United States Patent [19]

Venker

[11] **3,812,495**

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[54] **MOSAIC PRINTER**

[75] Inventor: **Hilrich Jan Matthijs Venker,** Heemstede, Netherlands

[73] Assignee: **Societe Industrielle Honeywell Bull (Societe Anonyme),** Paris, France

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[30] **Foreign Application Priority Data**

Oct. 13, 1971 France 71.36715

[52] **U.S. Cl.** ..... **346/101,** 197/1 R, 101/93 C

[51] **Int. Cl.** **G02b 5/12**

[58] **Field of Search** ..... 197/1; 346/101, 141; 101/93 C; 310/8.5

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Primary Examiner—Robert E. Pulfrey
Assistant Examiner—Ralph T. Rader
Attorney, Agent, or Firm—Fred Jacob

[57] **ABSTRACT**

A mosaic printer is provided with a cylindrical rotating drum on the outer surface of which is a raised spiral threading, and a plurality of print hammers in the form of elongated plates is located along the lengthwise edge of said drum, the print medium moved between the drum and the hammers at a fixed speed during printing. Each of the elongated plates is sloped in relation to the axis of the drum, the lower end of the plates, in relation to the movement of the print medium, being directed towards the upstream side of the corresponding movement of the spiral threading, as compared with these plates.

