

"PAPER FEED DEVICE"

This invention relates to a paper feed device, e.g. for feeding cut sheets to a printer such as a serial dot printer, a printer for an electron photograph recorder and that for a facsimile machine.

5 Cut sheets may be fed to a printer by stacking the cut sheets in a paper feed tray which is mounted on the printer so that the cut sheets are automatically supplied to the printer.

10 A tray holder for detachably holding the paper feed tray may be provided in the printer, and the tray holder may have a pick-up roller for one at a time picking up of a top sheet of the cut sheets in the paper feed tray. A hopper plate may be provided on the paper feed tray for pushing the stacked cut sheets up to the pick-up roller.

15 In order to facilitate correct setting of the cut sheets in the paper feed tray and correct setting of the paper feed tray in the printer, the hopper plate should be stably disposed at the bottom of the tray due to gravity when the paper feed tray is removed from the printer. Moreover, 20 when the tray is set in position in the printer, the hopper plate should resiliently urge the stacked cut sheets upwardly.

A device as described above has been suggested in which a manually operable lever is operated after the paper feed tray has been set in position in the printer so that the

hopper plate is moved upwardly, and a device has also been suggested in which the hopper plate gradually moves upwardly as the paper feed tray is inserted into the printer. However, in the former structure, it is necessary to lower the hopper plate by way of re-operating the lever when the paper feed tray is removed, and therefore, the operation of attaching and detaching the paper feed tray is complicated. On the other hand, in the latter structure, the cut sheets tend to become displaced, and proper feeding thereof is difficult because the cut sheets come into contact with the pick-up roller during the movement of the tray both when the paper feed tray is introduced into the printer and when the paper feed tray is removed from the printer.

According to the present invention there is provided a paper feed device comprising a paper feed tray for holding sheets of paper therein; a plate which is movably mounted in the paper feed tray for engagement with the lowermost sheet in the latter; plate engagement means which engage the plate and are movable to raise the plate to assist sheet feeding; a tray holder for detachably receiving the paper feed tray, the tray holder and the paper feed tray having cooperating parts which cause upward and downward movement of the plate engagement means when the paper feed tray is respectively introduced into and withdrawn from the tray holder; and a cam mounted within the tray holder

and which is engaged by the plate engagement means when the paper feed tray is introduced into and withdrawn from the tray holder so as to control the movement of the plate engagement means and thus of the plate.

5 Preferably, the said cooperating parts comprise at least one groove in the tray holder which is arranged to receive an abutment shaft carried by the paper feed tray when the latter is introduced into the tray holder and to stop movement of the abutment shaft when the latter has
10 entered the groove to a predetermined extent.

 The plate engagement means preferably comprises a plate-engaging shaft which is itself engaged by at least one lever an arm of which is connected to the abutment shaft by a resilient connection, movement of the paper feed tray
15 into the tray holder beyond the position in which the movement of the abutment shaft is stopped causing the resilient connection to rotate the or each lever and thus raise the plate-engaging shaft.

 The plate-engaging shaft preferably engages the plate
20 adjacent the end of the latter which in operation is introduced into the tray holder, the plate being pivotally mounted at its opposite end.

 The cam is preferably sector-shaped, the arrangement being such that, when the paper feed tray is introduced

into the tray holder, the plate engagement means first contacts the circumferential surface of the cam and then passes over a radial surface of the cam.

5 The invention also comprises a printer provided with a paper feed device as set forth above.

Thus in its preferred form, the paper feed device of the present invention can be easily attached to and detached from the printer without causing the feeding of paper sheets when the device is attached or detached.

10 The paper feed tray, in its preferred form, is constituted by a hopper plate which is rotatably mounted at the bottom of the paper feed tray for the purpose of stacking the cut sheets, a hopper shaft disposed on the lower surface of the front end of the hopper plate, a pair of movable
15 levers which are connected to opposite ends of the hopper shaft, and which are movably supported by two sides of the paper feed tray, guide grooves each of which is provided on the side surface of the paper feed tray and each of which extends in the direction in which the tray is
20 installed, a pair of movable members which are respectively movably supported by the corresponding two guide grooves, and in which securing portions each extending outwardly is provided, and a spring which is provided between each

movable lever and the respective movable member, and which can apply upward urging force to said movable lever so that it can raise the hopper plate by way of the hopper shaft.

5 The tray holder which is adapted to receive the paper feed tray is preferably constituted by a pair of side plates which are spaced apart to allow the paper feed tray to be inserted therebetween, securing grooves which are respectively provided on inner surfaces and at the rear portions of the two side plates, and which are brought into engagement with said
10 securing portions so that the latter prevent the movable members from movement and increase the spring force by expanding the spring, and a lock-cam which is movably supported on the inner surface and at the front portion of the two side plates, the lock-cam having a cam surface which is
15 engageable by the hopper shaft when the paper feed tray is inserted into the tray holder.

