

SPECIFICATION Printer

This invention relates to printers and in particular, although not so restricted, to thermal printers.

Conventional printers have various types of paper feeding mechanisms such as, a mechanism in which rubber paper feeding rollers are rotated by a motor, or a mechanism in which paper is gripped upon forward motion of a lever reciprocally moving in a circular arc and the paper is released therefrom when the lever moves in the opposite direction. However, these mechanisms are disadvantageous because complicated speed reduction gearing or intermittent feeding mechanisms are required. Thus conventional printers are relatively large in size and have a relatively large number of parts.

According to the present invention there is provided a printer comprising: a platen; a print head positioned opposite said platen; a print head driving shaft having a bidirectional cam-groove and oriented parallel to said platen; means on said print head for engaging said bidirectional cam-groove to effectuate reciprocating movement of said print head parallel to said platen in response to rotation of said driving shaft; and paper feeding and positioning means for feeding paper between said print head and said platen and for positioning the paper to be printed on, said paper feeding and positioning means comprising a paper feeding roller having a middle portion and a pair of end portions, said head and said paper feeding roller middle portion together comprising means for rotating said paper feeding roller through a predetermined angular interval each time said print head travels from one end of said platen to another in one particular direction, a pair of paper receiving rollers each disposed opposite a respective one of said paper feeding roller end portions, said paper receiving rollers and corresponding ones of said paper feeding roller end portions receiving therebetween, in use, paper to be printed on and which is advanced up to said platen by rotation of said paper feeding roller with the paper gripped between said paper feeding roller end portions and said paper receiving rollers, and means comprising a guide surface for guiding paper to advance between said paper feeding roller and said paper receiving rollers.

Preferably said paper feeding roller end portions have respective diameters larger than a diameter of said paper feeding roller middle portion, and said means comprising a guide surface is comprised of a plate-like member disposed between said paper feeding roller end portions opposite said paper feeding roller middle portion and spaced from said paper feeding roller middle portion a distance less than the difference between the radius of said paper feeding roller middle portion and said paper feeding roller end portions.

The printer may further comprise a mounting

shaft mounting said pair of paper receiving rollers for rotation about a common axis of rotation defined by a longitudinal dimension of said mounting shaft; a block defining a platen bed for supporting said platen at a position facing said print head, said block including means for mounting said platen bed on said mounting shaft to permit said platen bed to pivot toward and away from said print head about the axis of rotation of said paper receiving rollers; and means for resiliently biasing said block defining said platen bed toward said print head for maintaining said platen abutting said print head.

Said means for rotating said paper feeding roller through a predetermined angular interval may comprise a pin mounted on said print head; mounting means for mounting said pin on said print head oriented to contact and travel along said paper feeding roller middle portion and for mounting said pin for axial travel towards and away from said paper feeding roller middle portion; pin biasing means for resiliently biasing said pin toward said paper feeding roller middle portion; and surface grooves formed in said paper feeding roller middle portion for receiving said pin mounted on said print head as said print head travels transversely of said paper feeding roller and configured to permit said print head to travel the length of said platen in said one particular direction without said pin interfering with said paper feeding roller grooves and configured to cause said pin to interfere with said paper feeding roller grooves as said print head travels the lengths of said platen in the opposite direction and rotate said paper feeding roller through a predetermined angular interval.

Said paper feeding roller middle portion may have formed therein a family of surface grooves regularly spaced circumferentially of said paper feeding roller and extending generally in the length direction of said paper feeding roller and at an angle to the longitudinal axis of said paper feeding roller to that opposite ends of the respective grooves are circumferentially spaced around said paper feeding roller, and the surface grooves have a profile effective to permit said pin mounted on said print head to travel in a straight path along said paper feeding roller without interfering with said paper feeding roller as said print head travels in said one particular direction and to interfere with said paper feeding roller as said print head travels in said other direction so as to cause said paper feeding roller to rotate angularly through an interval determined by the angular spacing of the respective surface grooves on said paper feeding roller to advance paper to be printed on to said platen.

Said paper feeding roller may have surface grooves configured such that a cross section of said paper feeding roller is in the shape of a ratchet wheel.

