# United States Patent

**Perucca**

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[45] **July 11, 1972**


## [54] HIGH-SPEED PRINTER


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[73] Assignee: **Ing. C. Olivetti SC., S.p.A.**, Ivrea, (Turin), Italy



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[30] **Foreign Application Priority Data**

April 23, 1969 Italy ..... 51547 A/69

[52] **U.S. Cl.** ..... **197/18**, 197/49, 101/93 C

[51] **Int. Cl.** ..... **B41j 23/04**

[58] **Field of Search** ..... 101/110, 93; 197/18, 48, 49



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[57] **ABSTRACT**

A high-speed printer comprising at least one type-bearing element on which there is arranged at least one series of characters, means adapted to move the type-bearing element continuously in a substantially horizontal plane so as to cause each character to travel along a closed path, a hammer adapted to effect the printing of the characters of the element on the fly and means for shifting the type-bearing element and the hammer with respect to a paper support for a distance corresponding to a character space while the first said means moves the series of characters past the hammer, which prints a character on the passage of each of the series of characters when there are more than one series.


**13 Claims, 13 Drawing Figures**

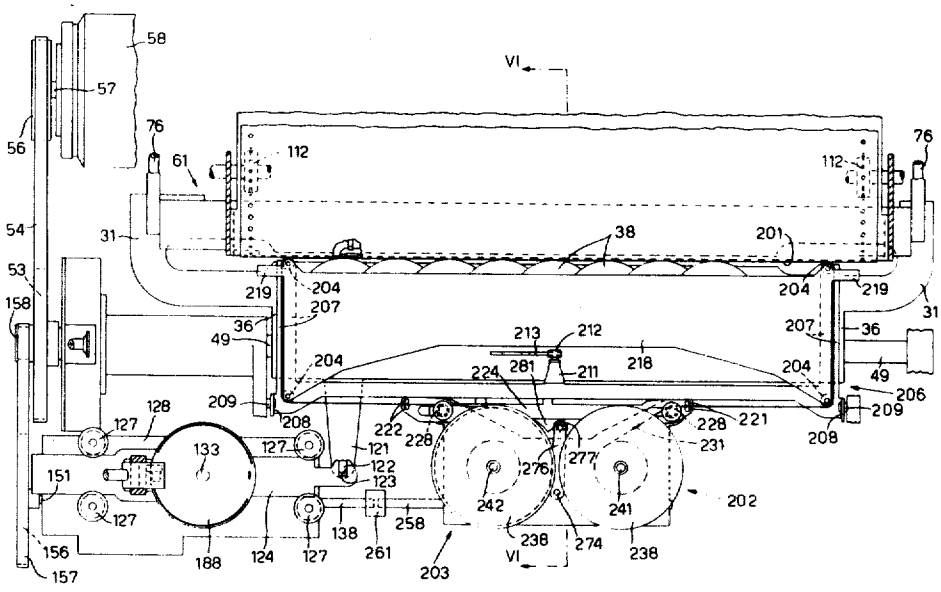
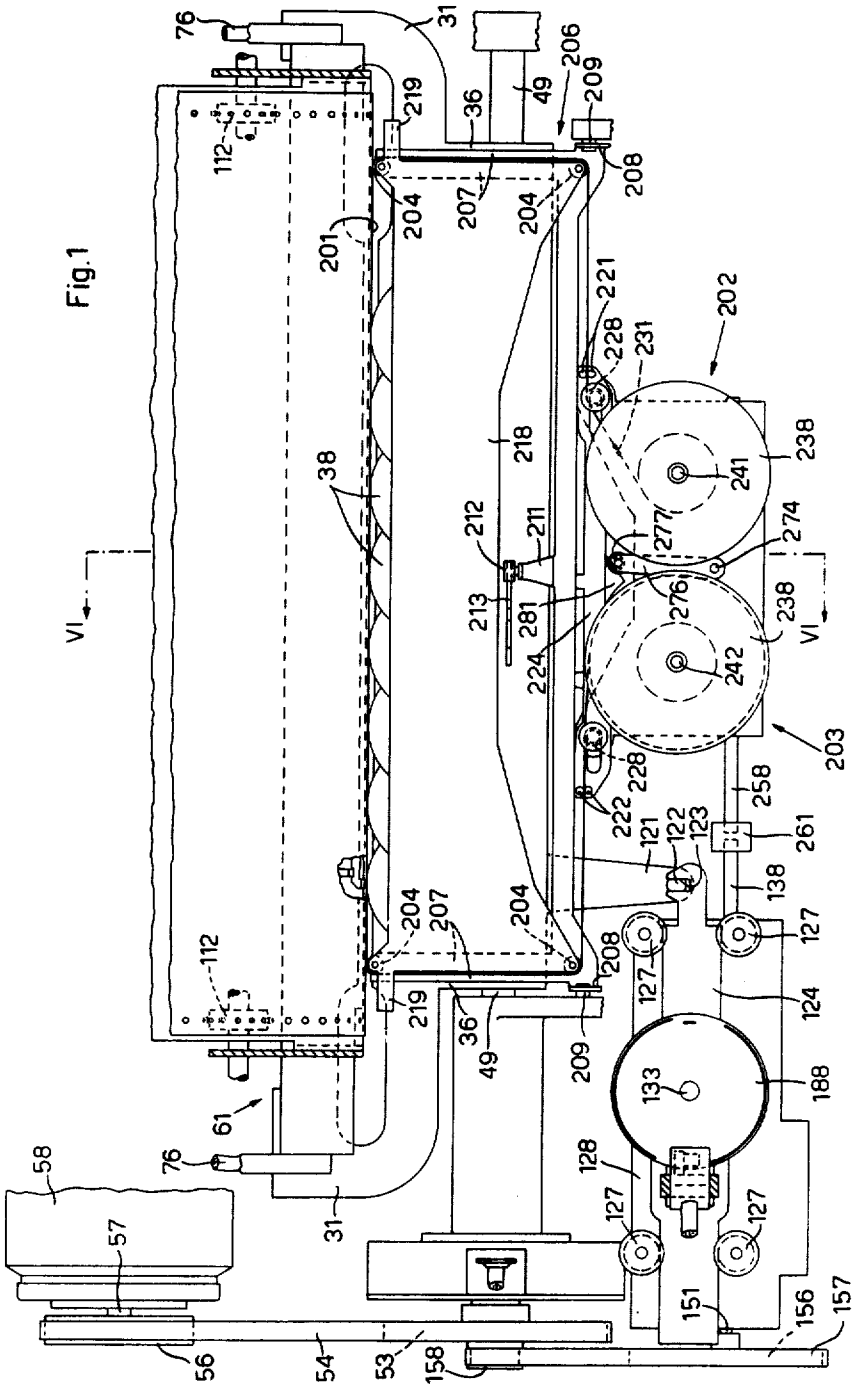


