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Bossi

[11] **3,741,110**

[45] **June 26, 1973**

[54] **HIGH SPEED ON-THE-FLY PRINTER PROVIDING ARRESTING OF THE TYPE CHARACTERS IN THE PRINTING POSITIONS**

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[22] Filed: **Apr. 7, 1971**

[21] Appl. No.: **132,011**

[30] **Foreign Application Priority Data**

Apr. 7, 1970 Italy 22973 A/70

[52] **U.S. Cl.** ..... **101/93 C,** 101/111

[51] **Int. Cl.** **B41j 1/20**

[58] **Field of Search** ..... 101/93 C, 93 R, 95, 101/96, 111, 297

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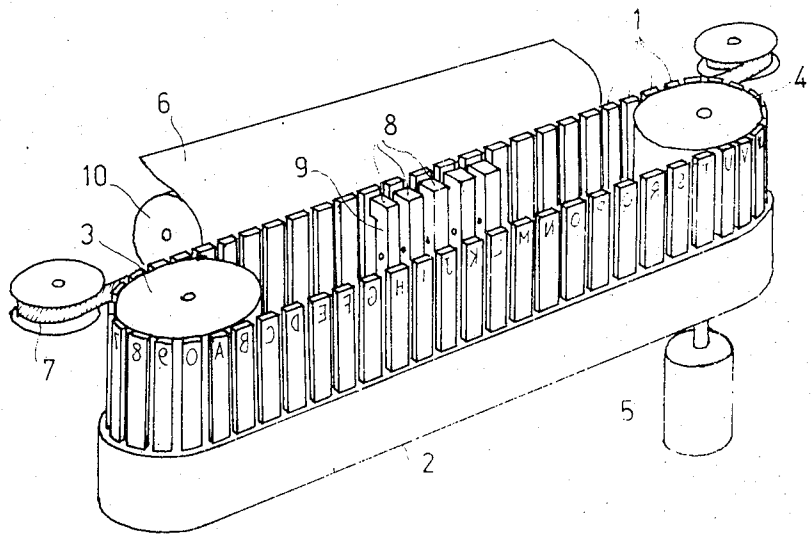
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Attorney—Fred Jacob, Ronald T. Reiling and Lewis P. Elbinger

[57] **ABSTRACT**

A high-speed on-the-fly impact printer effecting printing by impelling moving type characters to strike against a print-receiving member, wherein print smearing is suppressed by momentarily reducing the speed of the type character transverse to the print receiving member at the moment of impact with said member.

7 Claims, 17 Drawing Figures



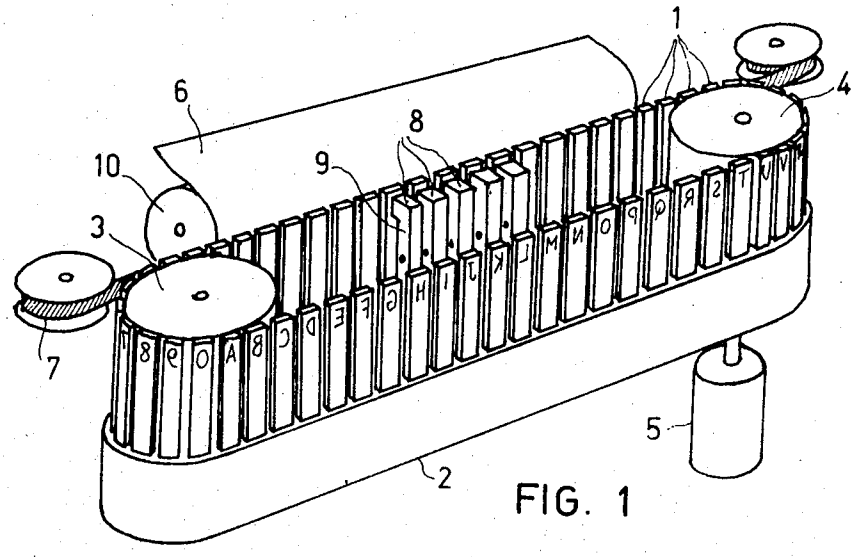


FIG. 1

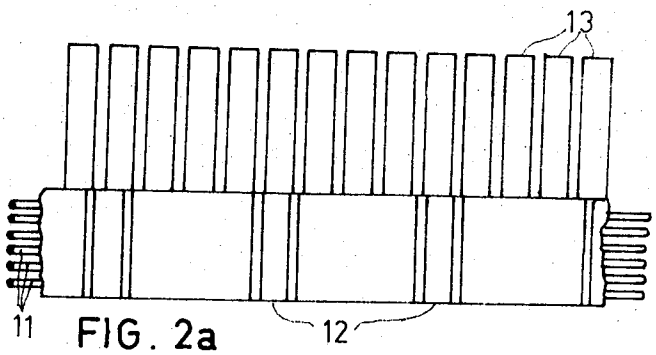


FIG. 2a



FIG. 2b

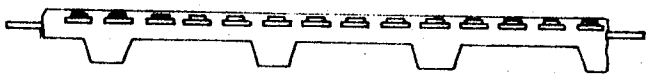


FIG. 2c

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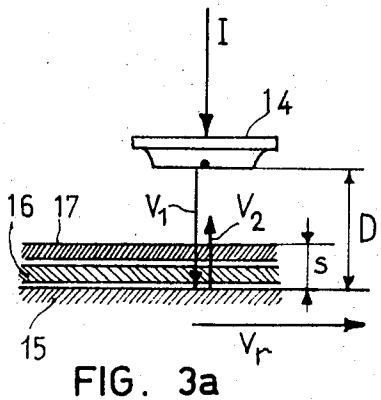


