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PRINTING APPARATUS

The present invention relates to a compact printing apparatus such as a time recorder and a time stamper, and more particularly to a printing apparatus for printing information on pieces of printing paper having various thicknesses, which paper is manually inserted into the apparatus.

A serial type printing apparatus is an example of one such printing apparatus. In order to obtain a high quality print it is necessary to maintain the gap between the printing head and the printing surface of the paper at 1mm or less during the printing operation. Also, it is necessary to keep the gap constant when printing on pieces of paper having various thicknesses.

In view of the fact that the sheet such as a time card or the like is manually inserted, it is important that the insertion of the printing paper is easy and the sheet is fixed so as not to be displaced in position.

Japanese Patent Application Laid-Open No. Hei 4-50253, discloses a frame plate on which is mounted a mechanical portion including a printing head, a guide shaft and the like, which is mounted to be movable relative to a base frame in a direction of the thickness of the printing paper, a spring is provided for always drawing the frame plate toward the base frame, and a cam disc is provided on a cam shaft for moving the printing head in the printing direction, and for moving the frame plate upwardly against the drawing force of the spring to thereby expand the passage, into which the printing paper is to be inserted, when the printing head is moved toward the printing start position and for moving the frame plate downwardly toward the base frame by releasing the force moving the frame plate upwardly, during the printing operation. Also, a rubber stopper is provided on the frame plate

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☒	Claim(s) : paged ...19... to paged ...21...	
☐	Drawing(s) : paged to paged	
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so that the gap between the printing head and the printing paper surface is kept constant and the printing paper is retained in place.

In such a previously apparatus the structure for moving the printing mechanical portion is complicated, because the entire printing mechanical portion including the printing head is moved and it is difficult to assemble. Also, since the portion which moves is heavy it is difficult to increase the speed of the operation and a motor having a high output power is necessary. Furthermore, since the high precision mechanical portion including the printing head is moved, the manufacture cost is increased and the printing quality is degraded.

In view of these defects, inherent with the prior apparatus, the present invention seeks to provide a printing apparatus in which a mechanical portion that is heavy in weight and needs a high precision is simplified in structure, to thereby increase the speed of the printing operation and ensure a stable printing quality at low cost.

According to the present invention, there is provided a printing apparatus comprising a printing head supported on a base frame, a platen facing the printing head and a platen driving means for moving the platen relative to the printing head so that, during a printing operation the platen is positioned such that the paper is clamped at a printing position, and during the printing stand-by mode, the platen is positioned such that a gap is kept between said platen and said printing head to a predetermined gap that is larger than that in the printing operation.

The platen driving means includes a biasing means for biasing the platen in a direction close to the printing head, and a platen moving means for moving the platen away from the printing head against a biasing

force of the biasing means; in the printing stand-by mode, the platen moving means keeps the gap between the platen and the printing head to the predetermined gap which is larger than the gap in the printing operation; and in the printing operation, the printing paper is clamped and fastened by the biasing force of the biasing means.

The platen moving means may be a cam which is rotated by a driving torque of the carrier driving means.

A guide surface for the printing paper is provided on the base frame, and the platen driving means causes, in the printing stand-by mode, the platen to be flush with the guide surface or to be shifted to a position away from the printing head beyond the guide surface.

For a better understanding of the present invention, and to show how it may be brought into effect, reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 is a perspective view showing the structure of the essential part of one embodiment of printing apparatus in accordance with the invention.

Figure 2 is a central cross-sectional view of the printing apparatus of Figure 1.

Figures 3(a) and 3(b) are cross-sectional views showing the printing apparatus of Figures 1 or 2 in a printing stand-by mode.

Figures 4(a) and 4(b) are cross-sectional views showing the printing apparatus of Figures 1 or 2 in a printing operation.

Figures 5(a) and 5(b) are cross-sectional views illustrating the printing of pieces of thin and thick paper, and

Figure 6 is a time chart diagram showing shift of a cam, shift of a platen, shift of a carrier and operation of a home sensor in the printing apparatus of the present invention.

An embodiment of the invention will now be described with reference to Figs. 1 and 2.

In the printing apparatus according to the present invention, a piece of printing paper P is guided in between a printing head 1 and a platen 2 for printing. A pair of stationary frame plates 20 are mounted on a base frame 10 for supporting the printing head so as to face each other at a predetermined interval, and a platen driving means 3 is mounted on the base frame 10 for contacting the platen 2 against the printing head 1 and separating the platen 2 away from the printing head 1.