When the paper feed tray is attached to the tray holder, the hopper shaft is brought into engagement with a cam surface of the lock-cam so that the upward movement of
20 the hopper shaft is restricted, and when the hopper shaft passes the cam surface, the above restriction is released.

When the paper feed tray is removed from the tray receiver, the hopper shaft is forced down by means of side surfaces of the lock-cam.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:-

Figure 1 is a partial cross-sectional view from one side showing a paper feed tray of a paper feed device according to the present invention removed from a tray holder thereof;

Figure 2 is a vertical cross-sectional view of the said paper feed tray;

Figure 3 illustrates the relationship between a lock-cam which forms part of the tray holder and a hopper shaft which forms part of the paper feed tray; and

Figure 4 is a cross-sectional view showing the paper feed tray mounted in the tray holder.

Referring to Figure 1, a printer provided with a paper feed device according to an embodiment of the present invention comprises a carriage 3 which is slidably mounted on guide shafts 1, 2 which are supported by a pair of side plates (not shown). A Printing head 4 is mounted on the carriage 3. Opposite to the printing head 4 there is a platen 5 which is rotated by a paper feed motor (not shown). A friction roller 6 is positioned in contact with the platen 5. The friction roller 6 is rotatably mounted on a movable lever 8 which is pivotally mounted on a shaft 7. The lever 8 is acted on by a spring 9 which urges the friction roller 6 into contact with the platen 5. Above the front end of the printing head 4 there is provided a paper feed roller 10

and a pinch roller 11 which is positioned in contact with the paper feed roller 10 and which follows the rotational movement of the latter. The rollers 10, 11 are arranged to be driven through the paper feed motor in unison with the platen 5 when the paper is fed to the latter. Beneath the platen 5 there are provided paper guides 12, 13 and 14.

A tray holder 15 which is disposed beneath the paper guide 13 will now be described.

In the tray holder 15, a pair of substantially similar side plates 16 (only one shown) are spaced from and are disposed opposite to each other. A space to be described hereinafter, and into which a paper feed tray 28 may be inserted, is provided between the two side plates 16 and plates 17, 18, and 19 which are respectively disposed at the upper portion, at the bottom portion and in the front portion of the tray holder 15. Paper guides 17a, 18a and 19a are integrally formed with the corresponding plates 17, 18 and 19. Reference numerals 20 and 21 represent pick-up rollers each of which is arranged to be driven when cut sheets P are drawn from the paper feed tray 28. The lower portion of the pick-up roller 20 extends to the inside of the plate 17 through an opening (not shown) in the latter.

A movable body 23 is rotatably mounted on a shaft 22 which is mounted behind the plate 19. The upper surface of the movable body 23 has fixed thereto plastics guides 24 provided with a smooth upper surface and load members 25 made of a material having a high coefficient of friction, such as rubber. Two pairs of the guides 24 and the load members 25 are provided between which there is a predetermined spacing when viewed from the side. A pick-up roller 21 is disposed at an intermediate position between the said pairs.

On the inner surface and at the rear of each of the side plates 16 there is provided a securing groove 16a. A sector-shaped lock-cam 26 is rotatably mounted on a shaft 27 extending inwardly of and at the front of the side plates 16. The lock-cam 26 is usually disposed as illustrated due to its dead weight. A projection 26a projects from the outer surface of the lock-cam 26. The projection 26a is engaged with a groove 16b provided in the inner surface of a side plate 16. As a result of this engagement, the movement of the lock-cam 26 is restricted in the tray inserting direction, that is, towards the right as seen in Figure 1, while the movement of the lock-cam 26 in the reverse direction, that is, in the tray removal direction, is not impeded. However, this restriction of movement can

be also achieved by another structure. For example, a pin or a projection may be provided which abuts against the right hand surface of the lock-cam 26, the pin or projection extending from the inner surface of the side plate 16.

5 The paper feed tray 28 which may be inserted into and removed from the tray holder 15, will now be described with reference to Figures 1 and 2.

 The paper feed tray 28 has an open front surface and is formed in substantially a box shape, whereby cut sheets
10 P can be accommodated therein. A hopper plate 29, for receiving the cut sheets P thereon, is disposed at the bottom 28a of the tray 28. An end portion 29a of the hopper plate 29 is rotatably and slidably supported by a bearing member 29c which is held in place by a portion 28b of the tray 28.