FIG. 3a

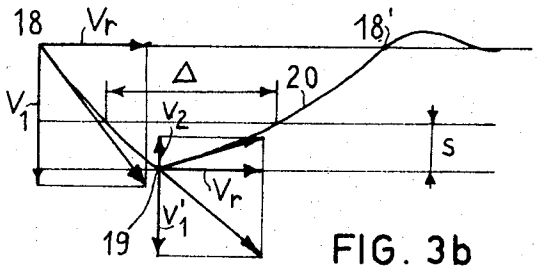


FIG. 3b

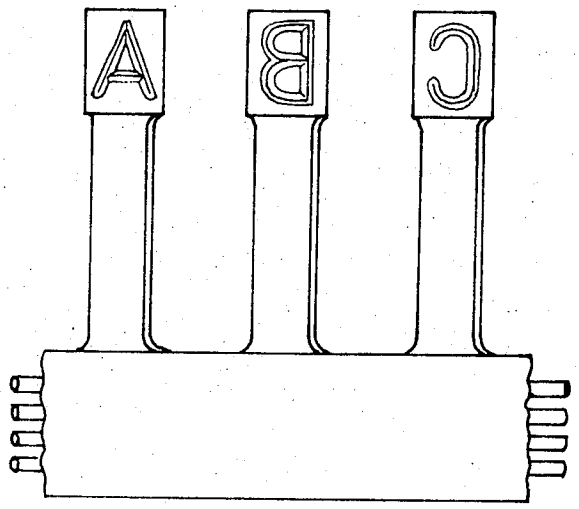


FIG. 4a

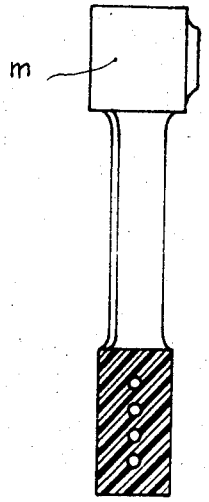


FIG. 4b

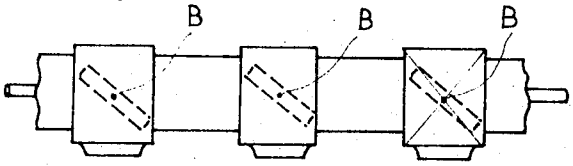


FIG. 4c

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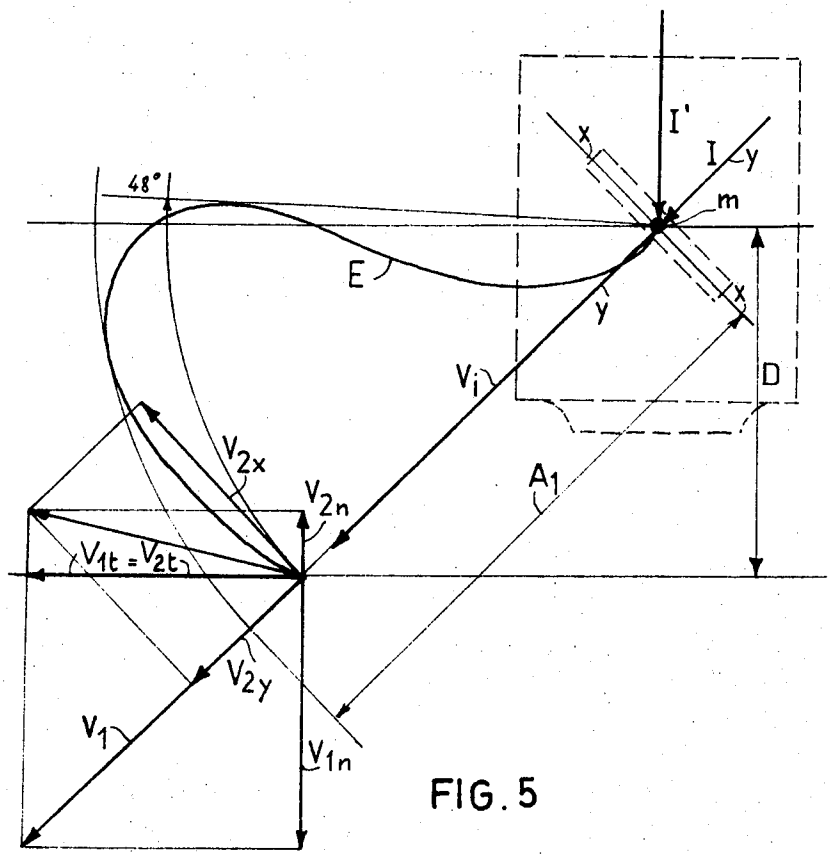