8 Claims, 14 Drawing Figures

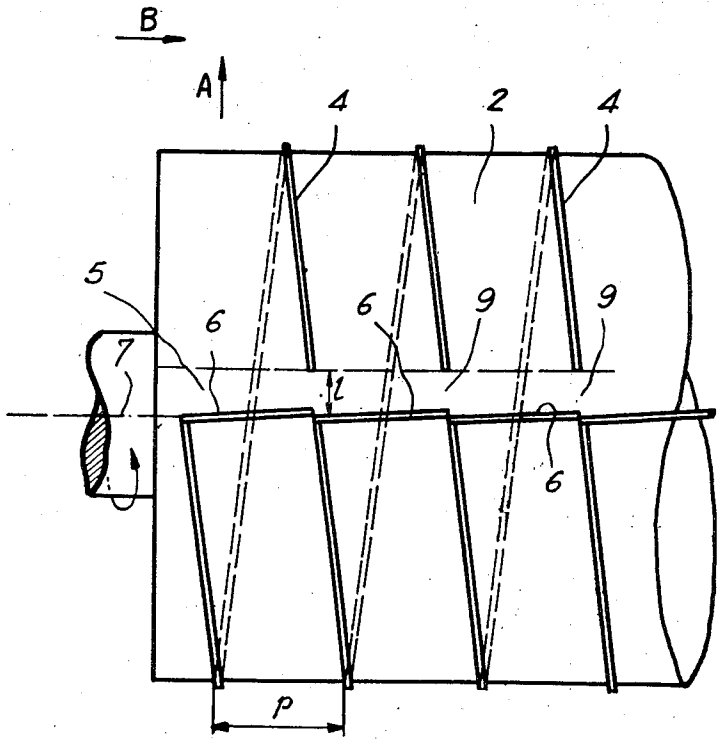


FIG.2

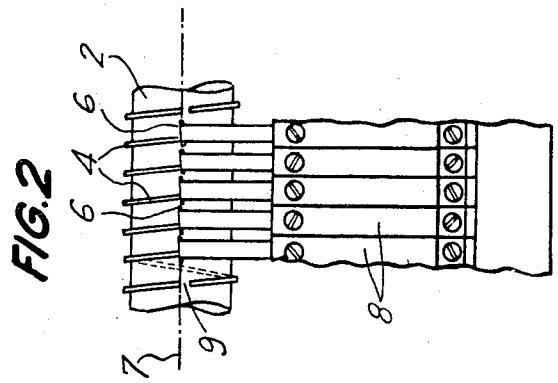


FIG.1

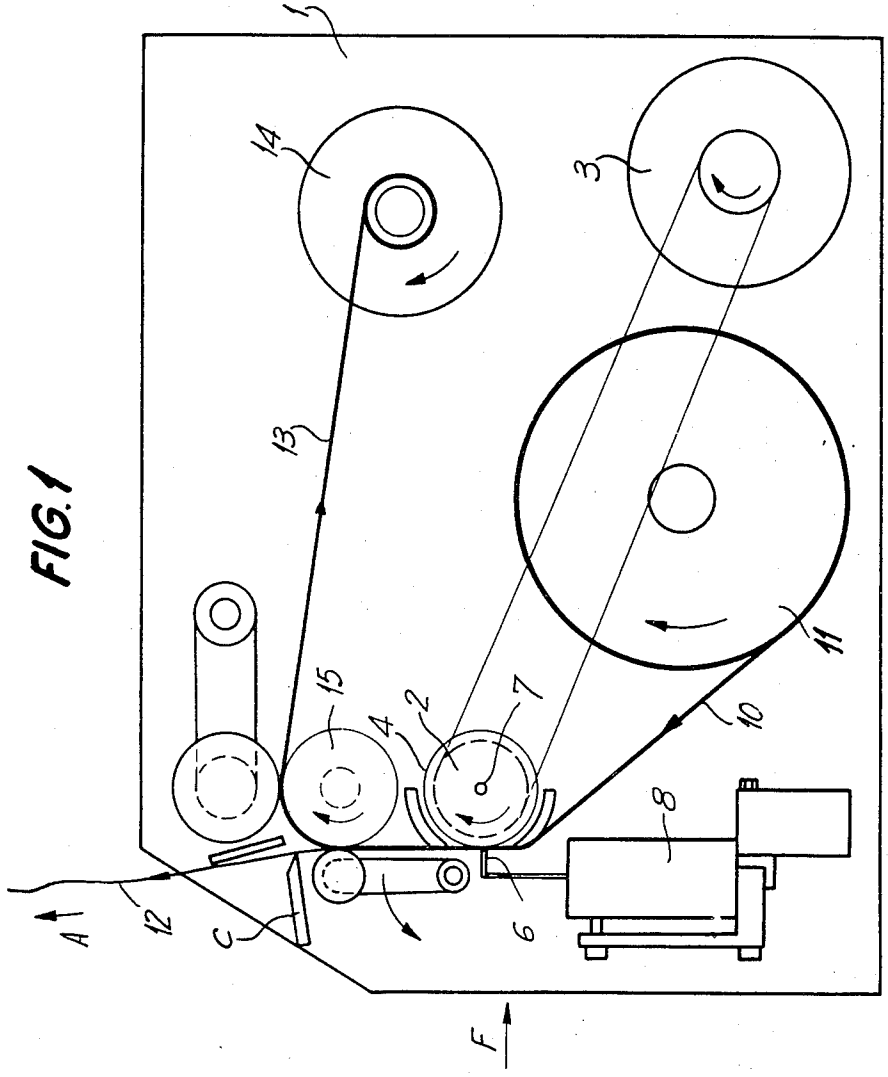


FIG.3

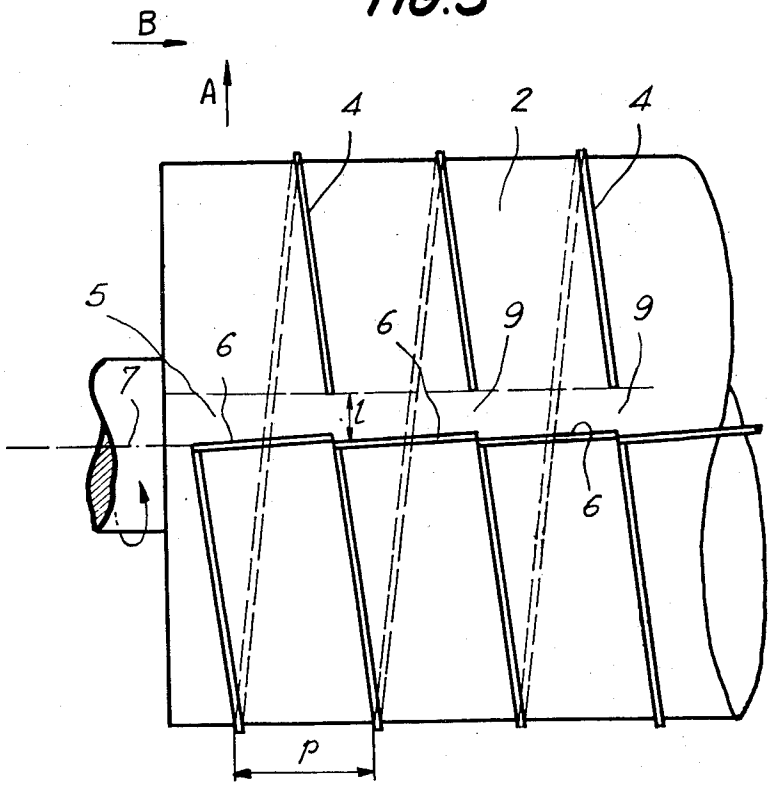


FIG.4

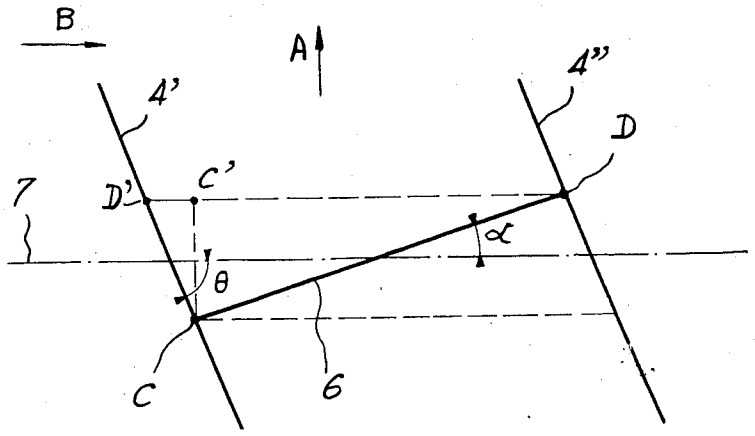