A guide shaft 4, a carrier driving means 5 and stoppers 6 are mounted on the stationary frame plates 20.

The guide shaft 4 is used to guide the carrier 7, which carries thereon the printing head 1, in a printing direction (in the left and right direction in Fig. 1, i.e., a direction perpendicular to the paper surface of Fig. 2). The guide shaft 4 penetrates bearing portions 7a provided on the carrier 7, and an engaging portion 7b formed on the top surface of the carrier 7 slidably moves along a guide plate 8 fixed to a ceiling plate of the stationary frame plates 20

so that the printing head 1 is guided in the printing direction always with its correct posture. A ribbon cassette 9 is loaded on the carrier 7 by engaging protrusions 9a, each of which protrudes from the ribbon cassette side, with recess portions 7c on the carrier side. An ink ribbon R drawn from the ribbon cassette is adapted to pass through a space defined between a front surface 1a of the printing head 1 and the platen 2.

There is shown a cylindrical cam 13 which is the carrier driving means 5 for moving the carrier 7 in the printing direction. The cylindrical cam 13 is pivotally mounted on the stationary frames 20 by a shaft 14 and is provided around its outer circumferential portion thereof with a spiral groove 13a. A cam follower (not shown) which extends from the carrier 7 is engaged with the groove 13a so that a reciprocating motion defined by the groove is effected by the rotation of the cylindrical cam 13. In order to drivingly rotate the cylindrical cam 13, a transmission gear 15 is fixed to a protrusion end of the shaft 14 from the stationary frame 20 so that the rotation of a driving gear 16 of a motor M is transmitted thereto through a reduction gear 17.

The stoppers 6 face the platen 2 around the front surface of the printing head 1 so that ends 6a of the

stoppers 6 are projected beyond the front surface 1a of the printing head 1 toward the platen. A pair of beams 18 are mounted on the stationary frames 20 for fixing the stoppers at predetermined positions. Two pairs of stoppers 6 are fixed to predetermined position on bottom surfaces of the beams 18, respectively. It is preferable that the stoppers 6 are made of elastic material having a high frictional coefficient for dampening the shock caused when the platen is raised and for retaining the paper P.

The ends 6a of the plurality of stoppers 6 provided around the printing head 1 are flush with each other and arranged in parallel with the front surface 1a of the printing head 1. The gap g1 (see Fig. 4(b) between the end face of each stopper and the front surface of the printing head 1 is set to be identical with the gap between the printing surface of the printing paper P and the printing head 1 during the printing operation where the best printing quality is maintained in response to the performance of the printing head 1.

The platen 2 provided to face the printing head 1 is received by a platen receiver 19. Engaging pawls 19a provided on top end portions of legs extending upwardly from the surface of the platen receiver 19 are engaged with the

engaging holes 2a provided on the platen 2 to thereby engage the two components with each other.

The platen driving means 3 includes a compression spring 21 used as a biasing means for biasing the platen 2 in a direction close to the printing head 1 and a cam 22 used as a platen moving means for separating the platen 2 away from the printing head 1 against the biasing force of the compression spring 21.

In connection with the compression spring 21, a cylindrical guide member 23 is fixed to an inner bottom surface of the base frame 10, a slidable portion 19b is formed vertically on a lower surface of the platen receiver 19, and a protrusion of the guide member 23 is loosely engaged with a hollow portion of the slidable portion 19b. The compression spring 21 is interposed under compression around the slidable portion 19b between the inner bottom surface of the base frame 10 and the lower surface of the platen receiver 19, thereby imparting the biasing force to the platen receiver 19 upwardly.

Also, the cam 22 is fixed to the cam shaft 24 with such a shape that a cam portion 22a and a bottom portion 22b are connected with each other by a falling edge portion 22c. The

cam shaft 24 is rotatably connected at one end with a support plate 25 provided vertically on the base plate 10 (see Fig. 3(a)) and at the other end with the stationary frame plate 20. The drive torque from the motor M which is commonly used for driving the carrier driving means 5 is transmitted through a transmission gear 27 to a gear 26 fixed to a protrusion end from the stationary frame plate 20. Namely, the cam 22 is rotatably driven in synchronism with the cylindrical cam 13. In the embodiment, when the cam 22 is rotated through one turn, the cylindrical cam 13 is also rotated through one turn.