Fig.1




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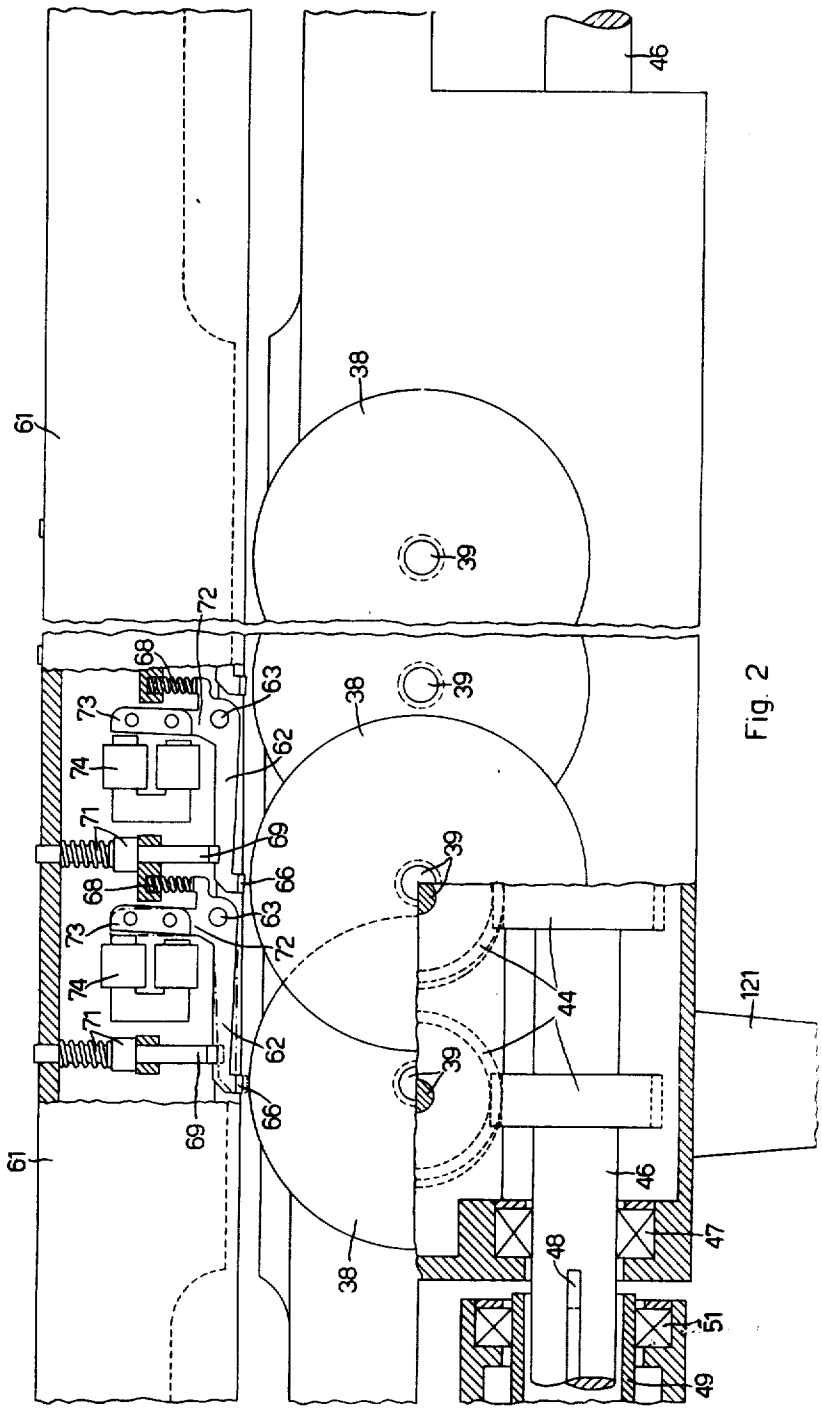



Fig. 2

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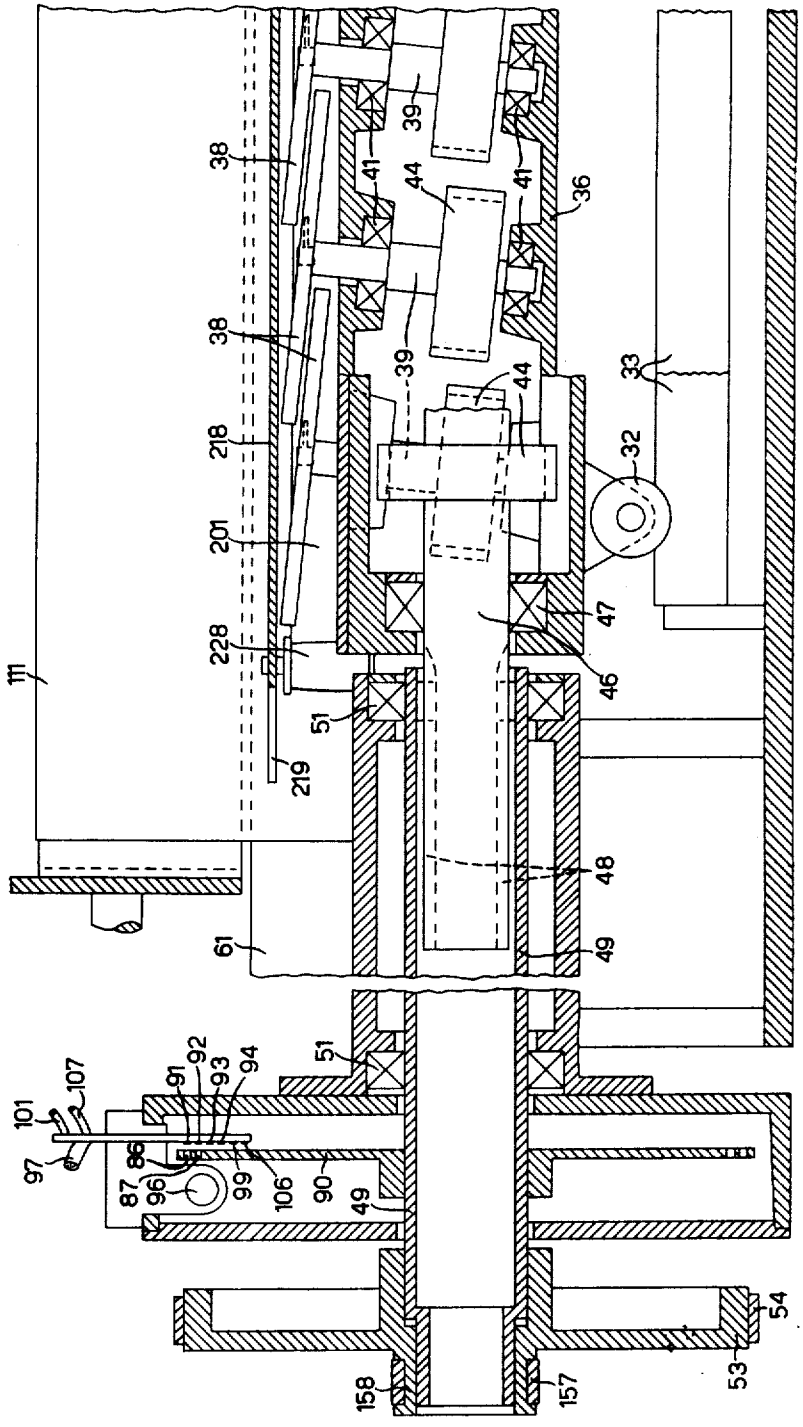



Fig.3

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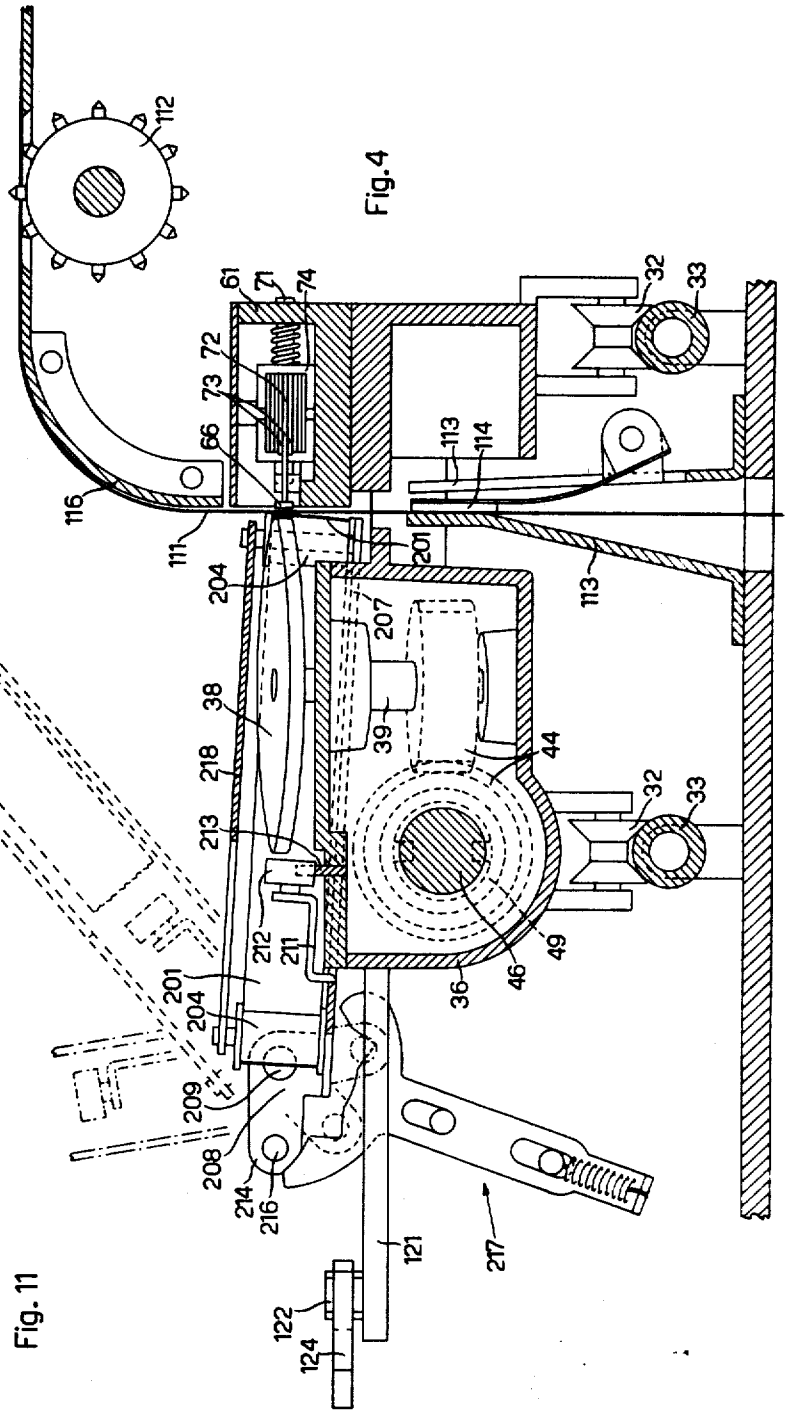



