

PATENT SPECIFICATION

(11) 1 240 603

1 240 603

DRAWINGS ATTACHED

- (21) Application No. 21998/69 (22) Filed 30 April 1969
 (31) Convention Application No. 34990 (32) Filed 30 April 1968 in
 (33) Japan (JA)
 (45) Complete Specification published 28 July 1971
 (51) International Classification B 41 j 9/32
 (52) Index at acceptance

B6F 6B12K6 6B12KY 6B12Y 6B2Q2 6B2QY 6B2S 6B7B
 6B7C4 6B7C7 6B7D3 6B7N1 6B7R 6B7Y 6R5C 6R5Y
 7B4 7BY



(54) ON-THE-FLY PRINTER

(71) KABUSHIKI KAISHA SUWA SEIK-
 OSHA, a Japanese company, of 3-4,
 4-chome, Ginza, Chuo-ku, Tokyo, Japan, do
 hereby declare the invention, for which we
 pray that a patent may be granted to us, and
 the method by which it is to be performed,
 to be particularly described in and by the
 following statement:—

This invention relates generally to an
 on-the-fly printer utilised in electronic desk
 calculators and other numerical readout
 devices.

In such printers, the hammer strikes a
 character disposed on a continuously rotating
 print drum. However, the known arrange-
 ments of this type of printer have several
 substantial drawbacks. Specifically, relative
 motion will occur in the printing process if
 the contact time between the hammer and
 the print drum (mutually gripping the print
 carrier) is too great, resulting in smudged
 printing or ripped paper. In order to
 overcome this defect, the contact time of
 the hammer with the character must be
 shortened, thereby increasing the operating
 speed of said hammer.

According to the present invention, there is
 provided a printer including a rotatable print
 drum arranged in operation for continuous
 rotation, a hammer lever having a hammer
 mounted thereon for striking said print drum
 upon the displacement of said hammer lever
 to effect printing, a linearly displaceable
 trigger lever adapted upon linear dis-
 placement thereof to displace said hammer
 lever, and a hammer lever stopper disposed
 to engage said hammer lever at a point
 spaced from said hammer to stop the dis-
 placement of said hammer lever immediately
 before said hammer strikes said print drum.

Preferably, said hammer lever is sub-
 stantially L-shaped and adapted for pivotal
 displacement about the junction of its two
 arms, said hammer being mounted on one of
 said arms, said hammer lever stopper being
 adapted to engage the other of said arms.

In a preferred embodiment, said trigger
 lever is adapted for rotational and linear

displacement, the printer further comprising
 a continuously rotatable ratchet wheel having
 at least one tooth extending therefrom for
 linearly displacing said trigger lever when
 said trigger lever is disposed in the path
 thereof, and means for selectively rotating
 said trigger lever into and out of the path of
 the or each said ratchet wheel tooth to effect
 printing, said trigger lever engaging said
 hammer lever upon the linear displacement
 thereof in response to the or a said ratchet
 wheel tooth to displace said hammer lever,
 said ratchet wheel being arranged in oper-
 ation to rotate in synchronism with said print
 drum.

The invention is illustrated, purely by way
 of example, in the accompanying drawings,
 wherein:—

Figure 1 is a schematic representation of
 one column of a printer according to the
 invention.

Figure 2 is a side view of the hammer lever
 of the printer of Figure 1, but without the
 hammer lever stopper, showing the action
 thereof during printing, and

Figure 3 is a side view of the hammer lever
 of the printer of Figure 1, shown with said
 hammer lever stopper, to illustrate the action
 of said hammer lever during said printing
 operation.

Referring now to the drawings, Figure 1
 is a schematic representation of one column
 of a printer according to the invention. The
 column includes a print hammer 1 mounted
 on one arm of a substantially L-shaped
 hammer lever 2. The hammer lever 2 is
 pivotably mounted at the junction of its
 arms on a hammer lever shaft 3. Disposed
 immediately below hammer 1 is a print drum
 4 having characters spaced on the peripheral
 surface thereof. The print drum 4 and a print
 drum gear 5 are mounted on a print drum
 shaft 6 for continuous rotation therewith in
 operation. Shaft 6, which defines the axis of
 the print drum 4, is disposed immediately
 below the position assumed by hammer 1
 when it strikes the print drum 4 via an inked
 ribbon 31 and a print carrier, e.g. paper 30,

whereby the hammer 1 is disposed normal to said axis when striking the print drum 4. Print drum gear 5 meshingly engages an intermediate pinion 7 and an intermediate gear 8 fixed thereto. The intermediate gear 8, in turn, meshingly engages with a ratchet gear 9 fixed to a ratchet wheel 10. The ratchet wheel 10 is shown as being formed with a single tooth 11 but could be formed with a plurality of circumferential teeth if desired. The gear ratio between gears and pinions 5, 7, 8 and 9 is selected so that the pitch time of tooth 11 equals the circumferential spacing of the characters on the peripheral surface of the print drum 4. Thus, each rotation of the tooth 11 corresponds to the advancing of one character on the print drum 4.

