

"DRIVE TRANSMISSION, E.G. FOR PRINTERS WITH
BI-DIRECTIONAL PAPER FEED"

This invention relates to a drive transmission and, although it is not so restricted, it relates more particularly to a drive transmission for forwardly and backwardly feeding continuous printing paper while the latter is being printed by a printer.

A printer is known which has upstream and downstream paper feed means on opposite sides of a printing means, the upstream paper feed means being operated at a speed lower than that of the downstream paper feed means. This is because a slight tension is preferably applied to the record paper while printing is performed so as to improve the quality of the printing.

The fact that the paper feed rate of the upstream paper feed means is lower than that of the downstream paper feed means is acceptable when the paper is fed forwardly, but if the paper feed is reversed in the middle of printing, this would cause slackness in the paper because of the feed rate difference, so that it is necessary to limit the amount of paper feed, for example, to about one third of a page.

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According to the present invention, there is provided a drive transmission comprising drive gear means having first and second gear portions which are integral or

interconnected to rotate in unison in the same angular direction, the drive gear means being selectively rotatable in either angular direction; first and second driven gears which are drivingly connected to the first and second gear portions respectively; a driven shaft; a first one-way drive transmission for transmitting drive from the first driven gear to the driven shaft so that the latter rotates in one angular direction only; and a second one-way drive transmission for transmitting drive from the second driven gear to the driven shaft so that the latter rotates in the opposite angular direction only; the gear ratio between the first gear portion and the first driven gear being different to that between the second gear portion and the second driven gear.

Preferably, the first and second gear portions are constituted by integral portions of a common drive gear, the said integral portions having different diameters.

Preferably, the first and second driven gears are mounted, directly or indirectly, on the driven shaft.

Thus the first driven gear is preferably mounted on the driven shaft by way of a one-way clutch which constitutes the said first one-way drive transmission.

The second driven gear is preferably freely rotatable on the driven shaft.

The second one-way drive transmission preferably comprises a member secured to the driven shaft; a slipping

drive transmission part which interconnects the second driven gear and the said member and is capable of slipping with respect to at least one of the latter; and means permitting the transmission of drive through the slipping drive transmission part only when the driven shaft is being driven in the said opposite angular direction.

The said member is preferably a cylindrical member, the second driven gear having a shaft portion, the slipping drive transmission part being constituted by a spring which is wound around the cylindrical member and the shaft portion.

Preferably, one end of the spring engages a rotary part which can rotate only in the said opposite angular direction.

The rotary part may be mounted on the driven shaft by means comprising a one-way clutch.

The invention also comprises a printer provided with a drive transmission as set forth above, the printer having a printing means and upstream and downstream paper feed means which are respectively disposed upstream and downstream of the printing means, the said driven shaft being the drive shaft of one of the paper feed means.

According to another aspect of the present invention, there is provided a printer having printing means and two paper feed means which are respectively arranged

on opposite sides of the printing means, the arrangement being such that the paper may be fed through the printer in either direction, and means for ensuring that in operation the paper feed means which is at any time on the upstream side of the printing means, is at that time operated at a lower feed speed than the downstream paper feed means.

Thus, in a preferred form of the present invention, there is provided a printer having a forward and backward feed apparatus which completely avoids the necessity of limiting the amount of backward feed of record paper, for example, continuous paper.

In the said preferred form of the present invention, when the paper is fed forwardly, the drive force is transmitted from a smaller diameter gear portion and via a forward feed gear wheel, a clutch spring and a spring seat to the driven shaft. At this time the upstream paper feed means has a lower paper feed rate than the downstream paper feed means. When the paper is fed backwardly, however, drive transmission from the smaller-diameter gear portion is impossible, and the drive force is transmitted from a larger-diameter gear portion via a backward feed gear wheel, and a one-way clutch to the driven shaft.

Therefore, during backward or reverse feed, the drive force is transmitted from the larger-diameter gear portion

to the respective gear wheel, so that the latter rotates faster than during forward feed, whereby the drive shaft during the backward feed rotates at a higher speed than the downstream paper feed means at the forward feeding.