Fig. 4

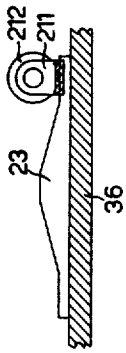



Fig. 11

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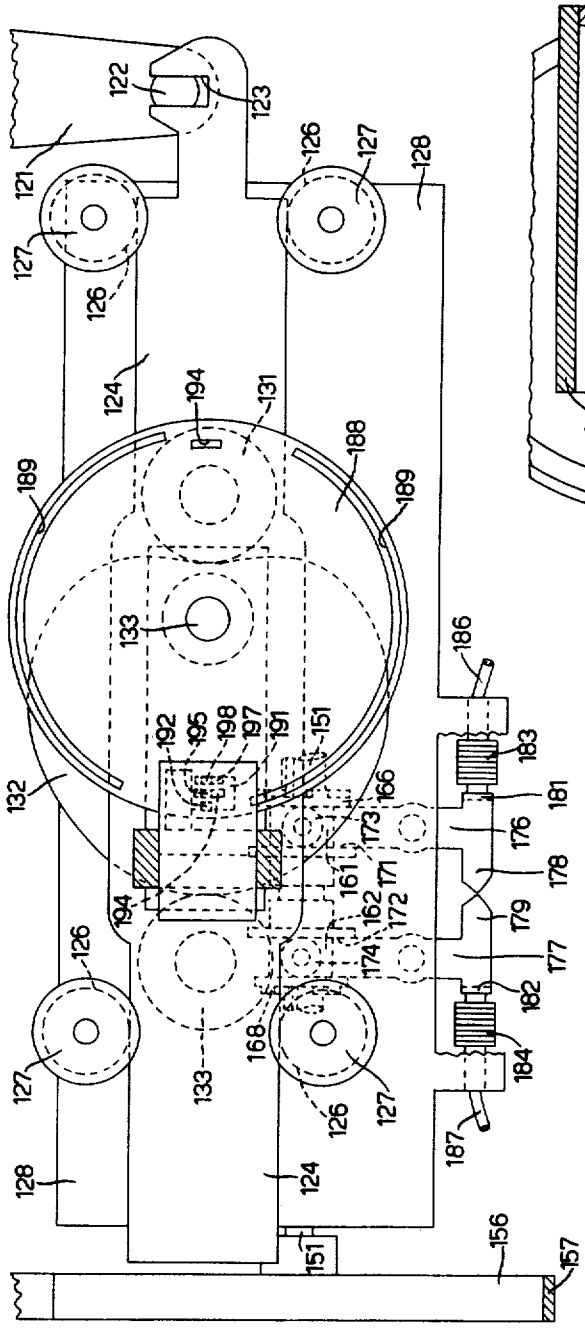



Fig. 5

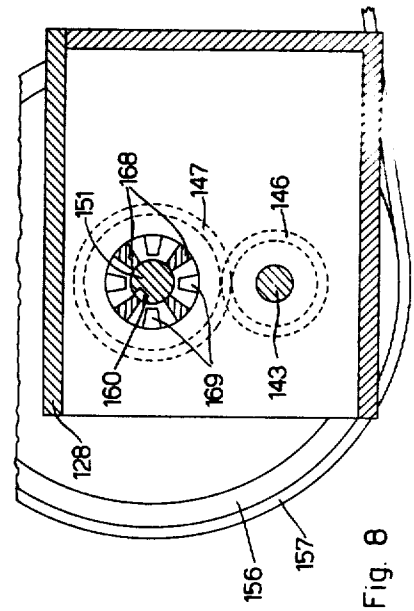



Fig. 8

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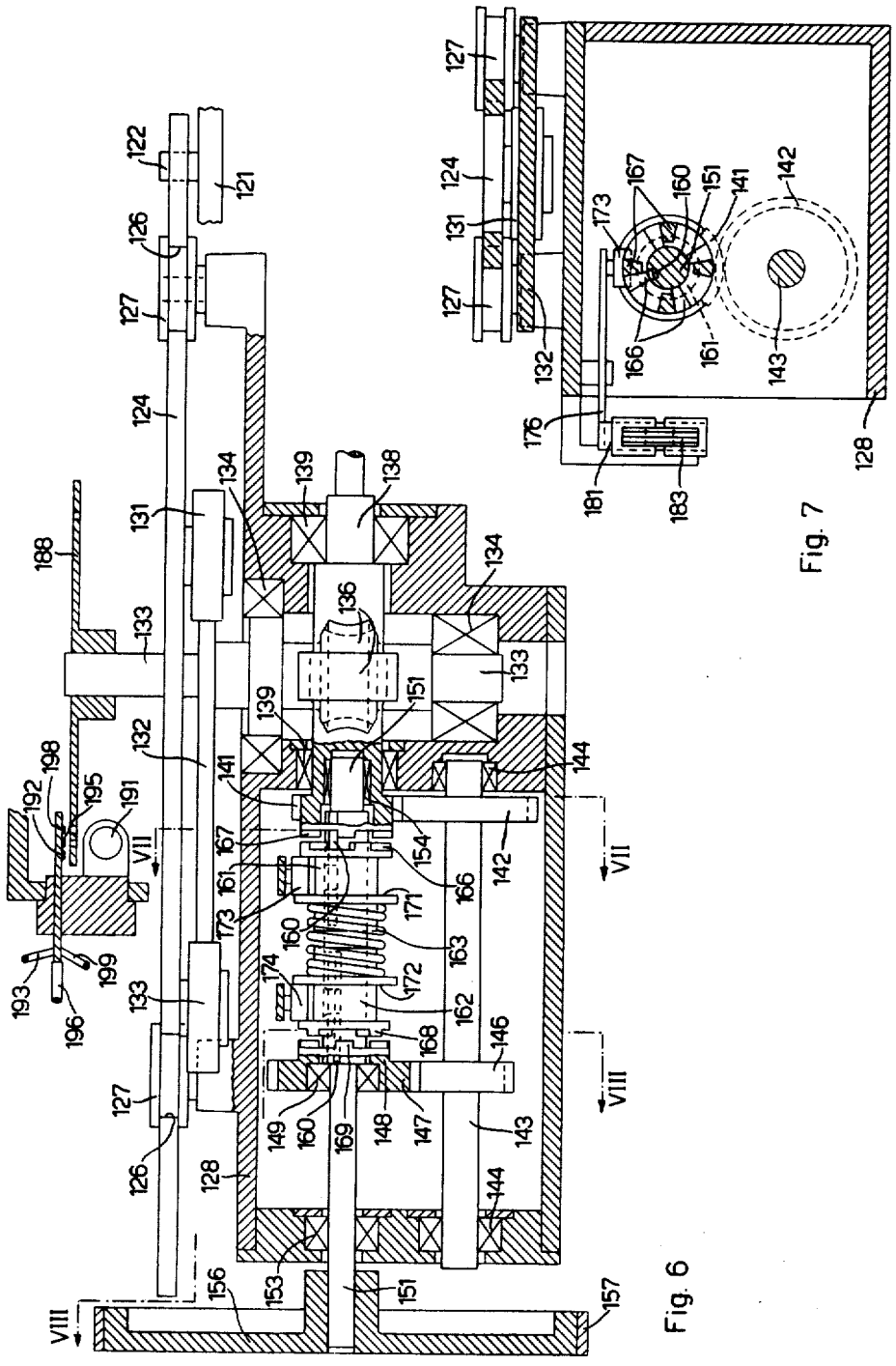