FIG. 5

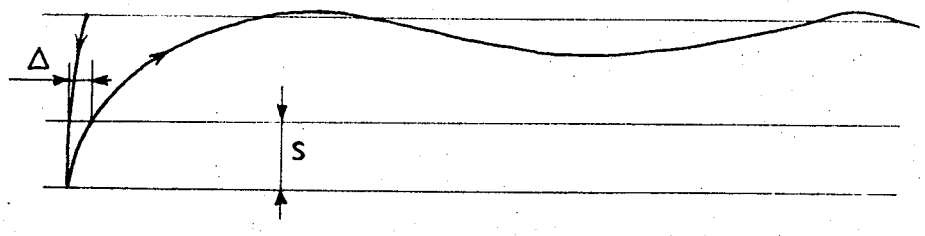


FIG. 6

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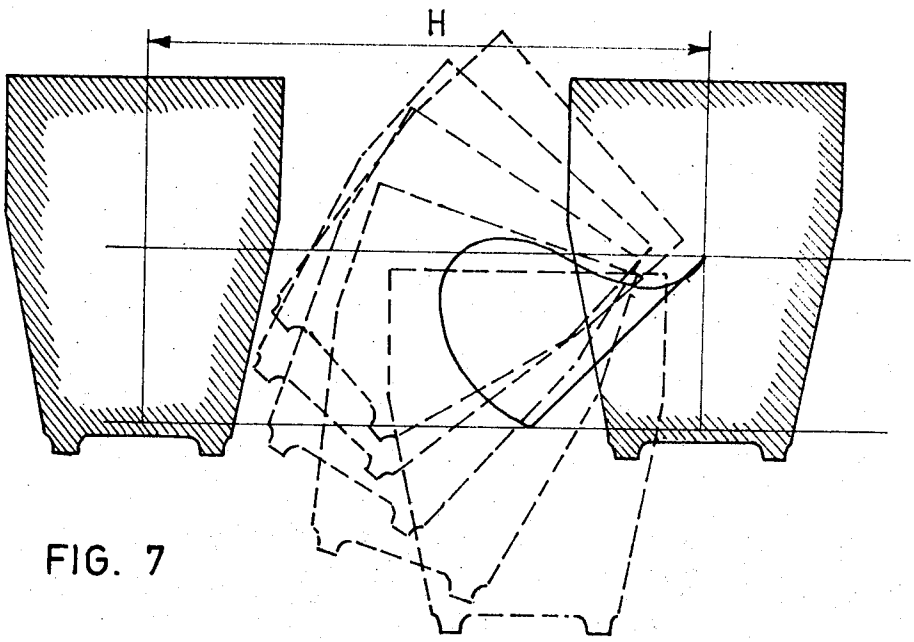


FIG. 7

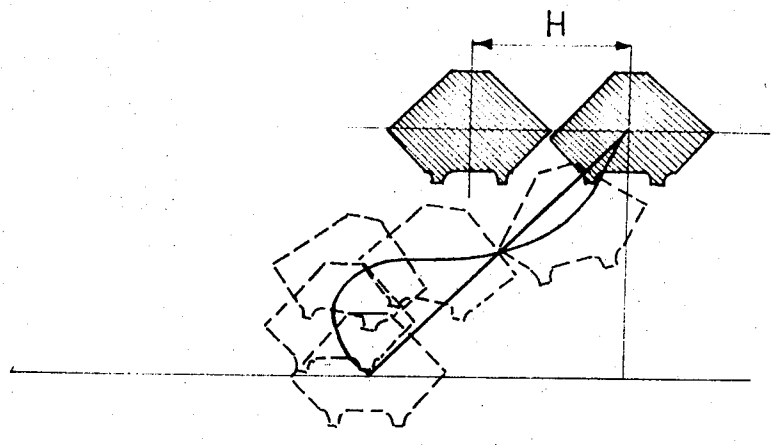


FIG. 8

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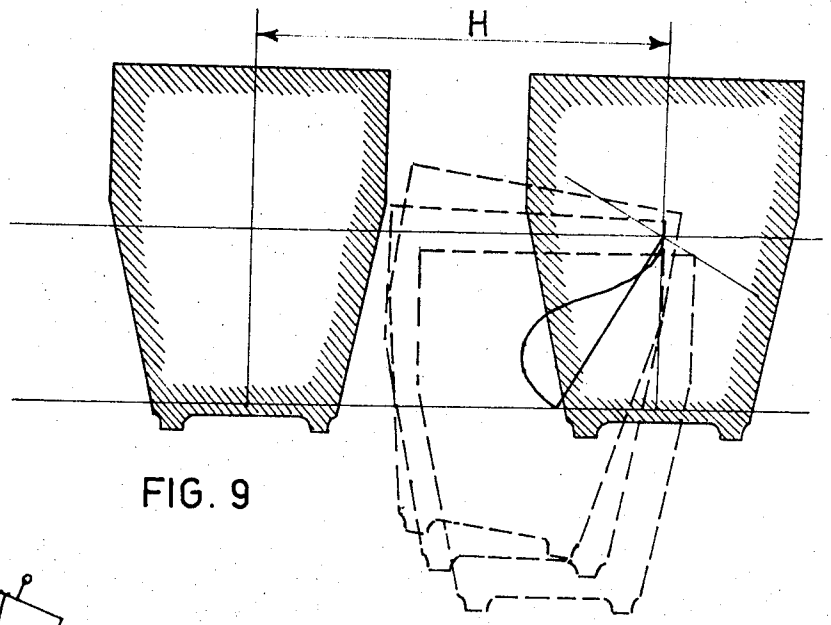