FIG. 6

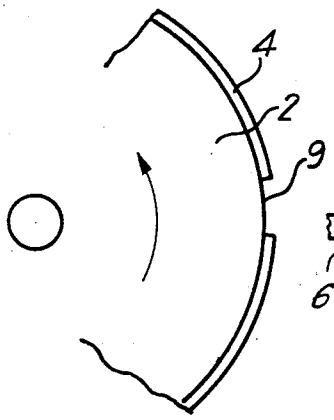


FIG. 5

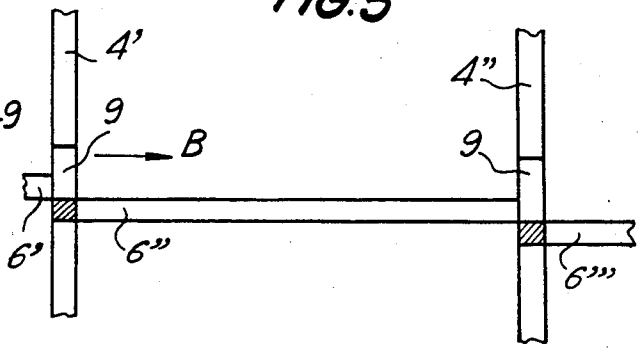


FIG. 8

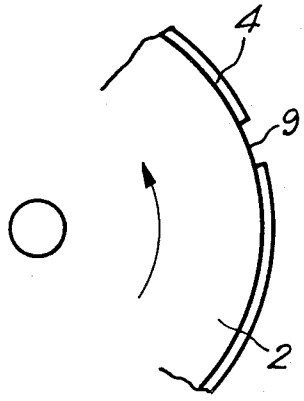


FIG. 7

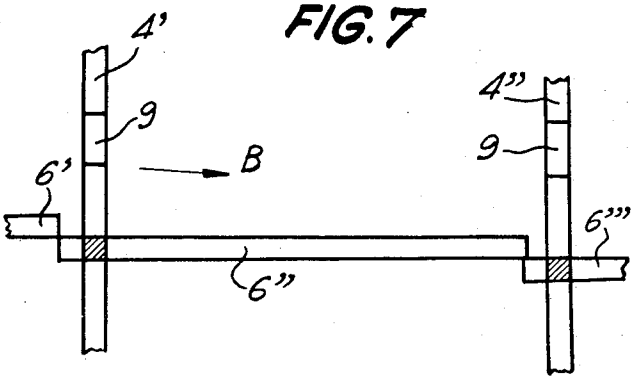


FIG. 10

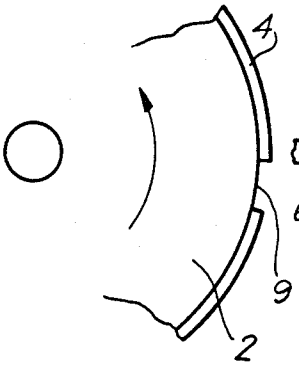