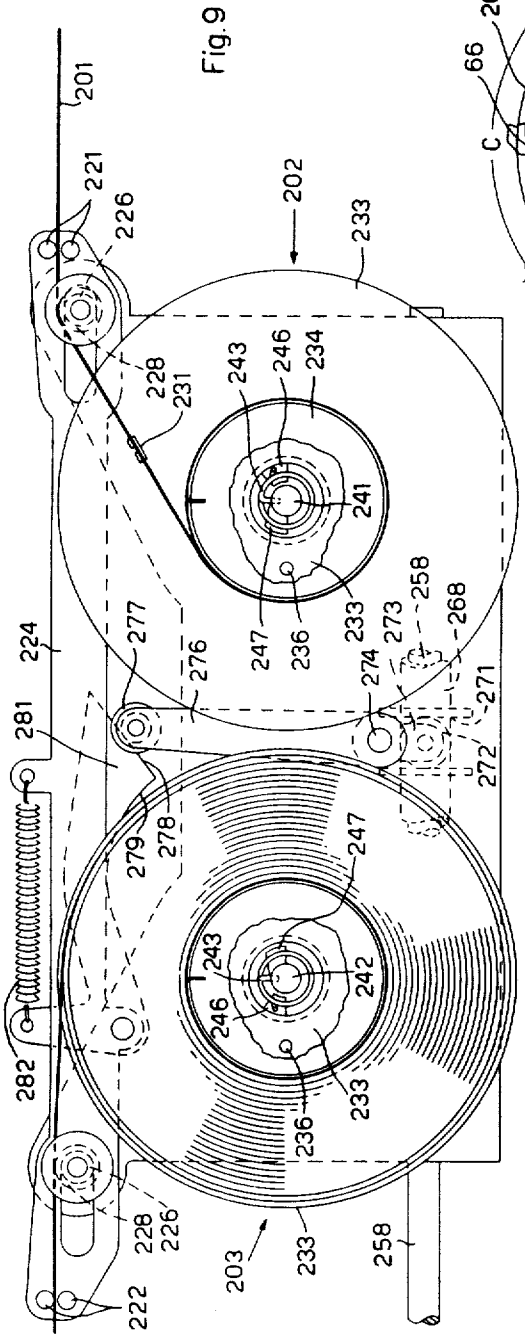
Fig. 6



Fig. 7

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Fig.9



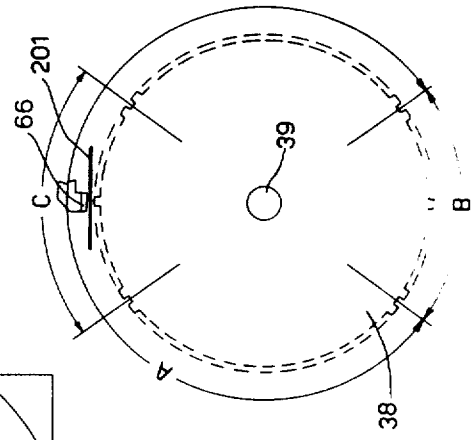




Fig.12

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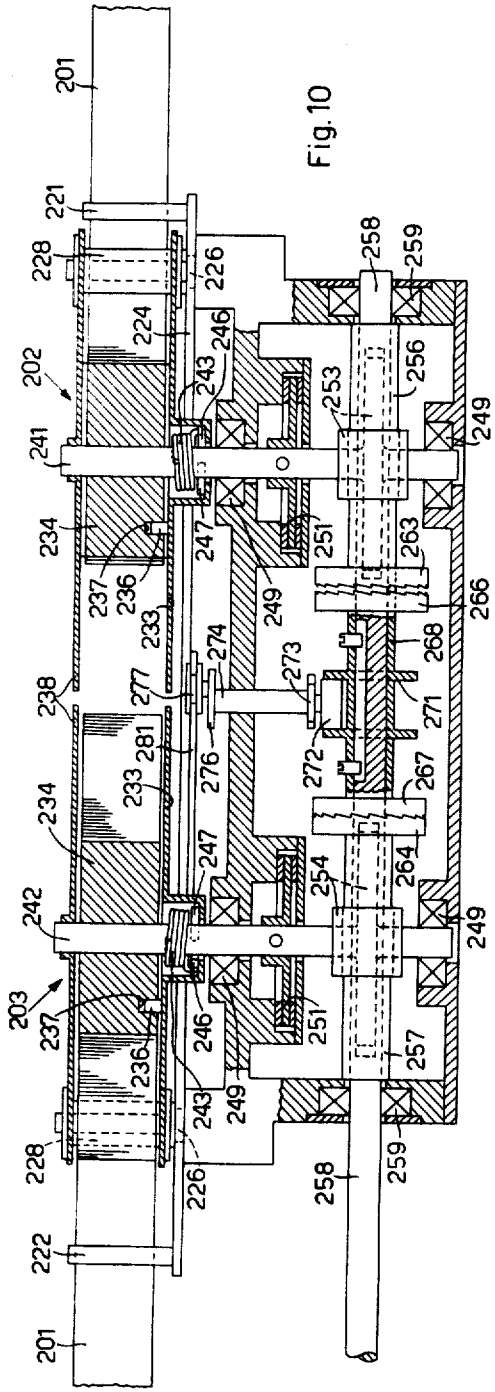


Fig. 10

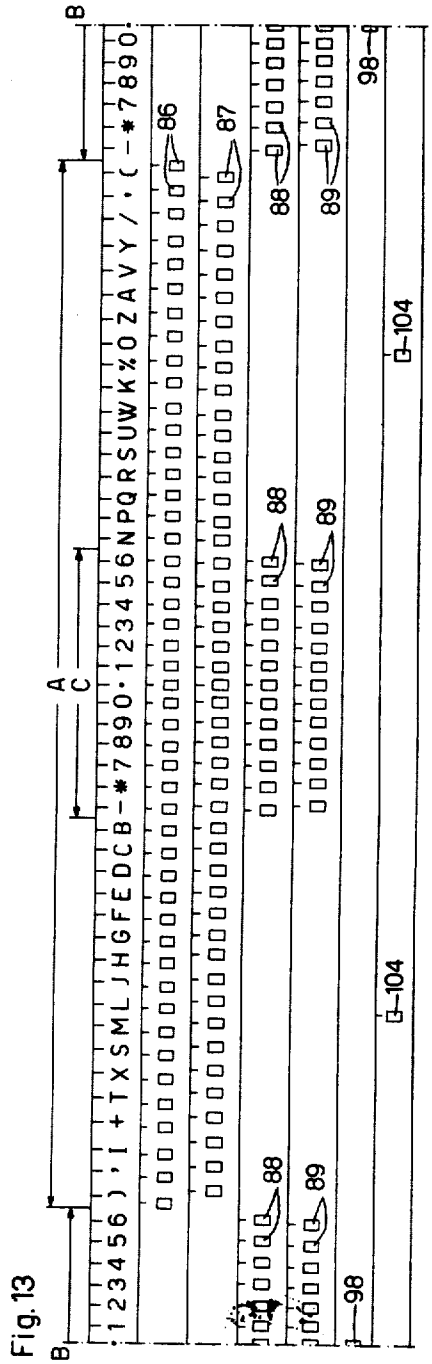


Fig. 13

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# HIGH-SPEED PRINTER

## BACKGROUND OF THE INVENTION

The technical problem which the present invention proposes to solve is the creation of a printer having greater simplicity and greater flexibility of use than the printers described above. In the basic use of these high-speed printers, that is as peripheral units of data processing systems, it is frequently necessary to change from the printing of alphanumeric data to the printing of exclusively numeric data, that is the printing of a smaller number of characters. The present invention proposes to create a printer adapted to print from a complete series of characters (e.g., alphanumeric data) or only from a group of the characters, e.g., numeric data, the two types of data being printed a different speeds so as to give the printing speed its optimum value in both cases.