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

Figure 1 is a cross sectional view of a printer provided with a drive transmission according to the present invention,

10 Figure 2 is an enlarged cross-sectional view of paper feed means positioned on the upstream side of the platen of the printer of Figure 1;

Figure 3 is an enlarged cross sectional view of paper feed means positioned on the downstream side of the platen of the printer of Figure 1;

15 Figure 4 is a plan view of a tractor unit forming part of the printer of Figure 1;

Figure 5 is a plan view of a base plate of the said tractor unit;

20 Figure 6 is a front view of a drive transmission of the printer of Figure 1; and

Figure 7 is an enlarged cross-sectional view taken along the line VII-VII of Figure 6.

An embodiment of the present invention will now be described with reference to the accompanying drawings.

A printer provided with a drive transmission according to the present invention comprises opposing side plates 1 (Figure 1) and 1A (Figure 6), which constitute a frame of a printer, and printing means 2. Upstream and downstream paper feed means 3, 4 are provided respectively on the upstream and downstream sides of the printing means 2.

The upstream paper feed means 3 is arranged to have a lower paper feed rate than that of the downstream paper feed means 4, the latter functioning as a paper removal means when record paper is fed forwardly by the upstream paper feed means 3. This difference in speed is provided because the printing quality is improved by doing so since tension is thereby applied to the record paper.

The specific structure of the printing means 2 will now be described. A platen 20 is rotatably mounted on a shaft 20a which is supported by the side plates 1, 1A. A printing head 21 is provided opposite to the platen 20. The printing head 21 is mounted on a carriage 22 which is adapted to be reciprocated along guide shafts 23 and 24 extending through the carriage 22. Drive means for the carriage 22 include an engagement member 22a extending integrally from the carriage 22, and an endless drive belt 25 coupled to the engagement member 22a and extending around a driven pulley 26 driven by a carriage motor (not shown).

Record paper, which is fed through a paper feed opening 5 provided at the front of a housing 1B of the printer (left side in Figure 1), is guided by means of guide plates 6a, 6b and 6c and a support plate 7 into a space between the platen 20 and the printing head 21 for printing purposes.

The specific construction of the upstream paper feed means 3, which operates when continuous paper is fed forwardly, will now be described with reference to Figure 1 and also with reference to Figure 2 in which the essential portion of the upstream paper feed means 3 is shown on an enlarged scale.

The side plate 1 has the support plate 7 mounted thereon. A mounting plate 30 protrudes from the back of the support plate 7 and has a shaft 31 fixed thereto. A lever 32 is pivotally mounted on the shaft 31. A bearing groove 7a is provided in the support plate 7. A shaft 33a of a pinch roller 33 is movably and rotatably mounted in the bearing groove 7a. The lower end of the lever 32 is resiliently urged against the shaft 33a of the pinch roller 33. The spring force for this is derived from a spring 34 which is engaged with the upper end of the lever 32. The pinch roller 33 protrudes through a hole in the support plate 7 into a guide passageway 7A. The pinch roller 33 is

resiliently urged against a drive roller 35 which protrudes into the guide passageway 7A, the drive roller 35 being adapted to effect feeding of the paper. The drive roller 35 is mounted on a drive shaft 35a, the drive means for which will be described in more detail later with reference to Figure 6.

The specific construction of the downstream paper feed means 4 will now be described with reference to Figure 1 and also with reference to Figure 3 in which the essential portion of the downstream paper feed means 4 is shown on an enlarged scale.

A drive roller 40 which draws out the record paper is driven by a drive shaft 40a thereof. The drive means therefor will be described later in more detail with reference to Figure 6. A pinch roller 41 is resiliently urged against the drive roller 40 to draw out the record paper which passes between the rollers 40, 41.

The pinch roller 41 is free to be engaged with or disengaged from the drive roller 40. The pinch roller 41 constitutes the downstream paper feed means. The pinch roller 41 is mounted on a rotary shaft 41a.