FIG. 9

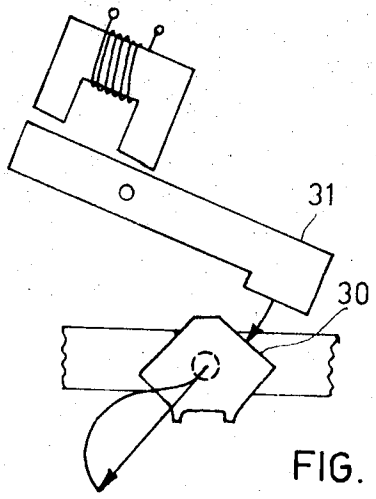


FIG. 10a

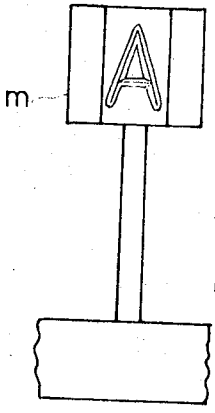


FIG. 10b

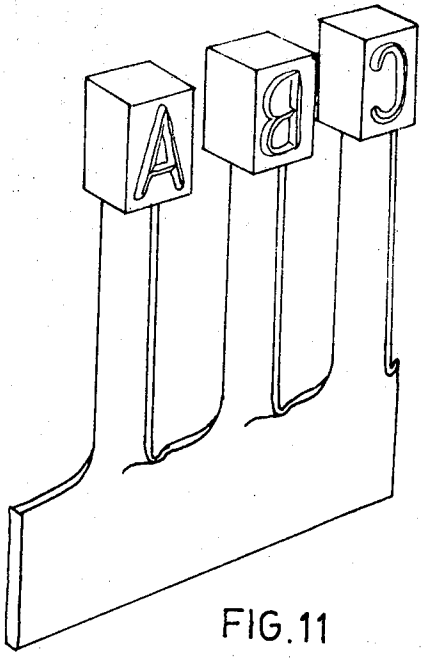


FIG. 11

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HIGH SPEED ON-THE-FLY PRINTER PROVIDING ARRESTING OF THE TYPE CHARACTERS IN THE PRINTING POSITIONS

BACKGROUND OF THE INVENTION

The present invention relates to high-speed impact printers intended for employment in data processing systems, and more particularly to platen printers, i.e., printers which effect printing by means of one or more print hammers and a platen.

In such printers a type-carrying member consisting, for example, of a set of flexible fingers cantilevered on a belt, bar, chain or equivalent supporting means, is interposed between the hammers and platen, and is suitably driven so that all characters on the type-carrying member pass in succession in front of a predetermined printing position.

It is known that printing smear constitutes a substantial obstacle to an improvement in performance of such printers. Thus, because printing occurs on-the-fly, the characters on the fingers move with a relative tangential speed with respect to the print receiving member and although the contact time between a character and the print receiving member is limited it is not negligible, so that the resulting printed image is not sharp and well-defined but somewhat stretched and smeared in the direction of the relation motion. This smearing increases as the relative tangential speed is increased. In order to obtain a reasonable print quality and readable printed characters, it is important that the relative tangential speed not exceed a certain limit (generally 5 m/s). Thus, the attainable printing speed is a compromise value which meets both the requirements of sufficiently good print quality and sufficiently high printing speed.

Many solutions have been proposed to obviate this disadvantage, but they require complex and expensive devices whose reliability and operating life is often very limited.

SUMMARY OF THE INVENTION

Substantial advantages and complete smear suppression, coupled with a simple, cheap, sturdy and reliable device, are obtained by designing such a printer according to the present invention which is characterized in that the type elements of the printing set have a suitable mass and are mounted on suitable elastic supports, for example flexible fingers, these supports having a predetermined resistance to bending and torsion so that printing is effected by momentarily reducing to zero the tangential speed of the characters to be printed. However, according to the invention the entire type-carrying member is not halted but, instead, only those type elements are selectively arrested which are to print. To this end the action of the impelling print hammer cooperates with the mechanical characteristics of the support for each type element.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be described with reference to the accompanying drawing, wherein:

FIG. **1** is a simplified perspective view of a parallel belt printer known in the prior art;

FIGS. **2***a*, **2***b* and **2***c* are respective elevational, end sectional, and top views of a belt type-carrying member known in the prior art;

FIG. **3***a* illustrates, for a type element support known in the art, the relative motion thereof with respect to a coordinate system moving with the type-carrying member;

FIG. **3***b* is a diagram of the relative motion of the type element support of FIG. **3***a* with respect to a static coordinate system;

FIGS. **4***a*, **4***b* and **4***c* are respective elevational, end sectional and top views of a belt type-carrying member provided according to the instant invention;

FIG. **5** is a diagram of the relative motion of a type element support of the invention moving with the type-carrying member;

FIG. **6** is a diagram of the relative motion of type element support of FIG. **5** with respect to a static coordinate system;

FIG. **7** illustrates a preferred form of the type element body wherein the element outline is represented in the rest position and in displaced positions;

FIG. **8** illustrates a modification of the invention wherein the type element bodies in the rest position are disposed a suitable distance from the platen;

FIG. **9** illustrates another modification of the invention for reducing, but not eliminating, smear;

FIGS. **10***a* and **10***b* illustrate another embodiment wherein the printing impulse is imparted to the type element body in an oblique direction; and

FIG. **11** illustrates an embodiment wherein the type-carrying member is made from a metalic flexible ribbon.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the prior art parallel belt printer of FIG. **1** the type elements are distributed, each on the tip portion of a respective finger **1.** Fingers **1** are mounted on a flexible belt **2,** which is appropriately stretched by wheels **3** and **4.** A motor **5** drives one of wheels **3** and **4** at constant speed, so that belt **2** moves between the two wheels, proximate and parallel to a print-receiving member **6.** An inking ribbon **7** is interposed between the tip portions of the fingers and a platen **10.** A plurality of print hammers **9** is disposed between wheels **3** and **4.** Each hammer **9** has its respective printing head **8** in juxtaposition with a printing position.