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

Figure 1 is a plan view of one embodiment of a

printer according to the present invention;

Figure 2 is a side view of the printer of Figure 1 with a plate member removed;

Figure 3 is a plan view, on an enlarged scale, of part of the printer of Figure 1;

Figures 4a and 4b are plan and cross-sectional views respectively of a paper feed roller of the printer of Figure 1 to illustrate its operation;

Figures 5a and 5b are plan and cross-sectional views respectively of a modification of the paper feed roller of Figures 4a and 4b;

Figures 6a and 6b are side and front views respectively of a second embodiment of a printer according to the present invention;

Figure 7 is a sectional view of the printer of Figures 6a and 6b;

Figure 8 is a plan view of a paper feed roller of the printer of Figures 6a and 6b; and

Figure 9 is an exploded perspective view of part of the printer of Figures 6a and 6b.

Referring first to Figures 1 and 2 there is illustrated one embodiment of a printer according to the present invention and comprising a pair of plate members 3, 4 which are secured to a supporting frame 1 and to a supporting rod 2 by screws 5 so as to hold them in position. A motor 6 is mounted on the supporting frame 1 and a pair of receiving rollers 7, 8 are arranged at opposite sides of the motor 6. The receiving rollers 7, 8 are rotatably mounted on the plate members 3, 4 respectively. Thermally sensitive printing paper 17 is disposed between the receiving rollers 7, 8 and a paper feed roller 10 presses against the receiving rollers 7, 8 so that the printing paper 17 is fed when the paper feed roller 10 is rotated in the clockwise direction (as seen in Figure 2).

A motor shaft 18 projects outwardly from the plate member 4 through a hollow portion of a spindle (not shown) of the receiving roller 8. A motor gear 19 is rigidly mounted on the motor shaft 18. The torque of the motor 6 is transmitted to rotate a head feeding shaft 11 through speed reduction gears 20, 21, 22 which are rotatably mounted on the plate member 4. A bi-directional cam groove 11a for causing reciprocating motion of a head carrier 13 upon unidirectional rotation of the head feeding shaft 11 is formed in the circumferential periphery of the latter. A thermal printing head 15 and a flexible base plate 14 are secured to the head carrier 13, and reciprocated together with the head carrier. The printing head 15 faces a platen 9 with the printing paper disposed therebetween. The platen 9 is urged by resilient means (not shown) towards the printing head. A plurality of grooves 10a are defined in the circumferential periphery of the paper feed roller 10. The reciprocating motion of the head carrier 13 is converted into intermittent rotation of the paper feed roller 10 by means of a projection 23 on the head carrier 13.

The mechanism which converts the reciprocating motion of the head carrier 13 into intermittent rotation of the paper feed roller 10 is illustrated in greater detail in Figure 3 which shows the relationship between the paper feed

roller 10 and the head carrier 13. The grooves 10a and the paper feed roller 10 act as a ratchet and the walls of the grooves 10a are arranged at a predetermined angle to the axis of rotation of the paper feed roller. In this embodiment there are six grooves 10a equiangularly spaced apart by 60°. The angle of torsion between one end of each of the grooves and the other end thereof is 70°. When the angle of torsion in the groove is larger than the angle of detent thereof the projection 23 mounted on the head carrier 13 can move from one groove to the next.

As seen in Figures 4a and 4b if the protection 23 starts at point A as the printing head and head carrier move to the left, the projection 23 also moves to the left towards a point B. As the projection 23 moves towards the point B it rides up a base wall 10b of the groove 10a in which it is located and enters the next adjacent groove 10a at a point C. The projection 23 continues to move to the left until it reaches a point D and then begins to move to the right. The projection 23 returns along the same path from the point D to the point C and comes into contact with a wall 10c of the groove at the point C. As the projection 23 continues to move to the right it presses against the wall 10c of the groove causing the paper feed roller to rotate. The projection 23 then reaches a point A'. Thus since the projection 23 moves from the point A to the point D and back to the point A', it follows that the paper feed roller 10 is rotated by one step until the point A' is coincident with the point A.