The cam 22 is positioned on the top surface side of the platen receiver 19. In the printing stand-by mode, when the cam shaft 24 is rotated by the drive torque of the motor M, the cam portion of the cam 22 depresses the platen receiver 19 downwardly against the biasing force of the compression spring 21 to keep the gap between the printing head 1 and the platen 2 to a predetermined gap g_2 which is larger than that in the printing operation (see Fig. 3(b)). In the printing operation, the pressure of the compression spring 21 by the cam 22 is released, and the platen 2 is raised by the biasing force of the compression spring 21 so that the printing paper is clamped and fixed between the platen 2 and the stoppers 6. In the printing operation, the gap between the printing head

1 and the printing surface of the printing paper P is identical with the gap g1 between the front faces of the stoppers 6 and the front surface 1a of the printing head 1.

As shown in Fig. 3(a), a paper supply slot 29 for the printing paper P is provided between a cover 28 for covering the printing head 1 and the base frame 10. The top surface of the base frame inside the paper supply slot 29 is used as a paper guide surface for introducing the printing paper P between the front surface 1a of the printing head 1 and the platen 2. In the printing stand-by mode where the cam portion 22a of the cam 22 causes the platen receiver 19 to move downwardly against the compression spring 21 to hold the platen 2 at the descending position, the platen driving means 3 causes the platen 2 to be flush with the paper guide surface 10a or to be shifted to the position away from the printing head 1 beyond the guide surface 10a.

A sensor 30 is disposed at a rear side of the guide surface 10a relative to the paper supply slot 29 beyond the platen 2 for detecting the printable condition in which the paper P is inserted for printing. The sensor 30 may be a reflector type photosensor or the like.

The operation of the platen driving means 3 will now be

described in detail with reference to Figs. 3(a), 3(b), 4(a) and 4(b). Figs. 3(a) and 3(b) show a position of the platen 2 in the printing stand-by mode. The cam shaft 24 is rotatably driven by the driving torque of the motor M. The cam 22 is rotated so that the cam portion 22a causes the platen receiver 19 to move downwardly against the biasing force of the compression spring 21. As a result, the platen 2 is kept away from the front surface 1a of the printing head 1 and the gap g2 larger than that in the printing operation is maintained.

Figs. 4(a) and 4(b) show a position of the platen 2 in the printing operation. The cam shaft 24 is rotatably driven by the driving torque of the motor M. The cam rotates clockwise so that the bottom portion 22b of the cam 22 faces the platen receiver 19 with a clearance d. As a result, the biasing force of the compression spring 21 affects the platen 2 through the platen receiver 19, the platen 2 is elastically contacted with the ends of the stoppers 6, and the gap between the front surface 1a of the printing head 1 and the platen 2 is kept at the narrow gap g1 for the printing operation.

Figs. 5(a) and 5(b) illustrate that when the printing paper P has been fed between the printing head

1 and the platen 2 for the printing operation, the gap between the front surface 1a of the printing head 1 and the printing surface of the printing paper P is kept at the constant gap g_1 irrespective of the thickness of the printing paper P. More specifically, Fig. 5(a) shows the case where the printing is effected on a piece of thin paper P1 having a thickness t_1 , and the platen 2 is kept at the raised position for the printing operation so that the paper P1 is clamped and fastened between the platen 2 and the stoppers 6. Accordingly, the gap between the front surface 1a of the printing head 1 and the printing surface of the printing paper P1 is kept at the gap g_1 . On the other hand, Fig. 5(b) shows the case where the printing is effected on a piece of thick paper P2 having a thickness t_2 , and the platen 2 is kept at the raised position for the printing operation so that the paper P2 is clamped and fastened between the platen 2 and the stoppers 6. Accordingly, also in this case, the gap between the front surface 1a of the printing head 1 and the printing surface of the printing paper P2 is kept at the gap g_1 . The same gap g_1 is kept irrespective of the thickness of the paper.

Fig. 6 is a diagram showing a time chart representative of the relationship among the shifts of the cylindrical cam 13; the cam 22, which is the platen moving means; the shift

of the platen 2; the shifts of the carrier 7, and hence the printing head 1; and the operation of a home sensor.

The home sensor (hereinafter referred to as an H sensor) for detecting the home position is composed of a detecting piece (not shown) mounted on the carrier 7 and a transmittance type photosensor mounted on one of the stationary frames 20. The H sensor is kept in a dark level and turned on when the carrier 7 is moved close to the home position and is kept in a bright level and turned off when the carrier 7 is separated from the home position.