When the type element to print in a predetermined printing position reaches such position by virtue of the movement of belt **2,** the corresponding print hammer **9** is actuated, whereby the tip of associated finger **1** is driven against inking ribbon **7,** print-receiving member **6** and platen **10.** Appropriate electronic means provides control for such operations as slowing of the print-receiving member each time printing of a line is completed, identification of the instantaneous position of the type elements etc.

Devices of the type of FIG. **1** are well known in the art; accordingly their general description herein is not necessary for an understanding of, or for practicing, the present invention. However, an explanation of the structural details of the type-carrying member is provided to emphasize the difference between the prior art devices and the embodiments of the present invention. A type-carrying member of the prior art is illustrated in FIGS. **2***a*, **2***b* and **2***c*. This type-carrying member consists of a belt of flexible material, such as rubber, reinforced and stiffened relative to tensile stress with steeel wires **11.** Teeth **12** are distributed at regular intervals

along the belt and cooperate with grooves on the driving wheel to provide a positive transmission of motion. Flexible steel fingers **13**, of proper length, are cantilivered by insertion of one end thereof in the belt. The free end of each finger **13** bears a type element in relief.

Fingers **13** have a generally rectangular cross-section, for example 2mm wide and 0.3 mm thick. Fingers **13** are inserted in the belt so as to be parallel to the printing plane, therefore the cross-section and disposition of the fingers cause each finger to have a low flexural rigidity in the direction perpendicular to the printing plane and a high flexural rigidity in the direction of the print line. A force applied by a print hammer to the tip of a finger in a direction perpendicular to the printing plane easily bends the finger against the print-receiving member whereas forces acting transverse to this direction encounter high flexural rigidity and do not have any significant flexing effect.

The same behavior prevails in printers in which the tip of the fingers is provided with a type element body of suitable mass, and flexing of the fingers is obtained by using the principles of impulse dynamics; however, even in this instance, the type element body is easily propelled against the printing plane by the flexing of the finger but is practically insensitive to transversely applied impulses. FIG. **3***a* illustrates this behavior.

In FIG. **3***a*, a finger **14** is shown in the rest position, which is a distance D (for example 1.4 mm) from platen **15.** A print-receiving member **16** and an inking ribbon **17,** having together a thickness S (for example 0.4 mm), are against the platen. For a coordinate system moving with the type-carrying member, platen **15** and print-receiving member **16** (and possibly, but not necessarily, inking ribbon **17**) appear moving at a relative transverse velocity V_r.

Upon application of a suitable impulse I to the tip of finger **14** (in the direction perpendicular to platen **15**) finger **14** is bent, and the type element body of mass m is propelled toward the platen with a velocity $V_1 = I/m$. The impact velocity V'_1 will be slightly less than V_1 because the kinetic energy of the mass m is partially converted into energy of elastic deformation. Upon impact, the major part of the kinetic energy is utilized in the work of printing and results in a permanent modification (indentation and inking) of the print-receiving member. A fraction of the kinetic energy of impact is returned to the elastic system, which is repelled to the rest position with a velocity V_2 that progressively increases by reason of the elastic attraction of the finger. However, contact with the print-receiving member occurs with a transverse velocity V_r, so that possible transverse friction does not have an insignificant effect.

The path of the type element with respect to the print-receiving member is shown in FIG. **3***b*. From the rest position **18** the type element is propelled in an oblique direction defined by the two velocity components V_1 and V_r and strikes the platen at point **19** with a velocity defined by components V'_1 and V_r. The path of the type element is slightly curved with a sinusoidal shape by reason of the change in velocity component perpendicular to the platen. Next, the type element leaves impact point **19** with the same transverse velocity V_r and a low perpendicular velocity V_2 which progressively increases until the type element reaches the rest position **18'**. At rest position **18'** suitable dampeners provide speed reduction and stop the type element in rest position **18'**. The resulting path in qualitative form is shown by curve **20** in FIG. **3***b*.

If S is the combined thickness of the print-receiving member and the inking ribbon, within these limits shown schematically the type element exerts a varying pressure on the print-receiving member during a particular time interval. At the same time a relative transverse displacement Δ occurs between the type element and the print-receiving member, consequently smearing of the printing occurs.