If the angle of torsion of each groove 10a is less than the angle of the detent thereof, the projection 23 cannot enter the next adjacent groove at the point A and if the angle of torsion of the groove is larger than twice the angle of detent thereof, the projection 23 moves to the next but one groove. Therefore, the angle of torsion of each groove should be larger than the angle of the detent thereof and less than twice the angle of detent thereof. If this condition is satisfied, the paper feed roller 10 will advance by one step for each complete reciprocation of the projection 23. It will be appreciated that whilst the paper feed roller is shown with six grooves 10a it may have any number i.e. three or more.

Figures 5a and 5b illustrate a modification of the paper feed roller which is referenced 10' in these Figures. A zig-zag groove 10'a is formed on the circumferential periphery of the paper feed roller 10'. A first portion of the groove 10'a is parallel to the axis of the paper feed roller and an adjacent second portion is at a predetermined angle to the axis of the paper feed roller. The first and second portions alternate around the circumference of the paper feed roller. The depth of the first portion of the groove decreases from right to left and the depth of the second portion decreases from left to right. The projection 23 mounted on head carrier 13, is engaged in the groove 10'a and is initially moved along the first portion of the groove from right to left with the head carrier. The projection 23 goes up a slope

formed by the taper from a deep region at the point A to a shallow region at the point B and then it enters a deep region of the second portion of the groove at the point C.

- 5 The projection 23 moves along the second portion of the groove from left to right and the projection 23 goes up a slope formed by the taper from a deep region at the point C to a shallow region at the point B'. Then the projection enters
10 the deep region of the next adjacent first portion of the groove at point A'. In operation, since the projection moves from point A to point C and back to point A' the paper feed roller 10' rotates by one step until the point A' is coincident with
15 the point A.

- In the above described printer the reciprocating motion of the printing head is converted, in a relatively simple manner, into intermittent rotation of the paper feed roller, and moreover,
20 misoperation in which the printing paper is returned to its original position is prevented since the paper feed roller always rotates stepwise in the same direction as that of paper feeding. Consequently, the printing paper can be exactly
25 fed by one step after each line of printing. Due to the reduction of the number of parts, it is possible to obtain a small size printer and, furthermore, cost reduction and improvement in reliability is obtained.

- 30 A second embodiment of a printer according to the present invention is illustrated in Figure 6a, 6b and 7. This printer comprises a motor gear 100 driven by a motor 119 which is mounted on a frame and which drives intermediate gears 102,
35 103, 104. As shown in Figure 6b the gear 104 is connected to drive a head feeding shaft 105. A bi-directional cam groove 105a is formed in the circumferential periphery of the head feeding shaft 105 and the end of a head feeding pin 106
40 is engaged with the cam groove 105a. The head feeding pin 106 loosely penetrates into a head carrier 107 which is arranged so as to move slidably in the direction of the axis of the head feeding shaft 105. As a result, the head carrier
45 107 can reciprocate upon unidirectional rotation of the head feeding shaft 105.

- A guide shaft 108 is arranged parallel to the head feeding shaft 105 in order that the head feeding pin 106 and the head carrier 107 can
50 smoothly move in the axial direction of the head feeding shaft 105. A thermal printing head 109 is secured to the head carrier 107 by means, for example, of adhesive. A platen bed 111 is urged by an elastic or resilient member 112 towards the
55 printing head 109 so as to keep the latter tightly in contact with an upper surface 110a of a platen 110 which is supported by a knife edge portion 111a of the platen bed 111. The printing head 109 is arranged to move parallel to the upper
60 surface 110a of the platen. Under the head carrier 107 a resilient member 113 and a projection 114 are arranged. The projection 114 is engaged with a ratchet portion 115a of a paper feed roller 115. The ratchet portion 115a is twisted in the axial
65 direction from one end thereof to the other as

illustrated in Figure 8 so that the projection 114 is not engaged with any tooth of the ratchet portion 115a when the projection 114 moves from a point A in Figure 8 to a point B. As a result, the paper feed roller 115 is not rotated. On the other hand, the projection 114 is engaged with the tooth of the ratchet when it moves from the point B to the point A so that the paper feed roller is rotated by one step. Rubber rollers 115b are
70 provided at each end of the paper feed roller 115, and they face a respective receiving roller 116. These receiving rollers 116 and the platen bed 111 are supported loosely on a shaft 118.