First of all, when the H sensor is turned on and the carrier 7 is positioned in the home position, as shown in Fig. 3(a), the cam 22 comes into contact with the platen receiver 19 to depress the latter downwardly, and the platen 2 is in the descended position. When the printing paper P is fed and the insertion of the printing paper P is detected by the sensor 30, the motor M is driven to rotate the cylindrical cam 13 and at the same time, the cam 22 also rotates.

The carrier 7 is fed by the rotation of the cylindrical cam 13 but due to the shape of the groove 13a the carrier 7 is not moved until the rotational angle is 50° . During the

rotation of the cylindrical cam 13 from 50° to 210° , the carrier 7 is moved in a linear fashion, and the printing operation is effected in the range of about 144° during this period. When the rotational angle of the cylindrical cam 13 becomes 60° and the carrier 7 is separated away from the home position, the H sensor could not detect the carrier 7 and could be turned off.

Also, when the position of the cam portion 22 which is to come into contact with the platen receiver 19 is shifted by the rotation of the cam 22 and the falling edge portion 22c has come into contact with the platen receiver 19, the platen receiver 19 starts to gradually move upwardly by the biasing force of the compression spring 21 to thereby gradually raise the platen 2. During the rotational angle of the cam 22 from 30° to 60° , when the falling edge portion 22c faces the platen receiver 19 and the rotational angle of the cam 22 reaches 60° , a minimum diameter portion of the bottom portion 22b faces the platen receiver 19, the clearance d (see Fig. 4(b)) is generated between the platen receiver 19 and the bottom portion 22b. As a result, the platen 2 is kept at the raised position by the biasing force of the compression spring 21. As described above, in this case, since the carrier 7 starts to move, the printing operation is effected by the printing head 1.

Upon the completion of the printing operation, the rotational angle of the cam 22 reaches 210° , the platen receiver 19 again comes into contact with the bottom portion 22b of the cam, and the platen 2 is moved gradually downwardly while compressing the compression spring 21 in accordance with the rotation of the cam 22. Since the slant angle of the bottom portion is gentle, the lowering speed of the platen 2 is also gentle. When the rotational angle of the cam 22 reaches 330° , the platen 2 is returned back to the original descended position.

In the range of the rotational angle of the cylindrical cam 13 from 210° to 220° , the feed direction of the carrier 7 is reversed by the groove 13a. In the range of the rotational angle of the cylindrical cam 13 from 220° to 340° , the carrier 7 is fed toward the home position, until the rotational angle of the cylindrical cam 13 is at 330° . When the carrier 7 is moved close to the home position, the H sensor detects this and is turned on. Thereafter, the motor M is stopped in a predetermined period of time based upon the detection signal of the H sensor. The carrier 7 is kept under the stop condition and home position. At this time, the rotational angle of the cam 22 and the cylindrical cam 13 is at 360° .

When the carrier 7 is positioned at the home position, the platen 2 is kept in the descended position. In this condition, if pieces of printing paper are replaced, the next printing may be effected in the same cycle.

In the raised position of the platen 2, the top surface of the platen 2 is brought into elastic contact with the stoppers 6 through the printing paper P. However, since the slidable portion 19b and the guide member 23 are loosely engaged with each other, even if there is some tilts or displacements of the top surface of the platen 2, the platen 2 is uniformly elastically contacted against the stoppers 6 through the printing paper P. Thus, the printing paper P may be clamped and fastened between the platen 2 and the stoppers 6 without fail.

Also, since the beams 18 for supporting the stoppers 6 as well as the guide shaft 4 are fixed to the stationary plates 20, a parallelism of the front faces of the stoppers 6 with the printing direction of the printing head 1 to be transported by the guide shaft 4 may be relatively readily kept in a range in which the stable printing may be effected, for example, at about 0.1mm in consideration of the

assembling precision.

Incidentally, in another embodiment, the platen moving means is not limited to that shown in the drawings, and it is possible to use a solenoid instead of the cam 22, for example. Also, the biasing means is not limited to the compression spring 21 and it is possible to use an elastic member such as a leaf spring.

Also, it is possible to modify the mechanism so that a link, a screw and the like are used instead of the cam 22, and are driven by the motor to move the platen 2, the motor is stopped when the load imposed on the motor exceeds a predetermined value, and the printing paper is clamped and fixed between the platen 2 and the stoppers 6. In this case, the means for driving the link and the like is not limited to the motor and it is possible to use an air cylinder or the like.