## SUMMARY OF THE INVENTION

According to the invention, in a printer as set forth in the first paragraph above, at least one group of characters in each series appears on the type-bearing element a plurality of times, and means for varying the speed are provided, being adapted to vary the ratio between the speed of the shifting means and the speed of movement of the type-bearing element, a first ratio being used for the printing of the series of characters, a second ratio being used for the printing of the characters of the group of characters, and the ratio varying in proportion to the number of times that the said group and the said series of characters appear on the type-bearing element.

In a first printer of this type, the characters or types are arranged on a wheel with a vertical axis having a portion devoid of types in order to allow recocking of the hammer. The speed of rotation of the type wheel is such that it performs a revolution while said wheel and said hammer are shifted fOr a printing step, the printing taking place at the rate of one character at each revolution of said wheel. The distribution of the characters has been given its optimum form by imposing the two conditions that the hammer should completely cover each character in the actual printing position and that the hammer should not interfere with the two adjacent characters when printing any given character.

In a second printer of the same type, the characters are arranged with a constant spacing on an endless band movable at constant speed on two conveying and guide drums slidable transversely together with a printing hammer. Printing takes place substantially in accordance with the same principles as in the printer just described.

## DESCRIPTION OF THE DRAWINGS

FIG. 1 is a reduced-scale plan view of the printer embodying the invention;

FIG. 2 is a more detailed plan view of a number of details of FIG. 1;

FIG. 3 is a front view, partly in section, of the printer of FIG. 1;

FIG. 4 is a section on the line IV — IV of FIG. 1;

FIG. 5 is amore detailed plan view of another detail of FIG. 1;

FIG. 6 is a front view, partly in section, of the detail of FIG. 5;

FIG. 7 is a section on the line VII — VII of FIG. 6;

FIG. 8 is a section on the line VIII — VIII of FIG. 6;

FIG. 9 is a more detailed plan view of a third detail of FIG. 1;

FIG. 10 is a front view, partly in section, of the detail of FIG. 9;

FIG. 11 is a front view of a detail of FIG. 4;

FIG. 12 is a more detailed plan view of a type wheel;

FIG. 13 is a diagram illustrating the distribution of the characters and of the relevant synchronism signals.



## DESCRIPTION OF THE PREFERRED EMBODIMENT

In the embodiment hereinafter described, the printer according to the invention is designed for printing on pages or leaves, for example on continuous forms.

The printer includes a carriage 31 (FIG. 1) which is guided during its transverse movement by two series of rollers 32 (FIG. 4) supported by the carriage itself and rotatable on two rails 33 arranged on the frame of the printer.

The carriage includes a first housing 36 (FIGS. 2 and 3) in which there is mounted a series of eight type wheels 38. Each of these wheels 38 is fixed on a slightly inclined shaft 39. The wheels 38 are partly superimposed one over the other and are arranged at the minimum possible distance from each other. Each shaft 39 is rotatable in two bearings 41 carried by the housing 36 and is connected through a pair of helical gears 44 (FIG. 4) to a horizontal shaft 46 rotatable in turn in two bearings 47 (only one of which can be seen in the drawings) carried by the housing 36. The shaft 46 terminates in a slotted portion 48 (FIG. 3) engaged in a sleeve 49, which is rotatable in two bearings 51 fixed in the frame of the printer. On the sleeve 49 there is fixed a pulley 53 (FIG. 1) connected by means of a toothed belt 54 to a pulley 56. The pulley 56 is fixed on a shaft 57 of a conventional electric mOtor 58, which is started in a manner known per se when the machine is switched on.

The carriage 31 includes a second housing 61 (FIGS. 1 and 2) in which there is mounted, in correspondence with each type wheel 38, a hammer 62 adapted to effect printing on the fly. Each hammer 62 can pivot on a pin 63 fixed to the housing 61 and is provided with a projection 66 curved in accordance with the radius of the wheels 38 and having a transverse dimension such as to be able to cover each character completely in its printing position, as will be better explained hereinafter. Each hammer 62 is normally caused to bear by the action of a spring 68 against an extension 69 of a spring damper 71. Finally, each hammer 62 is provided with an arm 72 to which there is fixed a pack of laminations forming an armature 73 for a striking electromagnet 74 fixed to the housing 61. Each electromagnet 74 is connected through a pair of wires 76 (FIG. 1) to an electronic control unit of the printer, the control unit not being shown in the drawings. The electromagnets 74 are normally deenergized and are energized selectively for striking.

Each type wheel 38 is divided into two portions indicated by the references A and B, respectively, in FIGS. 12 and 13. In portion A there is arranged a first series of alphanumeric characters 81 and in portion B there is arranged a series of numeric characters 82 together with a number of operative and algebraic symbols. The numeric characters and the operative and algebraic symbols forming part of the series of alphanumeric characters 81 are disposed on the wheels 38 in a portion C in a position diametrically opposite the corresponding characters and symbols 82.

As will be better described hereinafter, the printer is adapted when operating to function fOr the printing of alphanumeric characters or of the numeric characters only. Moreover, the printing is effected both with the carriage moving from left to right and with the carriage moving from right to left.

FurthermOre, in the present embodiment, the printer has been arranged so that in the printing of the central character of the portion A, for alphanumeric printing, and in the printing of the central characters of the portions B and C, for numeric printing, the axis of the wheel 38, the axis of said central characters and the axis of the hammer 62 are in alignment. If it is desired that the characters be printed with constant spacing, the characters other than the central ones will be printed when their axis is not on the line joining the axis of the wheel 38 and the axis of the hammer 62. The hammer 62 must therefore be of a width such as to cover each character in its printing position.

The synchronism signals for the printing of the characters **81** and **82** are supplied by four series of holes **86, 87, 88** and **89** formed in a disc **90** fixed on the sleeve **49** and therefore movable in synchronism with the wheels **38**. The arrangement of these holes **86, 87, 88** and **89** in relation to the corresponding characters **38** is shown in the diagram of FIG. **12**. The synchronism signals are generated by the holes **86, 87, 88** and **89** in co-operation with four phototransistors **91, 92, 93** and **94** and a lamp **96** (FIG. **3**). The phototransistors **91, 92, 93** and **94** are connected to the control unit of the printer by means of the pairs of wires **97**. The holes **86, 87, 88** and **89** refer respectively to the cases of alphanumeric or numeric printing with the carriage **31** moving from left to right or from right to left.

In the disc **90** there is moreover formed a hole **98** (FIG. **13**) arranged in such manner as to pass in front of a phototransistor **99** when the line bisecting the portion B of the wheels **38** comes into correspondence with the printing zone. The phototransistor **99** is also connected to the central control unit by means of a pair of wires **101**. Finally, in the disc **90** there are formed two holes **104** disposed on the same circumference and off-set through 90° with respect to the hole **98**, so that they are positioned in correspondence with the center lines between the portions B and C. The holes **104** co-operate with a phototransistor **106** connected to the central control unit of the printer by means of two wires **107**.

The characters **81** and **82** are arranged on the wheels **38** in such manner that the greatest possible number thereof can be accommodated. In essence, the characters are distributed on the wheels **38** by imposing the following conditions: the hammer **62** must be of a width such as to cover each of the characters **81** and **82** completely in its printing position; the characters **81** and **82** must be arranged at a distance from each other such that the hammer does not interfere with the adjacent characters during its striking action; the portion B and the portions between B and C must be of an amplitude such as to allow the recocking of the hammer. This calculation can be solved analytically or by means of an electronic processor and supply the law of distribution of the characters **81** and **82**, the law of distribution of the holes **86, 87, 88** and **89** and the width of the hammer **62** as a function of the diameter of the wheels **38**, the printing step and the width of the characters. More precisely, these laws will be found by the combination of the laws relating to the four cases of alphanumeric and numeric printing with the carriage **31** moving from left to right or from right to left.

