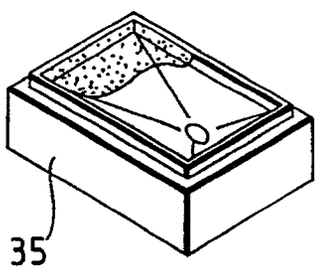


FIG. 24C

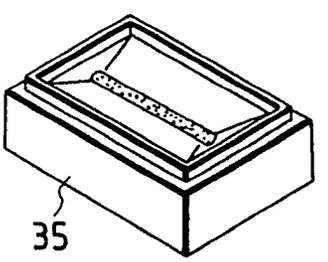


FIG. 25

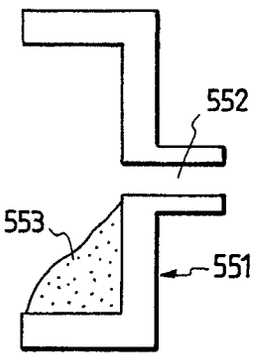


FIG. 26

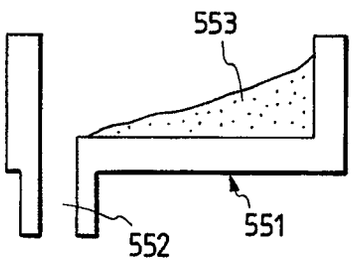


FIG. 27

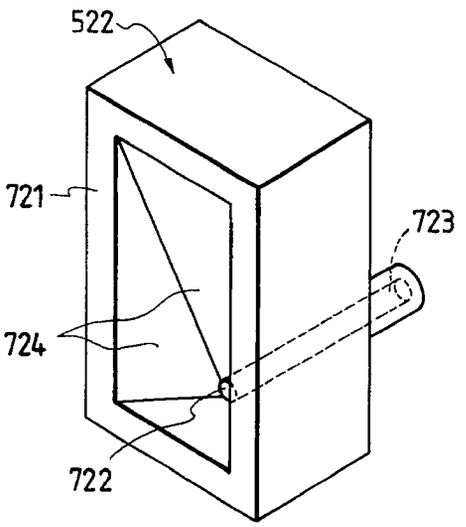


FIG. 28

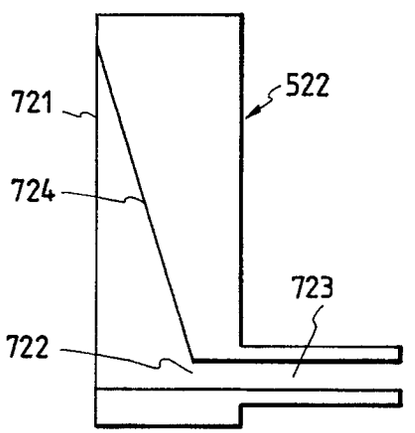


FIG. 29

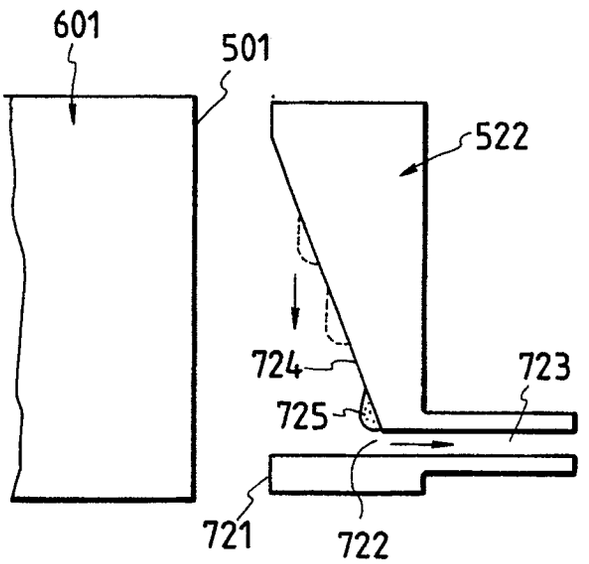