According to the instant invention, in order to obviate to such a disadvantage, the type-carrying member shown in FIGS. **4***a*, **4***b* and **4***c* is provided. The type-carrying member of the invention is substantially similar to those of the prior art, such as that described above, but differeing in that the type-carrying fingers are cantilever mounted in the belt with a suitable obliquity, for example 45° or 30°, with respect to the platen. The importance of such an arrangement will be described hereinafter. Type element bodies of mass m, of suitable shape and weight, are represented in the form of rectangular parallelepipeds mounted on the free tips of the fingers. FIG. **4***c* illustrates that the center-of-gravity B of such bodies preferably coincides with the center of inertia of the finger section, although this is not essential. The various characters to be printed are provided in relief on the faces of the parallelepiped bodies facing the platen.

By way of example, and in order to make reference to a practical numerical embodiment, a finger may be shown schematically as in FIG. **5.** It will be assumed that the mass is concentrated in a point located at the free tip of a flexible finger of width *b*, thickness h and free length **1.** The following values may be assigned to these parameters:

$b = 2$ mm $\qquad h = 0.4$ mm

$l = 15$ mm $\qquad m = 0.5$ grams

Assume, further, that the distance of the type element body from the platen is $D = 1.5$ mm and that the finger material is steel. Assume, finally, that the relative velocity between the type-carrying member and the print-receiving member is $V_t = 5$ m/sec and that the finger obliquity is 45°.

Upon application **8**suitable oblique impulse I to the type element body (this may be provided by a print hammer) so as to impart to the type element body an initial velocity $Vi = 8$ m/sec at 45°, the finger is bent in the direction of minimum inertia; i.e., in the same direction as the applied impulse. Since the physical characteristics of the finger and its initial status are known it is possible to define its law of motion. However before proceeding, it is to be noted that the impulse I may be applied in a direction perpendicular to the platen: i.e., the impulse may be represented by the vector I', or it may be applied in any intermediate direction. In such instance, the finger will be subjected to a deviation in bending. However, since the moment of inertia with respect to the xx axis is much less than the moment of inertia with respect to yy axis, the resulting deviation relative to the yy plane is so small as to be negligible.

It is known from the theory of elasticity that the deviation angle ϕ_{yn} is related to the stress angle ϕ_{ys} with respect to one of the principal axes of inertia by the expression $tg\ \phi_{yn} = (Jy)/(Jx)$. ctg ϕys, where Jy and Jx are the moments of inertia with respect to the principal axes. Since $Jy = (b^3 h)/12$ and $Jx = (h^3 b/12$, there is de-

rived: $tg\phi yn = 0.04$, so that the deviation angle is, in the example, $\phi yn \cong 2° 20'$, which is negligible.

It is also known from the laws of dynamics that, neglecting damping and mass distribution, the finger moves with harmonic motion. If f represents the displacement of the finger tip from the rest position, the law of motion is generally:

$$f = A \sin (wt + \phi)$$

where A and ϕ are coefficients which depend on the initial conditions and w is a parameter which depends on the mechanical characteristics of the finger. Precisely, $w^2 = K/m$, where m is the mass concentrated at the tip of the finger (the distributed mass of the finger is neglected) and K is the finger stiffness.

It is known that $K = 3(EJx)/l^3$, where E is the elastic modulus, Jx is the finger moment of inertia for flexing with respect to the xx axis, and l is the length of the finger. Consequently: $K = (3Ebh^3)/(12\ l^3)$. Considering the indicated values for b, h and l,

$$K \cong 1930 \text{ (Newton/m)}$$

and

$$W \cong 2.10^3 \text{ (rad/sec.)}$$

The characteristic oscillation period of the finger is therefore

$$T = 2\ (\pi/w) \cong 3.15.10^{-3} \text{ sec.}$$

The coefficients A and ϕ, which represent respectively the maximum displacement of the finger and the phase of the motion at the initial instant, may be calculated by considering that at the initial instant ($t = 0$), $f = 0$; i.e., the finger is not flexed. Therefore, $\phi = 0$.

To evaluate A, the equation for f is differentiated: $(df/dt)_{t=0} = A.w\cos(wt)_{t=0} = Vi$; whereby, $A = (Vi/w)$

Therefore, since Vi was assumed to be 8 m/sec., and

$$w = 2.10^3 \text{ rad/sec.},$$

there results: $A \cong 4\ mm$.

The known laws of motion provide for determining the moment of impact on the platen, as well as the velocity and kinetic energy of the type element body at such moment. Because in the rest position the distance of the type element body from the platen is $D = 1.5$mm, and because displacement occurs at an angle of 45° relative to the platen, the excursion required for impact is $E = 1.5\sqrt{2} \cong 2.12$ mm.

The impact time is determined from the equation $f = A \sin wt$, where $f = 2.12 \cdot 10^{-3}$; whereby $t_1 \cong 280\ \mu$sec. The impact velocity is determined from the equation $V_1 = Aw \cos wt_1$; whereby $V_1 = 6.8$ m/sec.

The respective velocity components in the directions normal to the platen, V_{1n}, and transverse to the platen, V_{1t}, are:

$$V_{1n} = (6.8)/(\sqrt{2}) \cong 4.8 \text{ m/sec.}$$

$$V_{1t} = 6.8/\sqrt{2} \cong 4.8 \text{ m/sec.}, \cong 5 \text{ m/sec.} = V_t$$

Therefore, the relative tangential speed of the type element body with respect to the print-receiving member in the proximity of the platen is virtually negligible.