- The diameters of the rubber rollers 115b are
80 larger than that of the ratchet portion 115a of the paper feed roller 115 and a paper pressing member (not shown) is arranged in the space therebetween. As a result, zig-zag feeding of printing paper is prevented.

- 85 The printers according to the present invention and described above consist of only about twenty parts so that they can be made of relatively small size, inexpensively and increased reliability compared to conventional printers can be
90 obtained.

Claims

1. A printer comprising: a platen; a print head positioned opposite said platen; a print head driving shaft having a bi-directional cam-groove
95 and oriented parallel to said platen; means on said print head for engaging said bidirectional cam-groove to effectuate reciprocating movement of said print head parallel to said platen in response to rotation of said driving shaft; and paper feeding and positioning means for feeding paper between
100 said print head and said platen and for positioning the paper to be printed on, said paper feeding and positioning means comprising a paper feeding roller having a middle portion and a pair of end
105 portions, said head and said paper feeding roller middle portion together comprising means for rotating said paper feeding roller through a predetermined angular interval each time said print head travels from one end of said platen to
110 another in one particular direction, a pair of paper receiving rollers each disposed opposite a respective one of said paper feeding roller end portions, said paper receiving rollers and corresponding ones of said paper feeding roller
115 end portions receiving therebetween, in use, paper to be printed on and which is advanced up to said platen by rotation of said paper feeding roller with the paper gripped between said paper feeding roller end portions and said paper
120 receiving rollers, and means comprising a guide surface for guiding paper to advance between said paper feeding roller and said paper receiving rollers.

2. A printer as claimed in claim 1, wherein said
125 paper feeding roller end portions have respective diameters larger than a diameter of said paper feeding roller middle portion, and wherein said means comprising a guide surface is comprised of a plate-like member disposed between said paper



formed by the taper from a deep region at the point A to a shallow region at the point B and then it enters a deep region of the second portion of the groove at the point C.

- 5 The projection 23 moves along the second portion of the groove from left to right and the projection 23 goes up a slope formed by the taper from a deep region at the point C to a shallow region at the point B'. Then the projection enters
10 the deep region of the next adjacent first portion of the groove at point A'. In operation, since the projection moves from point A to point C and back to point A' the paper feed roller 10' rotates by one step until the point A' is coincident with
15 the point A.

In the above described printer the reciprocating motion of the printing head is converted, in a relatively simple manner, into intermittent rotation of the paper feed roller, and moreover,
20 misoperation in which the printing paper is returned to its original position is prevented since the paper feed roller always rotates stepwise in the same direction as that of paper feeding. Consequently, the printing paper can be exactly
25 fed by one step after each line of printing. Due to the reduction of the number of parts, it is possible to obtain a small size printer and, furthermore, cost reduction and improvement in reliability is obtained.

- 30 A second embodiment of a printer according to the present invention is illustrated in Figure 6a, 6b and 7. This printer comprises a motor gear 100 driven by a motor 119 which is mounted on a frame and which drives intermediate gears 102,
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40 is engaged with the cam groove 105a. The head feeding pin 106 loosely penetrates into a head carrier 107 which is arranged so as to move slidably in the direction of the axis of the head feeding shaft 105. As a result, the head carrier
45 107 can reciprocate upon unidirectional rotation of the head feeding shaft 105.

A guide shaft 108 is arranged parallel to the head feeding shaft 105 in order that the head feeding pin 106 and the head carrier 107 can
50 smoothly move in the axial direction of the head feeding shaft 105. A thermal printing head 109 is secured to the head carrier 107 by means, for example, of adhesive. A platen bed 111 is urged by an elastic or resilient member 112 towards the
55 printing head 109 so as to keep the latter tightly in contact with an upper surface 110a of a platen 110 which is supported by a knife edge portion 111a of the platen bed 111. The printing head 109 is arranged to move parallel to the upper
60 surface 110a of the platen. Under the head carrier 107 a resilient member 113 and a projection 114 are arranged. The projection 114 is engaged with a ratchet portion 115a of a paper feed roller 115. The ratchet portion 115a is twisted in the axial
65 direction from one end thereof to the other as

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75 provided at each end of the paper feed roller 115, and they face a respective receiving roller 116. These receiving rollers 116 and the platen bed 111 are supported loosely on a shaft 118.