Disposed on either side of a trigger lever 14 there are provided first and second trigger lever guide pins 12 and 13. The trigger lever 14 is formed with a tail portion 15 and a projection 16. The trigger lever 14 is adapted for pivotal and linear displacement and a trigger lever guide member 18 is provided to guide the trigger lever 14 during said displacement. A spring 19 is secured between lever 14 and a fixing point 20 for biasing the end 34 of the trigger lever 14 out of the path of tooth 11. The end 21 of the lower arm (as viewed) of the hammer lever 2 is engageable by a shoulder 22 of trigger lever 14 upon the linear displacement of the trigger lever 14 to cause pivotal movement of the trigger lever 14 and thus to cause hammer 1 to strike the print drum 4. A hammer lever stopper 40 is provided in the path of arm 21 of hammer lever 2.

A timing lever 23 is disposed so as to be engageable by tail 15 of trigger lever 14 and is pivotally mounted on a timing lever shaft 24. Fixed to the timing lever 23 is a magnetic plate 25 adapted to co-operate with an electromagnet 26 for the pivoting of said magnetic plate 25 and timing lever 23 in response to the energization of the electromagnet 26. A spring 28 is mounted between the said junction of the arms of hammer lever 2 and a fixing point 29 normally to bias the hammer lever 2 in the position shown in Figure 1 with hammer 1 spaced from the print drum 4.

Interposed between said hammer and said print drum are the paper 30 upon which the character is to be imprinted and the inked ribbon 31.

In Figure 1, only one column is illustrated by way of example. However, an actual printer would include the desired number of columns, each of which would comprise a hammer 1, a hammer lever 2, a trigger lever 14, a trigger lever spring 19, a timing lever 23, a magnetic plate 25, an electromagnet 26, and a hammer lever spring 28.

Turning now to the operation of the

printer according to the present invention, when the printer is actuated but no timing signals are applied (by means not shown) to the electromagnets the ratchet wheel 10 rotates in the direction of arrow 32, thereby also rotating the print drum 4 in the manner described above, the print drum 4 rotating in the same direction as the ratchet wheel 10. The rotation of tooth 11 of the ratchet wheel 10 follows a path defined by a dashed line 33. In the absence of any signal energizing electromagnet 26, the column is disposed with the end 34 of trigger lever 14 disposed outside of the path of the tooth 11 and maintained in that position by the spring 19. When so disposed, the trigger lever 14 is positioned by means of the second trigger lever pin 13 and the trigger lever guide member 18. The magnetic plate 25 is also maintained spaced from the electromagnet 26 in the direction of arrow 35 by spring 19 acting through the tail 15 of said trigger lever which engages timing lever 23.

In order to print a character, a pulse signal is applied (by means not shown) to the electromagnet 26 immediately before the desired character on the peripheral surface of the print drum 4 passes under hammer 1. The energization of the electromagnet 26 causes attraction and rotatable displacement of the magnetic plate 25 in the direction of arrow 36, carrying timing lever 23 therewith, which engages the tail 15 of trigger lever 14 to rotate it in turn in the counter-clockwise direction about trigger lever guide member 18. When so disposed, as shown in Fig. 1, the end 34 of said trigger lever lies in the path of tooth 11, wherein it may be linearly displaced in the direction of arrow 37.

The linear displacement of trigger lever 14 is transmitted to arm 21 of hammer lever 2 by means of shoulder 22 of the trigger lever 14. The hammer lever 2 is in turn rotated in a clockwise direction causing hammer 1 to strike the print drum 4 through the inked ribbon 31 and paper 30 at the moment that the desired character is positioned under the hammer 1.

At this point in the cycle, it is necessary to rotate the trigger lever 14 in the clockwise direction to bring end 34 out of the path 33 of tooth 11 before the tooth 11 completes a single revolution. If this is not done, the trigger lever 14 will be linearly displaced in the direction of arrow 37 a second time during the next revolution of the ratchet wheel 10, resulting in the double striking of hammer 1 on a single line.