The energy of the system in the direction normal to the platen is $E = \frac{1}{2} mV^2 \cong 62{,}000$ erg. which is an optimum value for the printing function. In fact, it is known from experimental tests that the energy required for printing must be between 30,000 and 80,000 erg. However this energy is not spent entirely for printing, but, instead is partly converted into rebound kinetic energy. Although the rebound energy depends on the elastic characteristics of the platen, experimental tests show that, on the average, the striking member (in this instance the type element body) rebounds with a velocity component normal to the platen of the order of 1 m/sec. The tangential velocity component, on the other hand, is not substantially altered by the impact.

In FIG. 5 the type element body is shown to depart from the platen with a velocity V_2, having components $V_{2n} \cong 1$/m/s and $V_{2t} \cong 5$ m/s. Under such conditions the elastic behavior of the finger supporting the type element body will be considered again. Velocity V_2 may be resolved into a component V_{2y} lying in the flexing plane and a component V_{2x} normal to the bending plane. Because of the existence of the component V_{2y} the finger is subjected to a bending stress whose effects may be calculated as before, and significantly, by reason of the component V_{2x} the finger is subjected to a torsional stress. The combined effect of the two stresses defines the return path of the type element body towards the rest position.

Consider first, the torsional effect: The torsional elasticity of a cantilever mounted finger is

$$K_t = K\ (GJ_t)/l$$

where K is an appropriate numerical coefficient depending on the sectional shape, J_t is the polar moment of inertia of the finger section, and G is the shear modulus. In particular, for a finger with a rectangular-shaped section: $K_t = (bh^3G)/(ul)$, where u is a torsion constant depending on b and h. In this instance, $\mu \cong 3.40$ and $G \cong 5.500$ Kg./mm^2, so that: $K_t \cong 0.13$ N.m/rad. The characteristic torsional frequency of the finger is defined by the expression: $w_t^2 = (Kt)/J_p$, where J_p is the polar moment of the inertia of the type element body mass with respect to the torsion center.

Since the type element body, with respect to the fixed section, is in a position displaced 2.12 mm from the torsion center, and such throw decreases when considering sections more distant from the free end of the finger, it may be assumed with simplification that the average throw is $e_m = 2$mm.

Therefore $J_p \cong$ m. $e_m^2 \cong 2.10^{-8}$ Kg. m^2,

$$w^2_t = (Kt/J_p \cong 6.5 \cdot 10^6, \text{ and}$$

$$T_t = (2\pi/w_t \cong 2.45 \text{ msec.}$$

Therefore, the characteristic torsion period T_t is 2.45 msec. It is not necessary to refine this computation inasmuch as the experimental measurement is preferable because the combined effect of torsion and flexing (which varies with time) modifies this period as a function of time.

The harmonic torsion law of the finger tip is given by:

$$\theta = C \sin (w_t \cdot t + \psi)$$

where θ is the torsion angle in radians and the initial conditions enable defining the values of the parameters C and ψ. Without repeating the known techniques in this instance these parameters are found to be: $\psi = O$ $C \cong 48°$

Bending also occurs with torsion and is represented by the already known expression:

$$f = A_1 \sin (wt + \phi_1)$$

By considering the initial conditions it is determined that $A_1 \cong 2.5$mm and $\phi_1 \cong 58°$.

By combining these two effects it is possible to draw, for example point-by-point, the path followed by the type element body until it reaches the rest position. Such a path is represented by curve E in FIG. **5**. When the type element body reaches the rest position, suitable dampeners provide for stopping it with only small residual torsional oscillation and bending.

The path shown in FIG. **5** is that which appears when considering a coordinate system moving with the type-carrying member. This same path may be converted to the actual path, that which appears when considering a coordinate system static with the platen, and such actual path is illustrated in FIG. **6**. It is apparent by comparing the diagram of FIG. **6** with the diagram of FIG. **3***b*, that in the entire combined thickness S of the print-receiving member and the inking ribbon, the motion of the type element demonstrates a negligible transverse velocity component, so that the resulting transverse displacement Δ is negligible.

Therefore, by means of an appropriate design of the type-carrying member, as described previously herein; it is possible to effect printing wherein the type element which prints is virtually arrested at the print position and smearing is avoided. The relative path shown in FIG. **5** provides for defining the distance between adjacent type elements to avoid interference during their motions. In addition it provides for defining the optimum shape of the type element body to minimize the distance between type elements.

A top view of a preferred form of the type is shown in FIG. **7**. This embodiment achieves a reasonable compromise between height and section of the type element body. This section is represented by dotted lines for different positions of displacement, which clearly show the required spacing, or pitch H, between type elements. This pitch may be conveniently 5 mm.

However, by adopting a different value for the obliquity of the finger and by suitable design of the finger and of the type element body, in relation to velocity of the type-carrying member, it is possible to reduce pitch H. Thus, FIG. **8** shows, by way of example and qualitatively the motion of a type-carrying finger having a lower bending and torsional stiffness than those previously described. The distance between the type-carrying member and the platen is suitably increased, for example to 5 mm, and the type element body is shaped with oblique cuts. With such design it is possible to place the adjacent type elements very close together, because the distance from the platen provides for an excursion of the type element when displaced, between the type-carrying member and the platen without interfering with adjacent type elements.

Similarly closeness may be achieved by designs which provide for a suitable reduction in relative transverse speed without achieving complete elimination thereof. This embodiment is represented in FIG.**9**, wherein the obliquity of the finger with respect to the platen is reduced to 30°; and the pitch between the type elements is substantially reduced from that of the embodiment of FIG. **7**.