FIG. 30

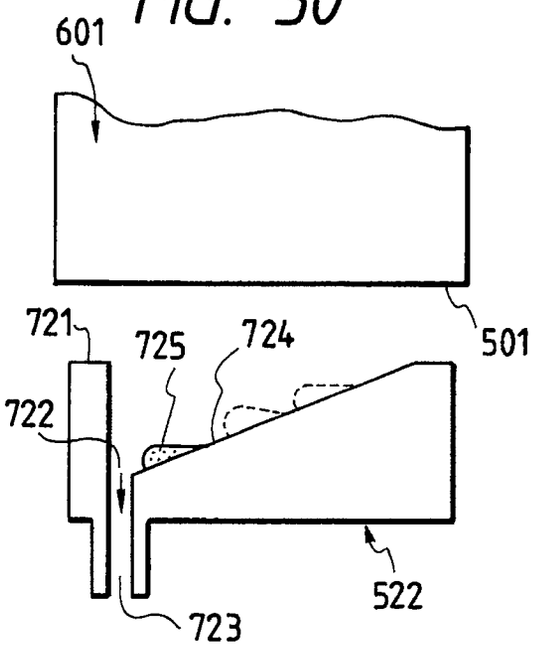


FIG. 31

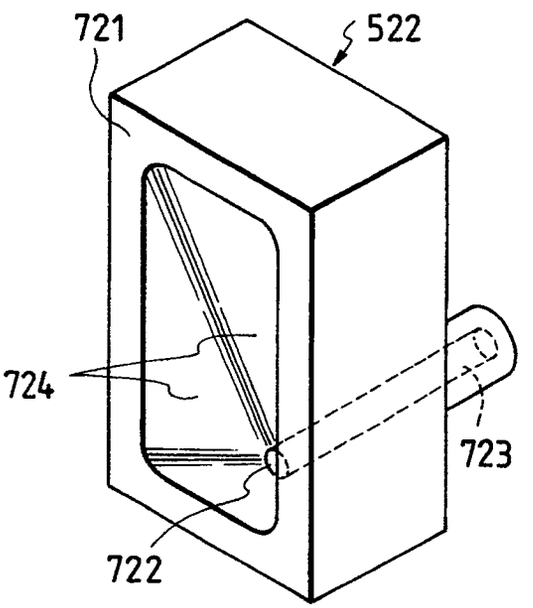


FIG. 32A

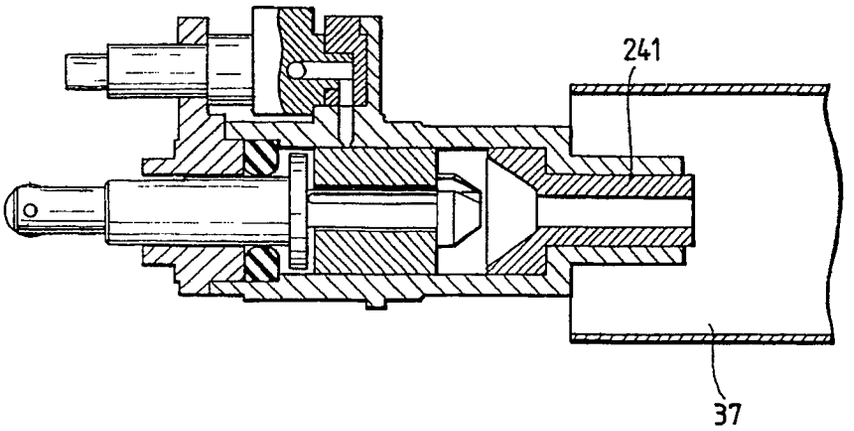


FIG. 32B