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80 larger than that of the ratchet portion 115a of the paper feed roller 115 and a paper pressing member (not shown) is arranged in the space therebetween. As a result, zig-zag feeding of printing paper is prevented.

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Claims

1. A printer comprising: a platen; a print head positioned opposite said platen; a print head driving shaft having a bi-directional cam-groove and oriented parallel to said platen; means on said
95 print head for engaging said bidirectional cam-groove to effectuate reciprocating movement of said print head parallel to said platen in response to rotation of said driving shaft; and paper feeding
100 and positioning means for feeding paper between said print head and said platen and for positioning the paper to be printed on, said paper feeding and positioning means comprising a paper feeding roller having a middle portion and a pair of end
105 portions, said head and said paper feeding roller middle portion together comprising means for rotating said paper feeding roller through a predetermined angular interval each time said print head travels from one end of said platen to
110 another in one particular direction, a pair of paper receiving rollers each disposed opposite a respective one of said paper feeding roller end portions, said paper receiving rollers and corresponding ones of said paper feeding roller
115 end portions receiving therebetween, in use, paper to be printed on and which is advanced up to said platen by rotation of said paper feeding roller with the paper gripped between said paper feeding roller end portions and said paper
120 receiving rollers, and means comprising a guide surface for guiding paper to advance between said paper feeding roller and said paper receiving rollers.

2. A printer as claimed in claim 1, wherein said
125 paper feeding roller end portions have respective diameters larger than a diameter of said paper feeding roller middle portion, and wherein said means comprising a guide surface is comprised of a plate-like member disposed between said paper



feeding roller end portions opposite said paper feeding roller middle portion and spaced from said paper feeding roller middle portion a distance less than the difference between the radius of said paper feeding roller middle portion and said paper feeding roller end portions.

3. A printer as claimed in claim 1 or 2, further comprising a mounting shaft mounting said pair of paper receiving rollers for rotation about a common axis of rotation defined by a longitudinal dimension of said mounting shaft; a block defining a platen bed for supporting said platen at a position facing said print head, said block including means for mounting said platen bed on said mounting shaft to permit said platen bed to pivot toward and away from said print head about the axis of rotation of said paper receiving rollers; and means for resiliently biasing said block defining said platen bed toward said print head for maintaining said platen abutting said print head.

4. A printer as claimed in any preceding claim, wherein said means for rotating said paper feeding roller through a predetermined angular interval is comprised of a pin mounted on said print head; mounting means for mounting said pin on said print head oriented to contact and travel along said paper feeding roller middle portion and for mounting said pin for axial travel toward and away from said paper feeding roller middle portion; pin biasing means for resiliently biasing said pin toward said paper feeding roller middle portion; and surface grooves formed in said paper feeding roller middle portion for receiving said pin mounted on said print head as said print head travels transversely of said paper feeding roller and configured to permit said print head to travel the length of said platen in said one particular

- direction without said pin interfering with said paper feeding roller grooves and configured to cause said pin to interfere with said paper feeding roller grooves as said print head travels the lengths of said platen in the opposite direction and rotate said paper feeding roller through a predetermined angular interval.

5. A printer as claimed in claim 4, wherein said paper feeding roller middle portion has formed therein a family of surface grooves regularly spaced circumferentially of said paper feeding roller and extending generally in the length direction of said paper feeding roller and at an angle to the longitudinal axis of said paper feeding roller so that opposite ends of the respective grooves are circumferentially spaced around said paper feeding roller, and the surface grooves have a profile effective to permit said pin mounted on said print head to travel in a straight path along said paper feeding roller without interfering with said paper feeding roller as said print head travels in said one particular direction and to interfere with said paper feeding roller as said print head travels in said other direction so as to cause said paper feeding roller to rotate angularly through an interval determined by the angular spacing of the respective surface grooves on said paper feeding roller to advance paper to be printed on to said platen.

6. A printer as claimed in claim 5, wherein said paper feeding roller has surface grooves configured such that a cross-section of said paper feeding roller is in the shape of a ratchet wheel.

7. A printer substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

ERRATUM

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