FIG. 9

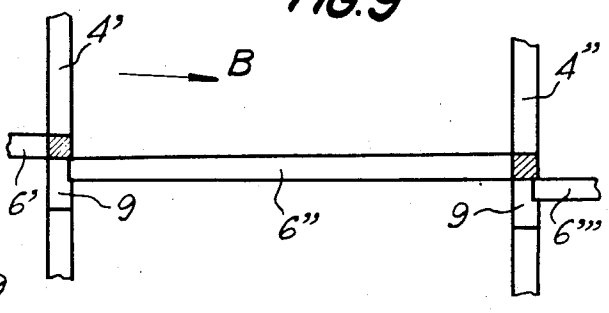


FIG. 11

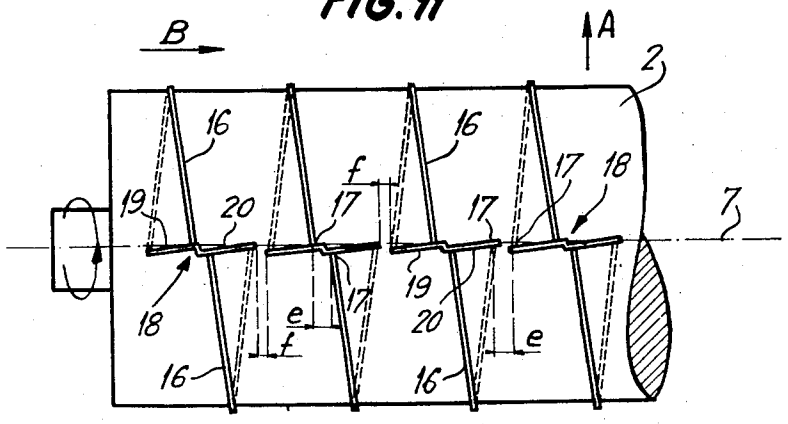


FIG. 12

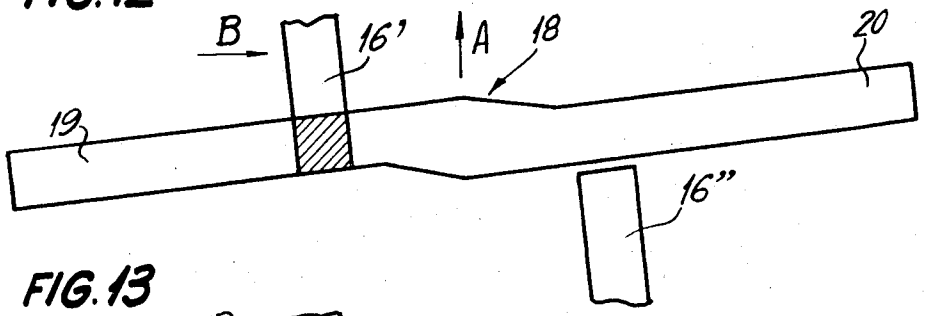


FIG. 13

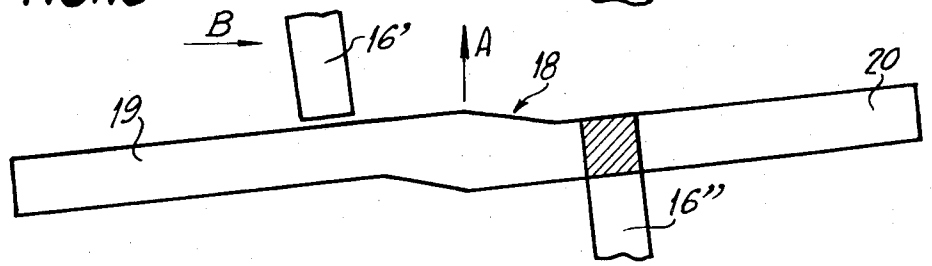
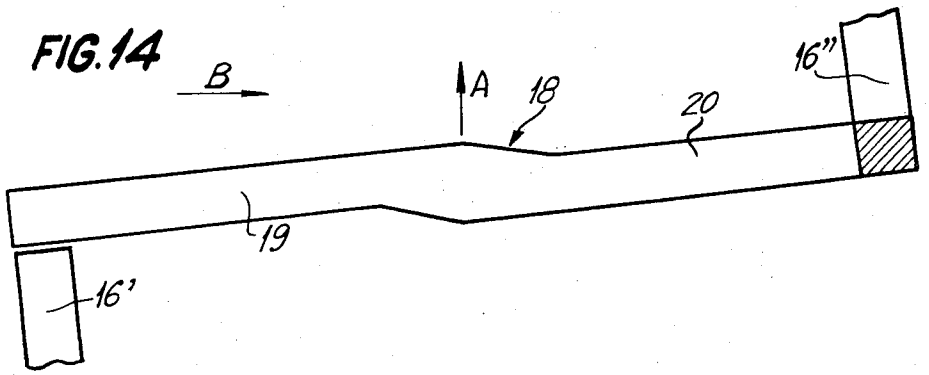