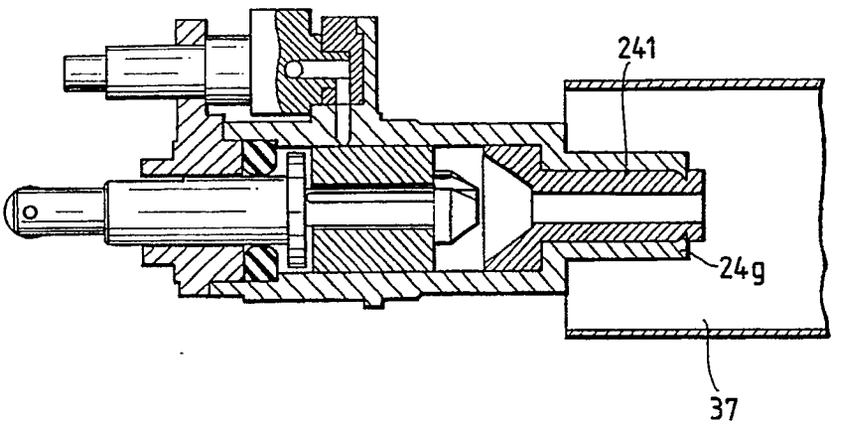


FIG. 32C

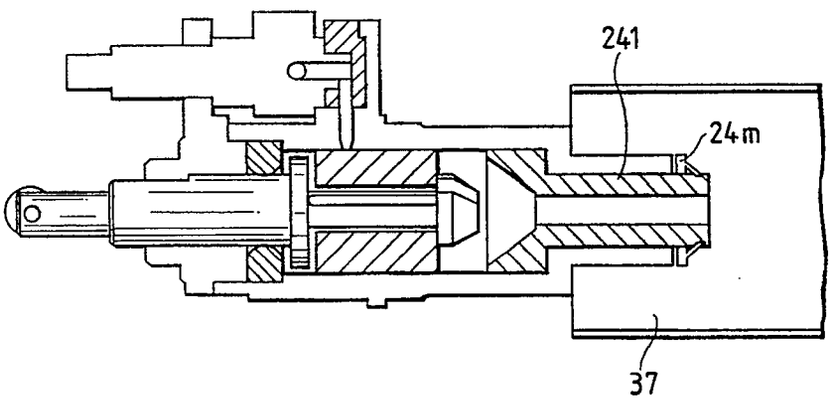


FIG. 33

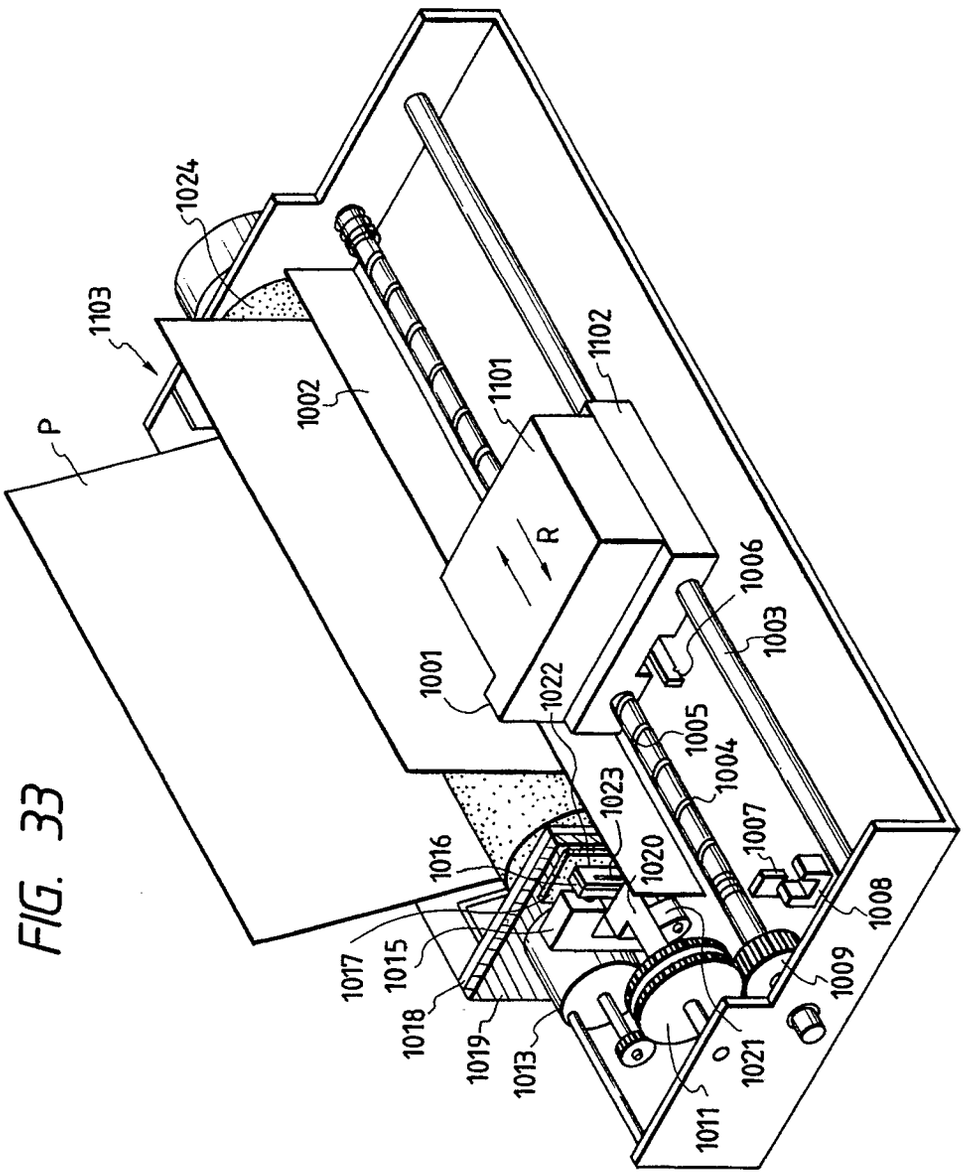
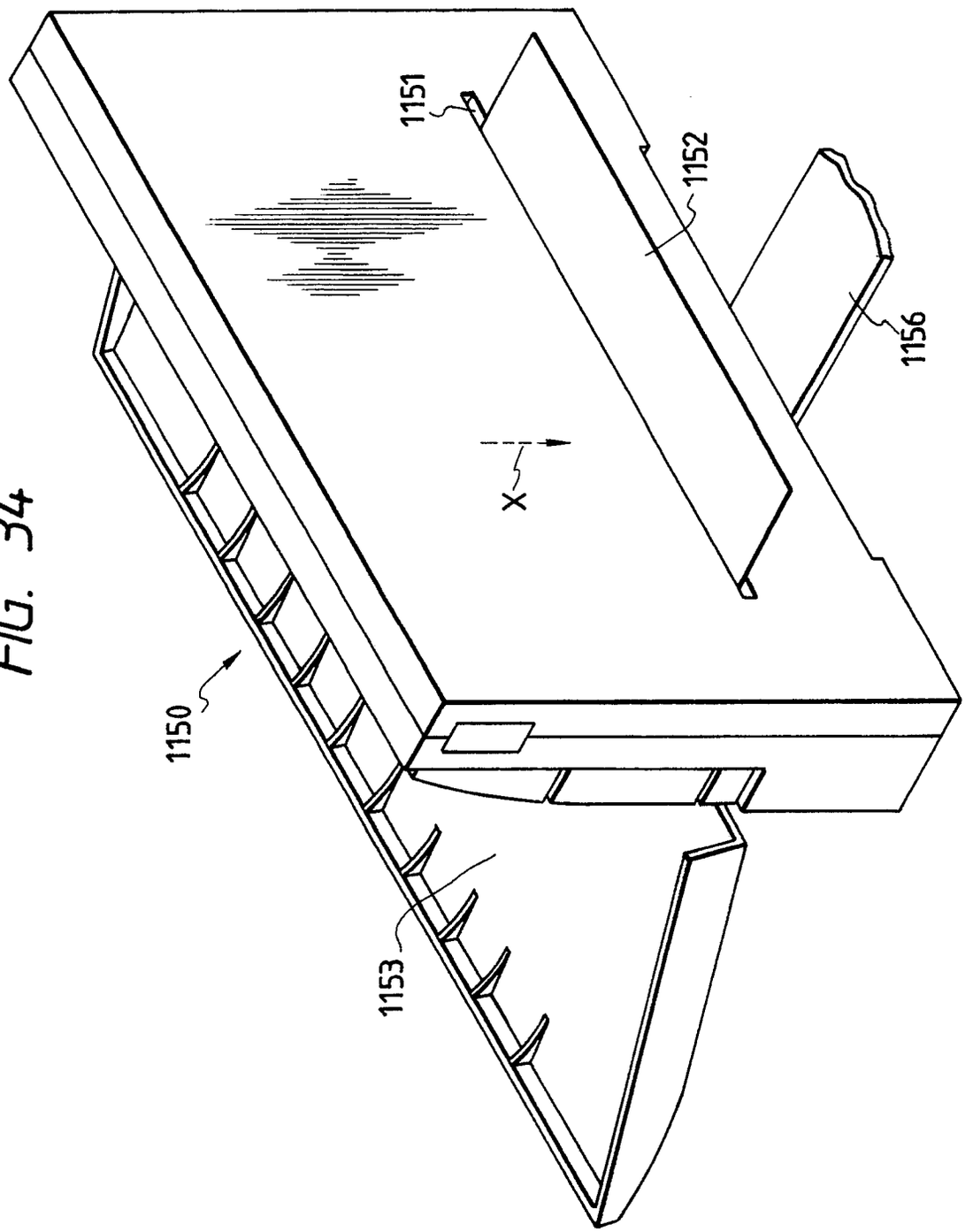