Several features of the printer prevent accidental double printing.

The first of these is the provision of trigger lever stopper 17 which co-operates with projection 16 on trigger lever 14, to operate as follows. At the moment when the end 34 of the trigger lever 14 is struck by tooth

70

75

80

85

90

95

100

105

110

115

120

125

130

11, hammer lever 2 starts its rotation. Specifically, at the moment when the trigger lever 14 is struck by the tooth 11, the trigger lever 14 starts its linear displacement in the direction of arrow 37 at a speed slightly faster than that of tooth 11. At the same moment, arm 21 of hammer lever 2 starts its displacement at a speed slightly faster than that of the trigger lever 14. This results from the fact that the coefficient of restitution at each striking point is not equal to zero.

Further, after hammer 1 strikes the desired character, hammer lever 2 returns to its original position at a faster speed than does trigger lever 14. Accordingly, in the absence of trigger lever stopper 17, arm 21 of said hammer lever would tend again to strike the shoulder 22 or the trigger lever 14 and would cause the hammer lever 2 again to rotate in the clockwise direction, and thus hammer 1 would again strike a character. The resulting double striking on a single line is of course undesirable. This possibility is avoided by the striking of projection 16 against the trigger lever stopper 17 immediately before hammer 1 strikes the character so that the trigger lever 14 rebounds in the direction of arrow 38 before the return of hammer lever 2 to its original position. In this manner, arm 21 of the hammer lever 2 will not strike the shoulder 22 during its return.

The striking of projection 16 against trigger lever stopper 17 also serves to rotate the trigger lever 14 in the direction of arrow 39 during the return thereof to its initial position. This effect serves to bring end 34 of said trigger lever out of the path of tooth 11. Also contributing to this rotation is the spring 19 which tends to return the trigger lever 14 to its original position with the inner surface of shoulder 22 resting against the trigger lever guide member 18 and the end 34 of said trigger lever out of the path of tooth 11.

The operation of the hammer lever stopper 40 is shown in Figures 2 and 3, although in Figure 2, the arrangement is shown without the hammer lever stopper 40, the ribbon 31 and the paper 30. In response to the linear displacement of the trigger lever 14, hammer lever 2 is rotatably displaced about shaft 3 to bring hammer 1 into engagement with the print drum 4. After hammer 1 strikes the print drum 4, the arm 21 continues to bend, assuming the position 21' shown in dashed lines. This bending time is determined by the natural frequency of the hammer lever 2. During said bending action, the hammer lever 2 tends to vibrate horizontally. Further, the contact time of the hammer 1 with the character will be relatively long, of the order of several hundred msec. This tends to result in tearing of the paper 30 or the smudging of the printed character or both.

On the other hand, when hammer lever

stopper 40 is provided, this defect is avoided. Referring to Figure 3, the hammer lever stopper 40 is positioned so that it engages arm 21 of the hammer lever 2 before hammer 1 strikes the print drum 4, so that a gap 81 remains between the hammer 1 and the print drum 4 at the instant of said engagement. After most of the kinetic energy of the hammer lever arm 21 is absorbed by striking of the arm 21 against the hammer lever stopper 40, the hammer 1 strikes a character as shown in dashed lines. The hammer 1 can then immediately return to its initial position so that the time during which the hammer 1 is in contact with the print drum 4 is negligibly short. In this manner, smudging and tearing are avoided.

Since the hammer lever 2 is not operated directly, but rather is operated indirectly through the trigger lever 14, the contact time of the hammer 1 with the character is determined by the natural frequency of the hammer lever 2 and the kinetic energy of the arm 21 of the hammer lever 2. Accordingly, the provision of a stopper 40 adapted to engage the arm 21 of the hammer lever 2 substantially shortens the contact time of the hammer 1 with the print drum 4.

In our copending Application No. 21999/69 (Serial No. 1,240,604), we have disclosed and claimed an on-the-fly printer including a trigger lever adapted for rotational and linear displacement, print hammer means for printing in response to the linear displacement of said trigger lever, a ratchet wheel which has at least one tooth extending therefrom for linearly displacing said trigger lever when said trigger lever is disposed in the path thereof and which is in operation rotated continuously, means for selectively rotating said trigger lever into and out of the path of the or a ratchet wheel tooth to effect printing, and a trigger lever stopper disposed in the path of the linear displacement of said trigger lever, said trigger lever having a portion adapted to strike said trigger lever stopper immediately before said print hammer completes striking, via a print carrier, a print drum, said trigger lever being arranged to rebound from said trigger lever stopper to return to its original position, and we have also therein disclosed and claimed a printer having a print drum, a ratchet wheel having at least one tooth, means for continuously rotating said print drum and said ratchet wheel in synchronism with each other, at least one printing column including a trigger lever adapted for rotational and linear displacement, the or a said ratchet wheel tooth in operation linearly displacing said trigger lever when said trigger lever is disposed in the path thereof, a hammer lever adapted for rotational displacement in response to the linear displacement of said trigger lever, a hammer mounted on said hammer lever