Through the space between the housings **36** and **61**, and therefore between the wheels **38** and the hammers **62**, passes the paper in the form of continuous forms **111** (FIGS. **1** and **4**) fed through the medium of two draw pin wheels **112** known per se. The forms **111** are moreover guided through a funnel **113**, in which a paper holder **114** is arranged, and over a shaped plate **116** which guides the paper as far as the pin wheels **112**.

The carriage **31** is provided with an arm **121** which is provided in turn with a stud **122** engaged in a fork **123** of a slider **124** (FIGS. **5** and **6**). The slider **124** is guided in the grooves **126** of four rollers **127** rotatable on a housing **128** fixed to the frame of the printer. Two rollers **131** can rotate on the slider **124** and co-operate with a cam **132** fixed on a shaft **133** which is rotatable in two bearings **134** fixed to the housing **128**. The cam **132** therefore has the characteristic of being of constant diameter on the pitch line.

The shaft **133** is coupled by means of a pair of helical gears **136** to a shaft **138** rotatable in two bearings **139** fixed in the housing **128**. The shaft **138** is provided with a gear **141** meshing with a gear **142** fixed on a shaft **143** rotatable in two bearings **144** fixed in the housing **128**. On the shaft **143** there is fixed a second gear **146** meshing with a gear **147** on a sleeve **148**. The transmission ratio between the sleeve **148** and the shaft **138**, which derives from the product of the transmission ratios between the gears **148** and **146** and the gears **142** and **141**, is 1 : 2. The sleeve **148** is rotatable by means of a bearing **149** on a shaft **151**, which is rotatable in turn in a bearing **153** fixed in the housing **128** and in a bearing **154** fixed in a recess in the shaft **138**. On the shaft **151** there is fixed a pulley **156** connected by means of a belt **157** (FIG. **1**) to a pulley **158** integral with the pulley **53** and therefore fixed on the sleeve **49**. The transmission ratio between the pulley **156** and the pulley **158** is 1 : 4.

The shaft **151** has two central slotted portions **160** in which there are slidable two collars **161** and **162** urged in opposite directions by a spring **163**. The collar **161** is provided with a toothed rim **166** adapted to engage with a toothed rim **166** adapted to engage with a toothed rim **167** of the shaft **138**. The collar **162**, in turn, is provided with a toothed rim **168** adapted to engage with a toothed rim **169** of the sleeve **148**. The couplings formed between the toothed rims **166** and **167** (FIG. **7**) and between the toothed rims **168** and **169** (FIG. **8**) are off-set in relation to one another by an angle of 22°30'.

The two collars **161** and **162** are provided with grooves or races **171** and **172**, respectively, (FIGS. **5** and **6**), in which there engage two rollers **173** and **174** rotatable on two levers **176** and **177** fulcrumed on the housing **128**. The lever **176** has a projection **178** adapted to co-operate with a projection **179** of the lever **177**. Moreover, the two levers **176** and **177** are provided with two projections **181** and **182**, respectively, constituting the armatures of two electromagnets **183** and **184** fixed to the housing **128**. The two electromagnets **183** and **184** are respectively connected by means of a pair of wires **186** and **187** to the central control unit and are normally kept energized.

At the end of the shaft **133** there is fixed a disc **188** provided along a first circumference with a pair of slots **189** which, in co-operation with a lamp **191** and a phototransistor **192** and by means of a pair of wires **193**, are adapted to send to the central control unit an indication that the carriage **31**, and therefore the wheels **38**, are in the printing position. The disc **188** is provided along a second circumference with another pair of slots **194** which, in co-operation with the lamp **191** and a phototransistor **195** and by means of a pair of wires **196**, are adapted to send to the central control unit an indication that the carriage **31** is in the two rest or inoperative positions on the left or right. Finally, the disc **188** is provided with another slot **197** which, in co-operation with the lamp **191** and a phototransistor **198** and by means of a pair of wires **199**, is adapted to send to the central control unit an indication that the carriage **31** is in the rest or inoperative position on the extreme left of its travel.

Between the paper **111** and the type wheels **38** there moreover passes an inked ribbon **201** (FIGS. **1** and **4**) which unwinds alternately from a pair of spools **202** and **203** and is guided over four rollers **204** disposed at the vertices of a rectangular frame **206**. The frame **206** includes a lower support **207** provided with two lugs **208** each of which can pivot on a pin **209** fixed to the frame of the printer.

The support **207** is moreover provided with a lug **211** on which there is mounted a roller **212** normally bearing against a linear cam **213** (FIG. **11**) formed on the frame of the printer. Each lug **208** (FIGS. **1** and **4**) is provided with an extension **214** to which there is fixed a stud **216** adapted to co-operate with a spring-biased positioning member **217**. The spring-biased positioning members **217** allow the frame **206** to be free in its normal working position and are able to hold it in two different positions: the first, indicated in FIG. **4** in broken lines, is the position that the frame must adopt to enable the ribbon to be changed, the second, indicated in chain-dotted lines in the same drawing, is the position that the frame is made to adopt for carrying out servicing of the wheels **38**.

Finally, the frame **206** includes an upper plate **218** provided with two lateral lugs **219** which can be used to facilitate the raising of the frame itself.

The ribbon **201** is wound on each of the spools **202, 203** by passing through two corresponding pairs of pins **221** and **222** fixed to a slider **204** (FIG. **9**). The slider **224** is guided on two fixed pins **226** on each of which a roller **228** can moreover

rotate, the roller being also used as a guide for the ribbon **201**. At the two ends of the ribbon **201** there is fixed a stop **231** having dimensions such that it cannot pass through the pairs of pins **221** and **222**.

Each spool **202**, **203** (FIG. **10**) consists of a base plate **233**, a ribbon-carrying core **234** rendered fast with the plate **233** for rotation by means of a stud **236** on the plate **233** which is inserted in a recess **237** in the core itself, and an upper cover plate **238**.

The two base plates **233** are connected to two corresponding shafts **241**, **242** by a spring **243** wound on the corresponding shaft and connected by one end to the shaft itself and by the other to the plate **233**. Each plate **233** is moreover provided with a dog **246** (FIG. **9**) adapted to engage with a dog **247** on the corresponding shaft **241**, **242**.

Each of the shafts **241** and **242** is rotatable in two bearings **249** (FIG. **10**) fixed in the frame of the printer and is provided with a friction brake **251** known per se. The shafts **241** and **242** are moreover connected through two pairs of helical gears **253** and **254**, respectively, to two sleeves **256** and **257** rotatable on a shaft **258**, which is rotatable in turn in the frame of the printer through the medium of two bearings **259**. The shaft **258** is connected to the shaft **138** by means of a flexible coupling **261** (FIG. **1**) known per se.

The sleeves **256** and **257** (FIG. **10**) are provided with toothed rims or rings **263** and **264**, respectively, which are adapted to co-operate with two toothed rims **266** and **267** formed at the ends of a sleeve **268** slidable on the shaft **258**, but fast angularly therewith. The sleeve **268** has a groove **271** in which there engages a roller **272** carried by a crank **273** (FIG. **9**) fixed to a shaft **274** rotatable in the frame of the printer.

On the shaft **274** there is fixed a second crank **276** provided in turn with a roller **277** adapted to co-operate selectively with two inclined profiles **278** and **279** of a lever **281** fulcrumed on the slider **224** and normally held in contact with the roller **277** by a spring **282**.

The printer operates in the following manner. The switching-on of the machine causes the closing of the circuit of the motor **58** (FIG. **1**), which begins to rotate and, through the pulley **56**, the belt **54** and the pulley **53**, sets the sleeve **49** (FIGS. **2** and **3**) in rotation. The sleeve, in turn, causes the shaft **46** to rotate and, through the gears **44**, said shaft sets the shafts **39** and, therefore, the eight type wheels **38** in anticlockwise rotation. Moreover, through the pulley **158**, the belt **157** and the pulley **156** (FIG. **1**), the shaft **151** (FIGS. **5** and **6**) is set in rotation.