The preceding description has referred to an elastic supporting member having a rectangular shaped cross-section; i.e., having its principal moments of inertia of different value. This is a requirement for obtaining an oblique bending of the finger even when the impulse is applied in a direction normal to the platen. However, it is apparent that the cross-section and shape of the elastic support can be of a different design (for example the finger may be replaced by two parallel rods circular in shape and lying in a plane obliquely disposed with respect to the platen). If the impelling means provides an impulse in the oblique direction, inequality between the principal moments of inertia of the elastic support is no longer required. Such an alternative solution is represented in FIGS. **10***a* and **10***b*.

In FIGS. **10***a* and **10***b*, the elastic supporting member of the type element body comprises a steel rod with circular-shape cross-section (and thereby a stiffness independent of the direction) and the type element body *m* is provided with a striking surface **30** oblique with respect to the platen. Striking surface **30** receives impacts perpendicular thereto from a print hammer **31** which applies to the type element body impulses in the oblique direction relative to the platen. In this embodiment, the behavior of the type-carrying member is qualitatively the same as that previously described.

FIG. **11** illustrates yet another embodiment of the invention. The flexible type-supporting elements are obtained from a flat steel ribbon or belt. This ribbon may be sheared so as to obtain along one edge thereof flat flexible cantilever mounted fingers. The fingers are appropriately twisted near the fixed portion of the ribbon. Subsequently the ribbon and the fingers may be hardened so as to obtain the desired mechanical characteristics. By brazing, welding, mechanically inserting, or any other suitable method, the type element bodies are attached to the ends of the fingers.

The foregoing description has referred to a parallel printer such as that shown in FIG. **1**. However, it is apparent that the invention is also applicable to serial and to serial-parallel printers and to printers in which the type-carrying member is in the form of a daisy, a bar, or a chain. It is also apparent that the present invention may be employed in connection with other features, provided for the purpose of improving performance, such as those described in the U.S. Pat. application Ser. No. 108,787, U.S. Pat. applications, Ser. No. 108,787 filed Jan. 22, 1971 in the name of Castoldi et al., Ser. No. 54,814 filed July 14, 1970 in the name of Niccolai and Ser. No. 123,277 filed Mar. 11, 1971 in the name of Bossi, all assigned to the assignee of the present invention, without departing from the scope and spirit of the present invention.

What is claimed is:

1. A high speed on-the-fly impact printer of the platen type comprising:

a type-carrying member supporting a character set and movable to bring to at least one selected printing position, one at a time and in sequence, all the characters of the set, said characters passing said printing position with a predetermined transverse velocity with respect to the platen, said type-carrying member comprising a flexible elastic supporting means for each character in the form of a cantilever mounted finger, each finger having a type element body mounted on the tip thereof, and

printing means to apply an impulse to a selected one of said type element bodies in a direction oblique with respect to said platen, said finger having a moment of inertia to bending in said oblique direction

not greater than the moment of inertia to bending in other directions, said impulse acting on said body to cause it to move against the platen with a predetermined velocity, said velocity having a tangential component with respect to the platen which is opposite to the transverse velocity at which the characters pass the printing position, such that during printing the relative transverse velocity between the selected type element body and the print receiving member is substantially reduced.

2. The high speed impact printer of claim 1 wherein each of said flexible elastic supporting means comprises a flexible finger having a rectangular cross section obliquely disposed with respect to said platen.

3. A high speed on-the-fly impact printer of the platen type comprising:

a type-carrying member supporting a character set and movable to bring all the characters of the set to at least one selected printing position, one at a time and in sequence, said characters passing said printing position with a predetermined transverse velocity with respect to the platen,

said type-carrying member comprising a flexible elastic supporting means for each character in the form of a cantilever mounted finger having a low principal moment of inertia to bending in a first plane oblique to said platen and a high principal moment of inertia to bending in a second plane normal to said first plane and printing means to apply an impulse to a selected one of said type element bodies;

said impulse acting on said body to cause said finger to bend and said body to move against the platen with a predetermined velocity, said velocity having a tangential component with respect to the platen which is opposite to the transverse velocity at which the characters pass the printing position, such that during printing the relative transverse velocity between the selected type element body and the print-receiving member is substantially reduced.

4. The printer of claim 3, wherein said impulse-imparting means strikes selected ones of said type element bodies in a direction perpendicular to the surface of said print-receiving member.

5. The high speed impact printer of claim 3 wherein each of said flexible elastic supporting means comprises a flexible finger having a rectangular cross section obliquely disposed with respect to said platen.

6. A type-carrying member for use in a high speed on-the-fly printer wherein said type-carrying member supports a character set movable to bring each of said characters to at least one print position in sequence, said member comprising a flexible belt and a plurality of equally spaced fingers, each having a character of said set mounted at one end and the opposite end cantilevered from one edge of said belt for bending about said belt edge, each of said fingers having a cross section with a lower principal moment of inertia to bending in a first plane at an oblique angle with the surface of said belt and a higher principal moment of inertia to bending in a second plane normal to said first plane.

7. The type-carrying member of claim 6 wherein each of said fingers has a rectangular cross section obliquely disposed with respect to said belt surface.

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