15 A hopper shaft 30 is positioned in contact with the lower surface of the front portion of the hopper plate 29. The hopper shaft 30 is, in this embodiment, held by claws 29b which extend vertically from the lower surface of the front end of the hopper plate 29. The opposite ends of the hopper
20 shaft 30 extend outwardly of the side walls 28c of the tray 28 after passing through holes 28d formed in the side walls 28c. A movable lever 31 is pivotally mounted on a shaft 32 on the outer surface of each of the side walls 28c. The opposite ends of the hopper shaft 30 pass through holes 31b

in the arms 31a of the movable levers 31. Shafts 33a and 33b of movable members 33 are slidably engaged with guide grooves 28f and 28g formed in the side walls 28e of the tray, the guide grooves 28f and 28g extending in the tray inserting direction. The shaft 33b, which projects by a predetermined length beyond the outer surfaces of the side walls 28e, is capable of engaging securing grooves 16a formed in the corresponding side plates 16 of the tray holder 15. Between an arm 31c of each movable lever 31 and the corresponding movable member 33 there is provided a spring 34. Since the movable members 33 are shifted to the right as seen in Figure 1 when the paper feeding tray 28 is withdrawn from the tray holder 15, the spring 34 is not expanded at this time and therefore no rotational force is applied to the movable levers 31. Therefore, the hopper plate 29 due to its dead weight, is positioned adjacent the bottom 28a of the tray 28 as shown in Figure 2. The hopper plate 29 is also disposed adjacent the bottom 28a due to its dead weight when there is no cut sheet P.

20 The operation of inserting the paper feed tray 28 into the tray holder 15 will now be described.

The paper feed tray 28 in which the cut sheets P have been stacked is pushed to the right of the tray holder 15

as shown in Figure 1. When the shaft 33b of the movable members 33 is positioned at the entrance of the securing grooves 16a in the side plates 16 of the tray holder 15, the hopper shaft 30 is positioned at A shown in Figure 3.

5 When the shaft 33b of the movable members 33 is brought into contact with the lowermost parts of the slanting surfaces of the securing grooves 16a, the hopper shaft 30 is positioned at B shown in Figure 3.

 When the paper feed tray 28 is further inserted, however,
10 the latter is prevented from further movement by reason of the shaft 33b of the movable members 33 being in contact with the slanting surfaces of the securing groove 16a.
 Therefore, the movement of the movable members 33 is prevented, while the movable levers 31 are further advanced together
15 with the paper feed tray 28. As a result of this, the spring 34 is expanded as the paper feed tray 28 is pushed towards the right, whereby the spring force of the spring 34 is increased. Consequently, a counter-clockwise rotational force
 is applied to the movable levers 31, and the hopper shaft
20 30 is pushed upwardly. However, the hopper shaft 30 is slightly pushed upwardly in this state, is brought into contact with the cam surface 26b of the lock-cam 26, and is then moved from point C shown in Figure 3 to point D shown in Figure 3 along the cam surface 26b. That is, the spring 34 imparts

a sufficient spring force as the paper feed tray 28 is pushed in, but the movement of the hopper shaft 30 is restricted so that it is moved substantially horizontally by means of the cam surface 26b of the lock-cam 26.

5 When the paper feed tray 28 is inserted into the tray holder 15 until it reaches a predetermined position, the hopper shaft 30 passes over the cam surface 26b of the lock-cam 26. As a result of this, the hopper shaft 30 is rapidly moved upwardly with its restriction released
10 (see E shown in Figure 3). Consequently, as shown in Figure 4, the hopper plate 29 is rotated counter-clockwise so that the top sheet P abuts against the pick-up roller 20. That is, the cut sheets P abut against the pick-up roller 20 only when the paper feed tray 28 is inserted to a predetermined depth.
15 In this state, a projection 28j which projects from the front surface of the paper feed tray 28, extends through a hole 19b so that the movable body 23 is displaced from the position shown in Figure 1 to that shown in Figure 4. As a result of this, the pair of members consisting of the
20 guide 24 and the load member 25 projects through a through hole in the paper guide 19a. When a recess 28h in the rear portion of the guide groove 28g shown in Figure 1 is shifted to a position at which it is opposite the slanting surfaces

of the securing grooves 16a, the shafts 33a and 33b of the movable members 33 are shifted to the left hand ends of the guide grooves 28f and 28g. The upward movement of the shaft 33b is allowed by the recess 28h, so that the shaft 33b advances to a position at which it abuts against the left hand end surface of the securing grooves 16a. As a result of this, removal of the paper feed tray 28 is restricted.

In the state shown in Figure 4, when the pick-up rollers 20 and 21 are rotated in the direction designated by the arrows, the top sheet P is fed. In this state, the simultaneous feeding of two or three sheets is prevented by means of the load members 25, whereby only the top sheet is fed forwardly. The cut sheet P is introduced in front of the printing head 4 after its passage between the platen 5 and the friction roller 6, and is printed in a predetermined manner by means of the printing head 4, and is then picked up by the paper feed roller 10 and the pinch roller 11.