The rotary shaft 41a is mounted on a support plate 42 which provides a rotatable mounting for a guide shaft, for example, the shaft of a pinion 43. The pinion 43 is

positioned within a guide hole 11 provided in the side plate 1. Rack teeth 11a are formed in one inner wall surface of the guide hole 11 and are adapted to mesh with the pinion 43. Therefore, when the pinion 43 moves upwardly while meshing with the rack teeth 11a in the guide hole 11, the support plate 42 also moves upwardly, so that the pinch roller 41 is moved away from the surface of the drive roller 40.

A pinch roller unit having such a construction is also provided at a corresponding position on the other side plate 1A. The reason why the rack teeth 11a are provided in the guide hole 11 is to equalize the movement of the right and left pinions 43. A recess 11b is formed in the inner surface of the guide hole 11, on the side of the latter opposite to the rack teeth 11a, in order to facilitate the manual lifting of the support plate 42 to the upper end of the guide hole 11 to cause the shaft 41a of the pinch roller 41 to be engaged in the recess 11b to thereby facilitate exchange of an ink ribbon when the parts are so disposed.

The disengagement of the pinch roller 41 from the drive roller 40 with which it is normally resiliently engaged is performed by causing a pinch roller release lever 44, which is rotatably mounted on a shaft 44a extending from

the side plate 1, to abut against a protrusion on the support plate 42 to thereby move the support plate 42. The pivotal movement of the release lever 44 is performed in conjunction with the rotation of a tractor unit 8.

5 The tractor unit 8 is provided at another paper feed port 5A, the tractor unit 8 being adapted to feed continuous paper. The drawing out of the record paper can be performed by the drive roller 40 and the pinch roller 41 while, when continuous paper is printed, the tractor unit 8 may be
10 reversed from its position at the port 5A to a drawing-out position in order to draw out continuous paper which is fed forwardly.

 The specific construction of the tractor unit 8 will now be described in more detail. The side plate 1 has a shaft
15 80 on which a protrusion 81a of a base plate 81 is rotatably mounted, the tractor unit 8 being secured to the base plate 81. As shown in Figure 5, the base plate 81 has a through hole 81c, through which extends a drive shaft 82, and a handle 81b which is used to reverse the tractor unit 8, the latter also
20 having a through hole 81d through which extends a support shaft 83.

 A base plate 81 (shown in Figure 5) is attached to each side of the tractor unit 8 shown in Figure 4. A drive wheel 87 (Figure 6) and a rotary wheel are rotatably mounted in an outer
25 frame of the unit. The drive shaft 82 and support shaft 83 respectively support the wheels with a drive belt 84 extending around both the rotating wheels. The drive belt 84 has protruding sprockets 84a on its upper surface, a cover 85, which is openable

and closable being provided to give access to the sprockets 84a. The cover 85 is opened when record paper is replaced. A click spring (not shown) is engaged with the cover 85. The tractor unit 8 is adjustable in position in a rightward and leftward direction along the shafts 82 and 83. A lock lever 86 is provided on the support shaft 83 to lock the tractor unit 8 in position.

The drive wheel train mechanism of the present embodiment will now be described with reference to Figure 6.

A reversible paper feed motor M is mounted on the side plate 1A opposite to the side plate 1. A pinion 90, which is mounted on the drive shaft of the motor M, meshes with a gear wheel 91, the pinion 91a of which meshes with a drive gear wheel 92 which drives the platen 20 and hence the shaft 20a of the platen. The drive gear wheel 92 of the platen 20 meshes with a pinion 93, the gear wheel 93a of which meshes with a gear wheel 94 to drive the shaft 40a of the wheel 94. The shaft 40a is the shaft of the paper drawing-out drive roller 40 of the downstream paper feed means 4.

The gear wheel 91 meshes with a drive gear wheel 95 which is mounted on a shaft 95A, the drive gear wheel 95 meshing with a gear wheel 96, the shaft 35a of which is the drive shaft of the drive roller 35 of the upstream paper feed means 3 which is provided to feed continuous paper toward the platen 20.