FIG. 14



MOSAIC PRINTER

BACKGROUND OF THE INVENTION

The present invention relates to a machine for printing by means of dots, frequently called "a mosaic type", more particularly to a machine by which each character or symbol is formed by a plurality of dots, printed separately.

A mosaic printing machine is a type of printer already known in the art. It includes, on the one hand, a cylindrical rotating drum whose surface carries a raised spiral threading, and, on the other hand, a multitude of print hammers in the form of elongated plates, aligned and positioned parallel to the axis of the drum.

The print medium, for example, a sheet of paper, is located between the print hammers and the drum and moves perpendicularly to the axis of the latter. When one of these hammers is set in motion it presses this medium against the spiral threading to print a dot whose shape corresponds with the surface of the contact between said spiral threading and the plate of said hammer.

In this machine, every character or symbol consists of dots arranged in rows and columns and is generated row after row, the rows of different characters or symbols of one line being printed at the same time.

However, such a machine has a serious disadvantage, for the print medium must be stopped during the printing of a row of dots by a hammer, or else said row would not be parallel to the length of said medium. Thus, not only does this stoppage during the printing restrict the printing speed of the machine, but is is also necessary to provide a costly system for driving the medium step by step because of the sequential printing of different rows of a symbol. The present invention corrects this disadvantage.

SUMMARY OF THE INVENTION

According to the invention, the mosaic printer includes, on the one hand, a cylindrical rotating drum whose outer surface bears a raised spiral threading, and on the other hand, a plurality of print hammers in the form of elongated plates, positioned along said drum while a print medium passes between the latter and said hammers at a continuous speed during the printing. The printer is distinguished in that each of said plates is inclined in relation to the axis of the drum, the lower end of the plate in relation to the direction of the movement of the print medium being directed towards the upstream side of the corresponding movement of the spiral threading, as compared with this plate.

Thus, by selecting a suitable slope for said plates, especially as a function of the movement speed of the print medium, it becomes possible to strike a row of dots with a hammer without stopping the movement of said medium, said row being parallel to the width of the latter, after printing. The angle of slope of the plates to the axis of the drum may be determined in an exact manner as a function of the speed v of the movement of the print medium, of the pitch p of the spiral thread, of the angle θ formed by a tangent to a point on the thread and the drum axis, and of the number of rotations N of said drum per time unit. The result of the calculation is as follows:

$$tg\alpha \cong (v/pN - (v/tg\theta))$$

So as to be in a position to simultaneously strike rows of lines of different symbols the centers of the plates are preferably aligned on a straight line parallel to the axis of the drum.

According to a first version of embodiment relating particularly to a machine called a "full page dot printer," which is capable of covering a full page with tightly positioned dots, the spiral threading consists of one single continuous spiral, and each plate is rectangular and has a length that is roughly equal to the pitch of this spiral. The ends facing one another of two sequential plates may also slightly overlap, while being staggered at a level parallel to the movement of the print medium. Hence. the last and the first dot printed by two sequential hammers are adjoining so that undesirable printing spaces are completely avoided.

Also, in order to prevent a single hammer of a length slightly greater than the pitch from striking the thread in two separate places, especially during the printing of the first or the last dot, said thread is equipped with a number of notches arranged in a strip parallel to the drum axis and separating the threading into a number of sequential and separate turns. The length of these notches (i.e. the width of that strip) is such that when one of the ends of a plate is positioned straight above the edge of the notch of a turn, the other end of said plate is located opposite the notch of the corresponding adjoining turn.