Also, it is possible to constitute the stoppers by non-elastic material such as metal and to constitute the surface portion of the platen 2 by elastic material such as rubber.

Also, the invention is not limited to an impact type printing head and it is possible to apply it to the case

where any other printing head such as an ink jet type or the like is used.

Also, the invention is not limited to the manual feed of the printing paper, and it is possible to apply the invention to the case where an automatically paper feeding mechanism is provided and the platen 2 is moved corresponding to the automatic paper feed.

As described above, in the printing apparatus according to the present invention, since only the light weight platen is moved close to or away from the printing head, it is possible to hold the mechanical portion, which needs a large weight and a high precision, in the stationary part, thus - structure and increasing the printing speed. Since the stoppers are projected toward the platen beyond the front surface of the printing head, and the printing paper is fixed with its printing surface being depressed against the stoppers irrespective of the thickness of the paper, namely, even if the thick paper or thin paper is used, the gap between the printing head and the printing surface is set to an optimum gap by setting the amount of the projection of the stoppers in consideration of the optimum printing condition, and it is possible to effect a stable printing operation with

a high printing quality. Furthermore, because of the simplification of the structure, it is possible to provide the printing apparatus in a low cost. Since the gap between the platen and the printing head is large in the printing stand-by mode, it is easy to insert the printing paper into the apparatus without any fear that the paper would be damaged. Also, since the printing paper is clamped and fastened between the stoppers and the platen in the printing operation, there is no fear that the printing paper would be displaced during the printing operation. Thus, it is possible to ensure a uniform high quality printing. If the guide surface for the printing paper is provided in the base frame and the platen is shifted to be flush with or somewhat lower than the guide surface, the paper may be inserted without any obstruction by the platen.



CLAIMS

1. A printing apparatus comprising a printing head supported on a base frame, a platen facing the printing head and a platen driving means for moving the platen relative to the printing head so that, during a printing operation the platen is positioned such that the paper is clamped at a printing position, and during the printing stand-by mode, the platen is positioned such that a gap is kept between said platen and said printing head to a predetermined gap that is larger than that in the printing operation.

2. A printing apparatus as claimed in claim 1, wherein the printing head is supported by a two frame plates mounted on said base frame and the frame plates have stoppers that face said platen around said printing head with their ends protruding toward said platen beyond a front surface of said printing head such that during printing the printing paper is clamped between the platen and said stoppers.

3. Printing apparatus according to claim 2, wherein said platen driving means includes a biasing means for biasing said platen in a direction towards said printing head, and a platen moving means for moving said platen away from said printing head against a biasing force of said biasing means; wherein in the printing stand-by mode, said platen moving means keeps the gap between said platen and said printing head to the predetermined gap which is larger than the gap in the printing operation; and wherein in the printing operation, the printing paper is clamped and fastened between said platen and said stoppers by said biasing force of said biasing means.

4. Printing apparatus as claimed in any preceding claim, wherein the printing head is carried by a carrier which is movable along a guide shaft arranged parallel to the platen surface under the





action of a carrier driving means.

5. Printing apparatus according to claim 4 when dependent on claim 3, wherein the platen moving means is a cam which is rotated by a driving torque of said carrier driving means.

6. Printing apparatus according to any preceding claim, wherein a guide surface for the printing paper is provided on said base frame, and said platen driving means causes, in the printing stand-by mode, said platen to be flush with said guide surface or to be shifted to a position away from said printing head beyond said guide surface.

7. A printing apparatus for guiding a piece of printing paper between a printing head and a platen and effecting the printing, characterized in that:

a pair of stationary frame plates are mounted to face each other on a base frame for supporting said printing head and at the same time, a platen driving means for contacting said platen with said printing head and moving said platen away from said printing head is mounted on said base frame;

a guide shaft for guiding a carrier, that carries thereon said printing head, in a printing direction, a carrier driving means for driving said carrier in the printing direction, and stoppers that face said platen around said printing head with their ends protruding toward said platen beyond a front surface of said printing head are fixed to said stationary frame plates; and

said platen driving means keeps, in a printing stand-by mode, a gap between said platen and said printing head to a predetermined gap that is larger than that in a printing operation, and in the printing operation, clamps and fastens the piece of printing paper between said platen and said stopper.

8. A printing apparatus substantially as herein





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described with reference to the accompanying drawings.

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