The drive shaft 40a of the drive roller 40 of the downstream paper feed means 4 has a slightly higher feed rate than that of the shaft 35a of the drive roller 35 of the upstream paper feed means 3 when the rollers 35, 40 are driven forwardly, as described above.

The gear wheels 95 and 96 have a mechanism which switches between the forward paper feed and the backward or reverse paper feed of the drive shaft 35a. The detailed construction of this mechanism will be described later in more detail.

Gear wheel 91 meshes with a gear wheel 97, the pinion 97a of which meshes with a gear wheel 98.

The pinion 97a is meshable with the drive gear wheel 87 of the tractor unit 8 when the latter is positioned at the paper feed port 5A (paper feed position). The gear wheel 98 is meshable with the drive gear wheel 87 of the tractor unit 8 when the latter is reversed to the position of the downstream paper feed means 4 (shown by chain lines in Figure 3).

In Figure 7 there is shown the mechanism by means of which the paper feed rate of the upstream paper feed means 3 (in this case, the term "upstream" should really be changed to "downstream", but it is used here for the purpose of keeping the terminology consistent) is set to be greater than that of the downstream paper feed means 4 (in this case, the term "downstream" should really, of course, be changed

to "upstream").

The drive gear wheel 95, which is mounted on a shaft 95A, transmits drive to the drive shaft 35a of the drive roller 35 of the upstream paper feed means 3. The drive gear wheel 95 includes a two-stepped structure comprising a larger-diameter gear portion 95a and a small-diameter gear portion 95b provided coaxially of the shaft 95a. A reverse feed gear wheel 96a is mounted on the drive shaft 35a such that it meshes with the larger-diameter gear portion 95a, the reverse feed gear wheel 96a being drivingly connected to the drive shaft 35a by way of a one-way clutch 100. A forward gear wheel 96b is mounted loosely on the drive shaft 35a such that it meshes with the smaller-diameter gear portion 95b. A cylindrical member 101, which acts as a spring seat, is coupled via a pin 106 to the drive shaft 35a. A clutch spring 102 is wound around the outer periphery of the stub shaft 96c of the forward feed gear wheel 96b and the spring seat 101 with one end of the spring 102 being engaged with a rotary member 103 which is supported via a one-way clutch 104 on a bearing 105 for the drive shaft 35a. The front (left in Figure 1) of the housing of the printer has upper and lower paper feed ports 501 and 502 through which cut paper is fed. Cartridges (not shown), in which cut paper is accommodated, are arranged to be inserted into cases 501 and 520 at the paper feed ports 501, 502.

The operation of this invention will now be described.

When cut paper is fed forwardly, the drive force from the paper feed motor M is transmitted via the gear wheel 91 to the smaller-diameter gear portion 95b of the gear wheel 95.

5 At this time, the clutch spring 102 becomes tensioned, so that the drive force is applied to the drive shaft 35a via the forward feed gear wheel 96b and the spring seat 101. At that time, the reverse feed gear wheel 96a is also rotated, but the torque therefrom is not transmitted to the drive shaft
10 35a because the one-way clutch 100 is not engaged.

At the same time, the drive roller 40 of the downstream paper feed means 4 is rotated from the gear wheel 91 via gear wheels 93a and 92 which drive the platen 20, and the printed cut paper is drawn out in cooperation with the
15 pinch roller 41. The paper feed rate of the drive roller 40 at that time is higher than the paper feed rate of the upstream drive roller 35.

When the tractor unit 8 is used to print on continuous paper, the handle 81b of the unit base plate 81 is rotated
20 by hand counter-clockwise around the shaft 80. This causes the tractor unit 8 to move through the guide groove and to be set at the paper drawing-out position, as shown by chain lines in Figure 3. By the reversing operation of the tractor unit 8, the angular portion of the base plate 81 rotates the
25 release lever 44 clockwise around shaft 44a, so that the support

plate 42 moves upward along the guide hole 11, and the pinch roller 41 is disengaged from the drive roller 40.