According to a second mode of design, relating particularly to a line printer, the spiral thread consists of a series of identical spiral half-turns which are alternatingly wound 180° around the drum axis in relation to the preceding one, the ends facing the two adjoining half-turns being separated from each other by the same span. Thus, each half-turn may be affiliated with the striking of a character, while the distance between said half-turns corresponds with the span between characters.

Each plate may comprise two rectangular sections which are parallel and are an integral part of one another, so that at their juncture point the end of the one directed towards the upstream side of the relative movement of the spiral thread is higher than the end facing the other section. Preferably, the shift in height of said ends is approximately equal to the half-height of a printing dot. Each of these plate sections is connected with one of two consecutive half-turns wound 180°.

If each half-turn corresponds with a printing possibility for x dots, and if the span between two sequential turns corresponds with y dots the length of such a plate has to correspond to $2x + y$ dots. The pitch of each character being $x + y$ dots, the span between the plates may be y dots so that the plates need not partially cover each other as was the case previously. They therefore could be shortened, compared to the preceding version of embodiment, which due to the reduction of their mass would favorably effect their speed.

Due to the special form of these plates the transition on the level, of the distance between characters entails, therefore, no loss of time, for the first dot struck by the plate positioned on the downstream side of the movement of the spiral threading may be printed immediately after the last dot has been printed by the plate positioned upstream of said movement.

BRIEF DESCRIPTION OF THE DRAWING

The figures of the attached drawing will serve to increase the reader's understanding of the operation of the invention, wherein:

FIG. 1 is a side view in diagramatic form of a version of embodiment of the printer according to the invention;

FIG. 2 is a partial view taken along the arrow F of the machine of FIG. 1;

FIG. 3 illustrates in diagramatic form and in an enlarged view, a part of the drum having a spiral threading, and the arrangement of the print plates in the position of printing the first possible dot;

FIG. 4 illustrates the principle of the invention;

FIGS. 5 to 10 show the printing of the terminal and the intermediary dots in the machine of FIGS. 1 to 3, FIGS. 5, 7, and 9 showing in diagramatic form the front of the drum, while FIGS. 6, 8, and 10 represent the drum from the side;

FIG. 11 shows the drum of an alternate embodiment of the invention; and

FIGS. 12, 13, and 14 depict the operation of the machine whose drum is shown in FIG. 11.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The printing machine shown in FIGS. 1 and 2 is of the type called a "full page dot printer" which is capable of covering a full page with tightly placed dots. It includes a frame 1 on which is mounted a rotating drum 2 driven in constant rotation by a motor 3, which may be for instance, a synchronous motor. The drum 2 is equipped on its periphery with a spiral threading 4 of square section, interrupted by notches 9 in the form of a longitudinal strip 5 of the width (see FIG. 3). Thus, the thread 4 is divided into a series of turns which are sequential and nearly complete, but separated.

Facing the drum 2, as shown in FIG. 2, there is mounted a number of striking modules 8, distributed along said drum in a fixed position. These striking modules carry hammers 6 (see FIG. 3) which have the form of elongated plates whose length is roughly equal to, and preferably slightly greater than, that of the pitch p of the threading 4, and whose direction is sloped at an angle α to the axis 7 of the drum 2. The width of these plates may be roughly equal to the width of the thread 4.

The striking modules 8 may be of any known type. The centers of the plates 6 are aligned on a straight line parallel to the axis 7 and the adjoining ends of two consecutive plates 6 overlap slightly, while being staggered in height (see FIGS. 5, 7, and 9).

The print medium in the form of a strip 10 is fed by a roll 11 and passes between the drum 2 and the print hammers 6 moving in the direction of the arrow A. This medium may be an original 12 which is rolled up on a roll, not shown, or may be cut by means of a knife C, or a copy 13 which is rolled up in a roll 14 after being sent back on a drum 15.

Hence, the turns of the thread 4 move from left to right (in FIGS. 2 and 3) in front of the hammers 6, while the print medium 10 passes from the bottom upwards (always in relation to these figures) between the drum 2 and the hammers 6. As a result a hammer 6 when set in motion prints a dot on the medium 10 which is positioned at the place of contact of its surface with the thread 4. When during a rotation of the drum, i.e. during one advance of the pitch 2 of the thread, a hammer 6 is set in motion n times, its interaction with a turn of said thread will entail the printing of n dots. The first of these dots will be printed by the left end of said hammer and the last dot by its right end. Each printed dot originates from a part of the hammer located further to the right than that which performed the printing of a preceding dot, and further to the left than that which will accomplish the printing of a following dot. Obviously, not all of the possibilities for the printing of dots are necessarily utilized by one hammer during a complete revolution of the drum. Only those dots are printed which correspond with those of a row of a representation of a symbol to be reproduced.