- to effect printing upon the rotational displacement of said hammer lever, means for selectively rotating said trigger lever into and out of the path of the or a said ratchet wheel tooth to effect printing, and a trigger lever stopper disposed in the path of the linear displacement of said trigger lever, said trigger lever having a portion adapted to strike said trigger lever stopper immediately before said print hammer completes striking, via a print carrier, a print drum, said trigger lever being arranged to rebound from said trigger lever stopper to return to its original position.
- 15 **WHAT WE CLAIM IS:—**
1. An on-the-fly printer including a rotatable print drum arranged in operation for continuous rotation, a hammer lever having a hammer mounted thereon for striking said print drum upon the displacement of said hammer lever to effect printing, a linearly displaceable trigger lever adapted upon linear displacement thereof to displace said hammer lever, and a hammer lever stopper disposed to engage said hammer lever at a point spaced from said hammer to stop the displacement of said hammer lever immediately before said hammer strikes said print drum.
- 20 2. A printer as claimed in claim 1, wherein said hammer lever is substantially L-shaped and adapted for pivotal displacement about the junction of its two arms, said hammer being mounted on one of said arms, said hammer lever stopper being adapted to engage the other of said arms.
3. A printer as claimed in claim 1 or claim 2 wherein said trigger lever is adapted for rotational and linear displacement, the printer further comprising a continuously rotatable ratchet wheel having at least one tooth extending therefrom for linearly displacing said trigger lever when said trigger lever is disposed in the path thereof, and means for selectively rotating said trigger lever into and out of the path of the or each said ratchet wheel tooth to effect printing, said trigger lever engaging said hammer lever upon the linear displacement thereof in response to the or a said ratchet wheel tooth to displace said hammer lever, said ratchet wheel being arranged in operation to rotate in synchronism with said print drum.
4. A printer substantially as hereinbefore described with reference to and as shown in the accompanying drawings.
- J. MILLER & Co.,
Agents for the Applicants,
Chartered Patent Agents,
262 High Holborn,
London, W.C.1.

to effect printing upon the rotational displacement of said hammer lever, means for selectively rotating said trigger lever into and out of the path of the or a said ratchet wheel tooth to effect printing, and a trigger lever stopper disposed in the path of the linear displacement of said trigger lever, said trigger lever having a portion adapted to strike said trigger lever stopper immediately before said print hammer completes striking, via a print carrier, a print drum, said trigger lever being arranged to rebound from said trigger lever stopper to return to its original position.

15 WHAT WE CLAIM IS:—

1. An on-the-fly printer including a rotatable print drum arranged in operation for continuous rotation, a hammer lever having a hammer mounted thereon for striking said print drum upon the displacement of said hammer lever to effect printing, a linearly displaceable trigger lever adapted upon linear displacement thereof to displace said hammer lever, and a hammer lever stopper disposed to engage said hammer lever at a point spaced from said hammer to stop the displacement of said hammer lever immediately before said hammer strikes said print drum.

2. A printer as claimed in claim 1, wherein said hammer lever is substantially L-shaped

and adapted for pivotal displacement about the junction of its two arms, said hammer being mounted on one of said arms, said hammer lever stopper being adapted to engage the other of said arms.

3. A printer as claimed in claim 1 or claim 2 wherein said trigger lever is adapted for rotational and linear displacement, the printer further comprising a continuously rotatable ratchet wheel having at least one tooth extending therefrom for linearly displacing said trigger lever when said trigger lever is disposed in the path thereof, and means for selectively rotating said trigger lever into and out of the path of the or each said ratchet wheel tooth to effect printing, said trigger lever engaging said hammer lever upon the linear displacement thereof in response to the or a said ratchet wheel tooth to displace said hammer lever, said ratchet wheel being arranged in operation to rotate in synchronism with said print drum.

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

J. MILLER & Co.,
Agents for the Applicants,
Chartered Patent Agents,
262 High Holborn,
London, W.C.1.



* C L M S *