Continuous paper is fed from the paper feed opening 5 and passes between the pinch roller 33 and the drive roller 35 and between the platen 20 and the printing head 21, and is disposed at its leading end in the tractor unit 8.

At that time, the motor M rotates the drive gear wheel 87 of tractor unit 8 via gears 91 and 98. The paper feed rate effected by the drive gear wheel 87 at this time is higher than the paper feed rate effected by the upstream drive roller 35.

The reverse feed of the continuous paper by using the tractor unit 8 will now be described. Part of the drive from the motor M is transmitted to the upstream paper feed means 3. At this time, the one-way clutch 100 is engaged so that torque is transmitted via the larger-diameter gear portion 95a to the reverse-feed gear wheel 96a so as to rotate the drive shaft 35a of the upstream drive roller 35. Simultaneously, the drive force from the motor M is transmitted to the drive shaft 82 of the tractor unit 8 via the wheels 91, 97, pinion 97a and gear wheel 98.

The torque of the motor M is transmitted via the larger-diameter gear portion 95a so that the backward paper feed rate becomes higher than the forward paper feed rate and is transmitted more rapidly to the drive shaft 35a. Therefore, the backward feed rate is higher than the

paper feed rate which is effected by the downstream drive roller 40.

Continuous paper may be fed from the paper feed port 5A by using the tractor unit 8. At that time, the tractor unit may be installed in the position shown by solid lines in Figure 1 such that continuous paper is fed between the platen 20 and the printing head 21 and is drawn out by the drive gear wheel 40 and pinch roller 41.

In the embodiment described above, during forward and backward feed of the record paper, the use of the larger-and-smaller-diameter gear portions 95a, 95b, enables the paper feed rate to be changed in such a way that the record paper does not become slack whether it is fed in the forward or backward direction, and it is unnecessary to limit the amount of backward feed.

C L A I M S

1. A drive transmission comprising drive gear means having first and second gear portions which are integral or interconnected to rotate in unison in the same angular direction, the drive gear means being selectively rotatable in either angular direction; first and second driven gears which are drivingly connected to the first and second gear portions respectively; a driven shaft; a first one-way drive transmission for transmitting drive from the first driven gear to the driven shaft so that the latter rotates in one angular direction only; and a second one-way drive transmission for transmitting drive from the second driven gear to the driven shaft so that the latter rotates in the opposite angular direction only; the gear ratio between the first gear portion and the first driven gear being different to that between the second gear portion and the second driven gear.

2. A drive transmission as claimed in claim 1 in which the first and second gear portions are constituted by integral portions of a common drive gear, the said integral portions having different diameters.



3. A drive transmission as claimed in claim 1 or 2 in which the first and second driven gears are mounted, directly or indirectly, on the driven shaft.

5 4. A drive transmission as claimed in claim 3 in which the first driven gear is mounted on the driven shaft by way of a one-way clutch which constitutes the said first one-way drive transmission.

10 5. A drive transmission as claimed in claim 3 or 4 in which the second driven gear is freely rotatable on the driven shaft.

15 6. A drive transmission as claimed in claim 5 in which the second one-way drive transmission comprises a member secured to the driven shaft; a slipping drive transmission part which interconnects the second driven gear and the said member and is capable of slipping with respect to at least one of the latter; and means permitting the transmission of drive through the slipping drive transmission part only when the driven shaft is being driven in the said opposite angular direction.

20 7. A drive transmission as claimed in claim 6 in which the said member is a cylindrical member, the second driven gear having a shaft portion, the slipping drive transmission part being constituted by a spring which is wound around the cylindrical member and the shaft portion.



8. A drive transmission as claimed in claim 7 in which one end of the spring engages a rotary part which can rotate only in the said opposite angular direction.

9. A drive transmission as claimed in claim 8 in which the rotary part is mounted on the driven shaft by means comprising a one-way clutch.

10. A drive transmission substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

11. A printer provided with a drive transmission as claimed in any preceding claim, the printer having a printing means and upstream and downstream paper feed means which are respectively disposed upstream and downstream of the printing means, the said driven shaft being the drive shaft of one of the paper feed means.