The operation of removing the paper feed tray 28 from the tray holder 15 will now be described.

If cut sheets P remain in the paper feed tray 28 when the paper feed tray 28 is removed from the tray holder 15, the cut sheets P abut against the pick-up roller 20, and several sheets are fed adjacent to the pick-up roller 21. When the paper feed tray 28 is removed to the left in this state the projection 28j at the front surface of the tray is reversed,

and the movable body 23 is restored to the state shown in Figure 1 due to its dead weight. Simultaneously, the hopper shaft 30 is moved left. As shown in Figure 3, since the hopper shaft 30 is positioned to the right of the side surface 26c of the lock-cam 26, the hopper shaft 30 is brought into engagement with the side surface 26c of the lock-cam 26, whereby the side surface 26c is moved. The movement of the lock-cam 26 is permitted until it is brought into contact (a position shown by a dotted line) with the plate 17 which is disposed on the upper surface, and further movement is prevented. Therefore, the hopper shaft 30 is rapidly passed along the side surface 26c of the lock-cam 26 (from point F to point C as shown in Figure 3). As a result of this, since the cut sheet P on the hopper plate 29 is moved away from the pick-up roller 20, several top sheets (which have been caused to project slightly towards the right over the paper feed tray 28) are prevented from being left in the tray holder 15. When the hopper shaft 30 is moved rearwardly to the position B shown in Figure 3, the spring 34 reduces to its original length and therefore the hopper plate 29 is disposed once again at the bottom 28a of the tray 23. As a result of this, the paper feeding tray 28 is completely removed from the tray holder 15 as shown in Figure 1.

In the embodiment described above, the movable members 33 can be disposed on the outer surfaces of the side surfaces 28e, while the movable levers 31 may be disposed on the inner surfaces of the side walls 28c. That is, it is a simple matter of design as to whether the movable levers 31 and the movable members 33 are disposed on either one of the side wall 28c or 28e.

Furthermore, the construction used to connect the movable levers 31 and the hopper plate 30 is not limited to that described above. Namely, the hopper plate 30 may be fixed for connection to arms 31a of the movable levers 31. In this case, through holes 28d may be formed in a concentric circle relative to the shaft 32. Furthermore, if the movable levers 31 are disposed on the inner surfaces of the side walls, the hopper plate 30 need not extend through the side walls of the tray, and therefore the through holes 28d also need not be provided.

In the paper feed device described above, the paper feed tray 28 can be attached to and detached from the tray holder 15 merely by pushing it in or pulling it out. As a result of this, attaching and detaching of the paper feed tray 28 is facilitated. Furthermore, when the tray 28 is attached or detached, no paper displacement occurs when the tray 28 is placed in position and therefore proper paper

feeding can be maintained, so that stable feeding of the paper to the printer can be realized.

C L A I M S

1. A paper feed device comprising a paper feed tray
for holding sheets of paper therein; a plate which is
movably mounted in the paper feed tray for engagement with
the lowermost sheet in the latter; plate engagement means
5 which engage the plate and are movable to raise the plate to
assist sheet feeding; a tray holder for detachably receiving
the paper feed tray, the tray holder and the paper feed
tray having cooperating parts which cause upward and
downward movement of the plate engagement means when the
10 paper feed tray is respectively introduced into and withdrawn
from the tray holder; and a cam mounted within the tray
holder and which is engaged by the plate engagement means
when the paper feed tray is introduced into and withdrawn
from the tray holder so as to control the movement of the
15 plate engagement means and thus of the plate.

2. A paper feed device as claimed in claim 1 in which
the said cooperating parts comprise at least one groove
in the tray holder which is arranged to receive an abutment
shaft carried by the paper feed tray when the latter is
20 introduced into the tray holder and to stop movement of the
abutment shaft when the latter has entered the groove to
a predetermined extent.



3. A paper feed device as claimed in claim 2 in which the plate engagement means comprises a plate-engaging shaft which is itself engaged by at least one lever an arm of which is connected to the abutment shaft by a resilient connection, movement of the paper feed tray into the tray holder beyond the position in which the movement of the abutment shaft is stopped causing the resilient connection to rotate the or each lever and thus raise the plate-engaging shaft.
4. A paper feed device as claimed in claim 3 in which the plate-engaging shaft engages the plate adjacent the end of the latter which, in operation, is introduced into the tray holder, the plate being pivotally mounted at its opposite end.
5. A paper feed device as claimed in any preceding claim in which the cam is sector-shaped, the arrangement being such that, when the paper feed tray is introduced into the tray holder, the plate engagement means first contacts the circumferential surface of the cam and then passes over a radial surface of the cam.
6. A paper feed device substantially as hereinbefore described with reference to and as shown in the accompanying drawings.



7. A printer provided with a paper feed device as claimed in any preceding claim.