The electromagnets **183** and **184** are both energized and hold the corresponding levers **176** and **177** so that they are turned anticlockwise and clockwise, respectively. The two collars **161** and **162** are thus pressed one against the other in opposition to the action of the spring **163**.

The switching-on of the machine moreover produces the lighting of the lamps **96** (FIG. **3**) and **191** (FIG. **6**). Assuming that the printer is in the state shown in the drawings, the disc **188** (FIG. **5**) is disposed with the slots **194** and **197** in correspondence with the lamp **191** and the phototransistors **195** and **198**.

When the store containing the data signals that it is available for printing a line of characters, the central control unit carries out a scanning of these characters to determine whether the characters to be printed are alphanumeric or only numeric. Let it be assumed that a line of alphanumeric characters is to be printed.

On the basis of this indication and on the basis of the indication by the phototransistor **198** that the carriage **31** is stationary at the left-hand end of the line, the input into the control unit of the signals coming from the photoelectric cells **91** and **99** appertaining to the holes **86** and **98** in the disc **90** (FIGS. **3** and **13**) is activated. Moreover, the electromagnet **183** (FIGS. **5** and **6**) is deenergized. The spring **163** therefore shifts the collar **161** to the right. The lever **176** turns clockwise, bringing the projection **178** into the path of the projection **179** of the lever **177**. Any possible erroneous deenergization of the electromagnet **184** therefore has no effect, since the lever **177** cannot turn anticlockwise.

The collar **161**, on shifting to the right, produces the meshing of the toothed rim **166** with the toothed rim **167** of the shaft **138** which, through the gears **136**, causes the shaft **133** to rotate clockwise. The cam **132**, acting through the rollers **131**, shifts the slider **124** to the right and, therefore, the carriage **31** with a considerable initial acceleration and then with a uniform motion.

After a rotation of about 15°, one of the slots **189** (FIG. **5**) is interposed between the lamp **191** and the phototransistor **192**, which sends to the control unit the information that the machine is ready to receive the first group of characters. On the first passage of the hole **98** in the disc **90** (FIGS. **3** and **13**) in correspondence with the phototransistor **99**, this element enables the control circuits of the eight hammers **62** to initiate the count of the signals sent by the phototransistor **91** on the passage of each hole **86**. The electromagnets **74** (FIGS. **2** and **3**) are energized selectively for the printing of the signals contained in the store by means of the pulses which cause the attraction of the armature **73**, and therefore the anticlockwise turning movement of the hammer **62**, which strikes by means of the projection **66** against the paper **111**, thus pressing it, together with the inked ribbon **201**, against the corresponding type of the wheel **38**.

The rotation of the shaft **133** takes place at a speed such as to shift the carriage **31** by one character space for each rotation of a revolution of the wheels **38** and, therefore, also of the disc **90**. At each passage of the hole **98** in correspondence with the phototransistor **99**, the count of the signals sent by the phototransistor **91** resumes from zero and the selection of another eight characters to be printed therefore takes place. Eight line portions are thus printed at the same time, each portion being able to contain a predetermined number *n* of characters.

After the hole **98** has started the *n*-th printing cycle, the slot **189** comes to an end. The phototransistor **192** is deenergized and, in response to this signal, the central control unit of the machine interrupts the transmission of the signals.

On the following first passage of the hole **98** in correspondence with the phototransistor **99**, a request is made to the control unit for orders for the printing of the following line.

The control unit may command the arrest of the carriage **31**. In this case, the electromagnet **183** (FIG. **5**) is reenergized and the collar **161** is brought back to the left, disengaging the rim **166** from the rim **167**. The carriage is thus stopped at the right-hand end of the line.

The arrest of the carriage may depend on the fact that the data to be printed are finished. In this case, no other instruction is associated with this instruction for arrest of the carriage.

On the other hand, the instruction for arrest of the carriage may be associated with the instruction for causing the forms **111** to perform a jump for a number of line spaces greater than that which can be effected in the time of mere reversal of the movement of the carriage **31**. The line-spacing and jumps are effected through a rotation of the pin wheels **112**.

Finally, the order for arrest of the carriage **31** may be associated with an indication that the following line is composed of numeric characters only. What happens in this case will be described hereinafter.

The position of the carriage **31** stationary at the right-hand end of the line is signalled by the photoelectric cell **198**.

The control unit may, on the other hand, command the carriage **31** to continue on its course. This command is always associated with the command for making at least one space between the lines. Thereafter, the first signal sent to the control unit by the phototransistor **99** causes the deactivation of the phototransistor **91** and the activation of the phototransistor **92** (FIGS. **3** and **13**) corresponding to the holes **87** in the disc **90**. The holes **87** control precisely the synchronism in the printing of the alphanumeric characters

when the carriage 31 moves from right to left. The cam 132 reverses the direction of movement of the slider 124 and, therefore, of the carriage 31, which beings to move from right to left. When the slot 189 brings the phototransistor 192 back into the light again, the control unit enables the store to send the signals for this second line. The printing of this second line takes place substantially in the manner described for the preceding line.

Let it now be assumed that a line of only numeric characters is to be printed, with the carriage 31 positioned at the left-hand end of the line itself. The control unit activates the inputs for the signals coming from the photoelectric cells 93 and 106 corresponding to the holes 88 and 104 in the disc 90 (FIGS. 3 and 13). Moreover, the electromagnet 184 (FIG. 5) is deenergized. The sprinG 163 shifts the collar 162 to the left. The lever 177 turns anticlockwise, bringing the projection 179 into the path of the projection 178 of the lever 176, which thus remains locked in the inoperative position.

The collar 162, on shifting to the left, causes the meshing of the toothed rim 168 with the toothed rim 169 of the sleeve 148 which, through the couplings formed between the gears 147 and 146 and between the gears 142 and 141, causes the shaft 138 to rotate. Through the coupling between the gears 136, said shaft causes clockwise rotation of the shaft 133 and, therefore, of the cam 132 at twice the speed with respect to that used before for the alphanumeric printing. The cam 132 shifts to the right the slider 124 and, therefore, the carriage 31, which is now shifted for a distance corresponding to the character space, while the type wheels 38 rotate for half a revolution.

The coupling between the toothed rims 168 and 169, as has already been said, is off-set through an angle of 22°30′ with respect to the coupling between the toothed rims 166 and 167 (FIGS. 7 and 8). The shaft 151 therefore rotates through 22°30′ before beginning to transmit the motion to the shaft 138. This rotation corresponds to a 90° rotation of the sleeve 49 (FIG. 3) and, therefore, of the type wheels 38, the zero axis of which will no longer be the axis forming the line bisecting the portions B and C, but the axis perpendicular thereto. The central character, which was reached before after a 180° rotation of the wheel 38 from the instant of the reading of the hole 98 in the disc 90 (FIGS. 3 and 13), is now reached after a rotation of only 90° with respect to the holes 104. In fact, the speed of the carriage 31 is twice as great. There are therefore two central characters, which are the central characters of the portions B and C, which are printed when their axis is on the line joining the axes of the hammer 62 and the wheel 38.

The transmission of the data to be printed is still controlled by the slots 189 (FIG. 5) and, therefore, by the phototransistor 192. The control circuits of the hammers 62 are reset by the passage of the holes 104 in the disc 90 in correspondence with the phototransistor 106 and then count the holes 88 by means of the phototransistor 93, which produces selective energization of the electromagnets 74 of the hammers 62. At each revolution of the wheels 38, two characters are printed for each wheel, one for the portion B and one for the portion C.

At the end of the printing of the line, the control unit provides, in the manner already described, for sending the orders for the following line. The arrest of the carriage now takes place by energizing the electromagnet 184. In the event of the printing having to be continued, the order for effecting line-spacing for the forms 111 is sent, the phototransistor 93 is deactivated and, instead, the phototransistor 94 is activated, which corresponds to the holes 89 in the disc 90 which control the synchronism for the printing of the numeric characters when the carriage 31 shifts from right to left.