1024
1103
P
1002
1101
1102
R
1001
1022
1006
1003
1005
1004
1023
1007
1016
1020
1008
1017
1015
1009
1018
1019
1013
1021
1011

FIG. 34



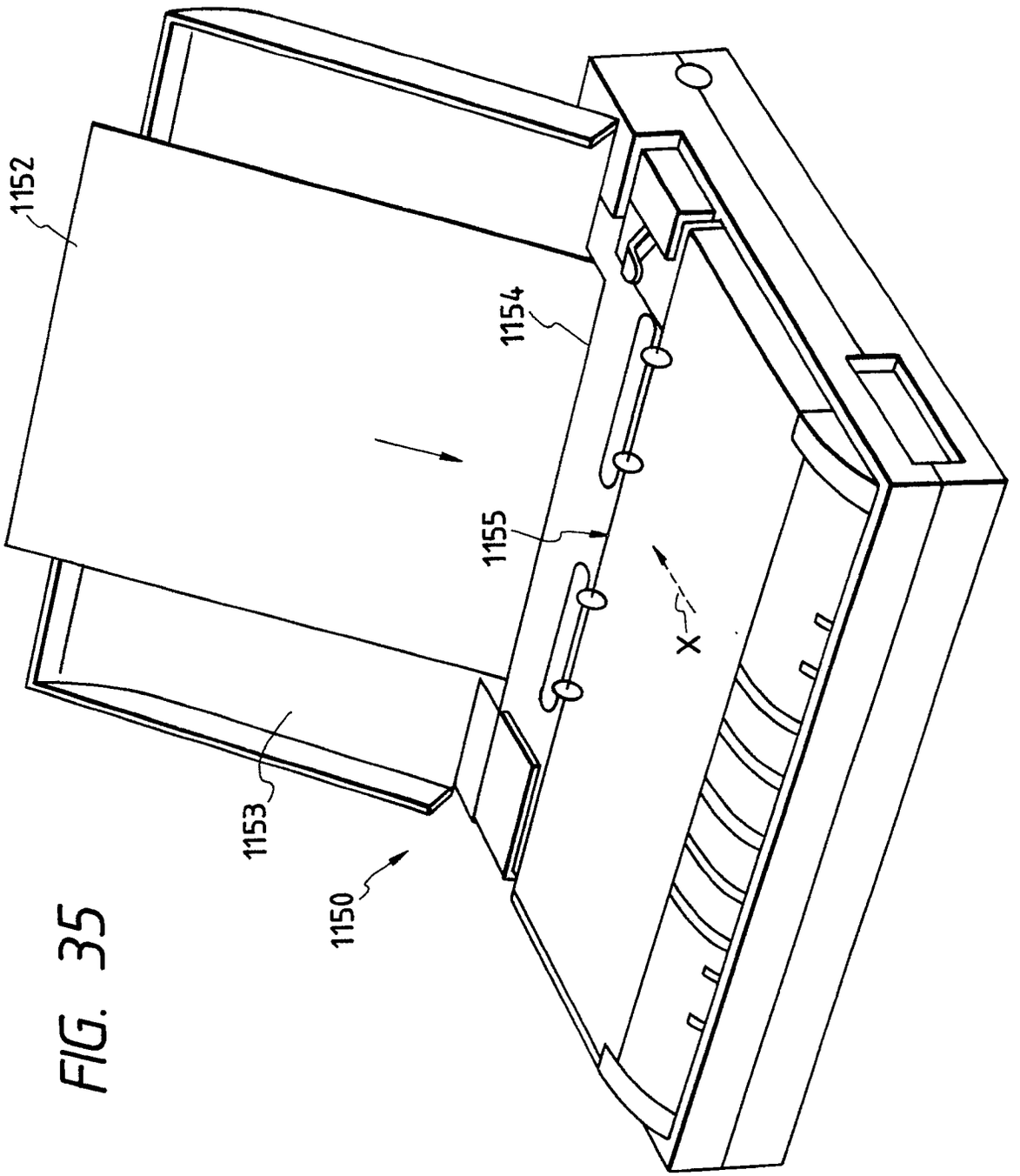


FIG. 35