The deenergization of one of the electromagnets 183 and 184 (FIGS. 5 and 6), as described, sets in rotation the shaft 138 (FIGS. 5 and 6) and, therefore, through the coupling 261 (FIGS. 1 and 10), the shaft 258. The shaft 258 causes the sleeve 268 to rotate and, therefore, assuming the position to be as shown in the drawings, causes the sleeve 257 to rotate through the coupling between the toothed rims 267 and 264. The sleeve 257, in turn, causes the shaft 242 (FIGS. 9 and 10) to rotate through the coupling between the gears 254. The shaft 242 rotates and compresses the spring 243 until its dog 247 encounters the dog 246 of the spool 203, which thus also begins to rotate clockwise. The ribbon 201 is wound around the core 234, being guided on the rollers 226, the pins 222, the four rollers 204 and the pins 221 and unwinding from the spool 202.

The spool 202 also rotates for a certain distance, loading the spring 243 until its dog 246 encounters the dog 247 of the shaft 241. The ribbon 201 is subjected to a certain pull due to the action of the brake 251, which opposes the rotation of the shaft 241. The ribbon 201 thus has a first movement of translation with respect to the paper 111.

During the movements of the carriage 31 from left to right and vice versa, it displaces the cam 213 with respect to the roller 212. The frame 206 (FIG. 4) is turned anticlockwise initially and raises the ribbon 201 with respect to the wheels 38. The point of maximum height is reached when the carriage 31 is at the halfway point of its travel. The ribbon 201 must therefore have a height, or width, sufficient for it to remain always in correspondence with the wheels 38. As already described, the carriage 31 can stop only at the two ends on the right and left; in these two positions, the ribbon 201 is lowered, so that the last printed line can also be read.

In the event of the carriage 31 stopping, the shaft 258 also stops and, therefore, the driving spool 203 stops. Due to inertia, the spool 202 tends to continue its rotation, thus causing a slackening of the ribbon 201, which could bear against the wheels 38 still in motion and therefore break. The springs 243 stretch, however, to return to their normal inoperative position, causing the two spools 202 and 203 to rotate in the opposite direction to the previous one and bringing the ribbon 201 under tension again.

When the portion of ribbon 201 wound on the spool 202 is about to come to an end, the stop 231 engages with the pins 221 and shifts the slider 224 to the right until the roller 277 of the crank 276 passes from the profile 278 to the profile 279 of the lever 281. Owing to the action of the spring 282, the roller 277 slides on the profile 279, causing the crank 276 to turn anticlockwise very rapidly together with the shaft 274 and the crank 273. This crank shifts the sleeve 268 to the right through the roller 272, disengaging the rim 267 from the rim 264 and engaging the rim 266 with the rim 263.

The sleeve 256 thus begins to rotate and, through the coupling between the wheels 253, sets the shaft 241 in rotation anticlockwise. The shaft rotates and loads the corresponding spring 243 until its dog 246 encounters the dog 247 of the spool 202, which thus becomes the driving spool for the ribbon 201, which is wound thereon and unwinds from the spool 203. When the ribbon wound on the spool 203 reaches its end, the operation which has just been described is repeated in a substantially identical manner.

Replacement of the ribbon is effected by raising the frame 206 manually by means of the lugs 209 as far as the position indicated in broken lines in FIG. 4.

Servicing and cleaning of the wheels 38, on the other hand, is effected by raising the frame 206 as far as the position indicated in chain-dotted lines in FIG. 4. In this position, the wheels 38 are in fact completely free or exposed.

It is understood that various modifications may be made in the printer described without departing from the scope of the invention. For example, the portions for recocking the hammer may be eliminated by deciding to print one character every two revolutions of the type wheel. The printing is effected during the first revolution of the type wheel, while the second revolution is used for recocking the hammer. In this way, the characters may be distributed over the entire circumference of the wheel.

If the characters to be printed are few in number, they may also appear more than twice on the type wheel, being spaced apart each time by a portion devoid of characters and having

an amplitude sufficient to ensure the recocking of the hammer. In this case, at each revolution of the wheel, there is printed a number of characters equal to the number of times that the characters appear on the wheel. The carriage, on the other hand, performs a travel of one character space while the type wheel performs a rotation corresponding to the sum of a portion devoid of characters and a portion bearing one of these series of characters.

Finally, both in the printer described and in the examples which have just been indicated, the type wheels may be replaced by an endless band which can revolve on two spools carried by a carriage.

It is to be understood that the invention is not to be limited to the specific form or arrangement of parts herein described and shown, but is limited only by the scope of the appended claims.

I claim:

1. A high-speed printer comprising

at least one type-bearing element on which is arranged a plurality of characters organized into at least one first series of characters and at least two identical second series of characters, said second series of characters appearing on said type-bearing element a plurality of times for each appearance of said first series of characters,

means to move said type-bearing element continuously in a substantially horizontal plane so as to cause each of said characters to travel a closed path,

a hammer to effect the printing of said characters on the fly,

a paper support for holding paper upon which said characters will be printed interposed between said hammer and said type-bearing element,

means for shifting said type-bearing element and said hammer with respect to said paper support throughout a printing zone a distance corresponding to a character space during the interval in which successive selected characters on said type-bearing element are positioned in front of said hammer,

means for varying the ratio of the rate of movement of said shifting means to the rate of movement of said type-bearing element and said hammer between a first ratio used when printing said characters of said first series of characters and a second ratio used when printing said characters of said second series of characters.

2. A printer according to claim 1 wherein said first ratio and said second ratio are dependent upon the number of times said first series of characters and said second series of characters appear on said type-bearing element.

3. A printer according to claim 2 wherein said type-bearing element and said hammer are mounted in spaced relationship upon a carriage, and wherein said means for varying the ratio of the rate of movement of said shifting means to the rate of movement of said type-bearing element and said hammer acts on said carriage, operating said carriage at a first rate for printing said first series of characters and at a second rate for printing said second series of characters.

4. A printer according to claim 1 wherein for each appearance of said first series of characters on said type-bearing element, said second series of characters makes a first appearance centrally disposed in each of said series of characters and a second appearance diametrically opposite thereto, and wherein said type-bearing element includes portions devoid of said characters to provide intervals for recocking said hammer.

5. A printer according to claim 4 wherein said type-bearing element and said hammer are mounted in spaced relationship upon a carriage and wherein said means for varying the ratio of the rate of movement of said shifting means to the rate of movement of said type-bearing element and said hammer acts on said carriage, said carriage moving at a first rate for printing said first series of characters and a second rate for printing said second series of characters.

6. A printer according to claim 5 wherein said means for shiftIng said type-bearing element and said hammer comprises

a first electromagnetic clutch selectively connecting said carriage to a means for driving said carriage at said first rate, and

a second electromagnetic clutch selectively connecting said carriage to a means for driving said carriage at said second rate, and

means for selectively engaging said first clutch or said second clutch.

7. A printer according to claim 6 wherein said means for shifting said type-bearinG element and said hammer further comprises a rotatable cam driven by said selected clutch and having a camming surface engaging a connecting link attached to said carriage, said cam causing said carriage to move with a uniform motion throughout said printing zone at a rate dependent upon said selected clutch driving said cam.

8. A printer according to claim 7 wherein said cam is rotatable in two opposite directions and said carriage is transversely movable in two directions.

9. A printer according to claim 8 further comprising means for synchronizing the printing action of said hammer with the arrival of said selected one of said characters in front of said hammer.

10. A printer according to claim 9 wherein said type-bearing element comprises a type wheel rotatable on a substantially vertical shaft, and wherein said means for synchronizing comprises a disc having a plurality of openings therein corresponding to said characters and rotatable in synchronism with said type wheel, and hammer control means activating said hammer upon the passage of a predetermined number of openings, whereby the presence of said selected character is sensed in front of said hammer.

11. A printer according to claim 10 wherein said openings are so phased with said characters to which said openings correspond that said hammer prints said characters on one line vertically adjacent with said characters of another line.

12. A printer according to claim 10 further comprising a plurality of type wheels and a plurality of hammers shifted together by said means for shifting, the axes of said type wheels being slightly inclined and disposed apart a distance less than the diameter of said wheels whereby adjacent wheels partially overlap, each of said wheels printing said characters for a portion of said printing zone, said characters being inclined on said wheels opposite and equal to the inclination of said axes whereby said characters are printed substantially vertically.

13. A printer according to claim 12 further comprising an inclined ribbon mounted in a frame and interposed between said hammers and said paper.

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