A synchronization disk, not shown, is attached onto the axle of the drum 2 by which, at any time through interaction with a transducer, the position of the thread 4 in relation to the front of the hammers 6 may be determined, and consequently, the spots where the dots have to be printed.

The number of the hammers 6 depends on the length of the line to be printed and on the part of that line which can be printed by a hammer. In a preferred version of design of the invention the length of the plates 6 was chosen to be 5mm, while the widths of the thread 4 and of the plates 6 are 0.25mm which enables each hammer to print approximately 20 square dots of 0.25 × 0.25mm per revolution of the drum 2. It should be quite apparent that these dimensions are not limitative.

If each strike of a hammer is for instance 2ms, the printing time for 20 dots will be 40ms. Since the hammers are fed in parallel, this time is not affected by the length of the line to be printed (defined by the number of hammers), nor by the maximum number of dots which are to be printed in series by each hammer.

The drum 2 and the print medium 10 are driven individually by autosynchronous motors. The drive of the drum 2 is continuous and at a constant speed, while the speed of movement of the medium 10 is variable. This speed of the medium 10 is relatively low during sequential printing of rows of dots, but accelerated during line spaces or skipping of lines. FIGS. 3 and 4 illustrate in diagramatic form the principle of the invention. A plate 6 is shown therein between two sections 4′ and 4″ of the turns of the thread 4 at a distance of pitch p. It is assumed that the plate 6 is sloped at an angle α to the axis 7, while the tangent to a point of the spiral thread forms an angle θ with this axis. The rotation of the drum 2 causes a relative movement of the thread 4 in the direction of the arrow B. When the thread arrives at 4′ at the left end of the plate 6, the plate is in a position to print a dot at C. The thread 4 continues to pass in front of the plate 6 and the last dot D which the latter can print corresponds, in interaction of its right end, with the thread which has now reached the position 4″. However, as a consequence of the movement of the print medium in the direction of the arrow A the dot C has reached C′ at the moment of the printing of dot D. For the dots printed during the passing from 4′ to 4″ to be positioned on a line C′D, parallel to the width of the medium 10, hence parallel to the axis 7, it is necessary that $tg\alpha = CC'/C'D$, the dot D′ being located upstream of the dot D by a distance of the pitch p. By setting $D'C' = x$ and $CC' = d$ one may write $tg\alpha = d/p - x$ and $tg\theta = d/x$, consequently $tg\alpha = d/p - (d/tg\theta)$.

If v is the designation for the speed of the movement of the medium **10**, it may be written that $d = v \cdot t$, t being the time necessary for the rotation of the drum causing the passing of the thread from C to D. If it is taken into account that the angle α is small, this revolution is very close to a turn. It may then be written $t \cong 1/N$, N being the number of turns of a drum per time unit. The distance d is now written $d \cong V/N$. When replacing d by that value $tg\alpha \cong (v/pN) - (v/tg\theta)$ is found.

In the frequent case in which θ is close to $\pi/2$, $tg\alpha \cong v/pN$ may be written. It will thus be realized that a good approximation of the tangent of the incline angle of the plates **6** to the axis **7** must be roughly proportionate to the movement speed of the medium **10** and inversely proportionate to the product of the pitch of the thread **4** by the number of turns of the drum **2** per time unit. This angle α is generally small, about a few degrees.

Since the adjoining ends of two hammers **6** overlap slightly it could occur that during the printing of the end dots these hammers hit the thread **4** in two places and that they would thus print two dots instead of one. It is for that reason that the notches **9** were formed into the thread **4** into a longitudinal strip **5** of the width **1** as shown by FIG. **3**.

FIGS. **5** to **10** illustrate the striking of different dots by three consecutive hammers **6'**, **6''**, and **6'''**. FIGS. **5** and **6** show that during the printing of the first possible dot by the left end of these hammers their right end drops in front of the notches **9** and can, therefore, not execute the printing of a dot. In the same way, FIGS. **9** and **10** show that during the printing of the last possible dot by the right ends of the hammers, their left ends drop facing the notches **9**. FIGS. **7** and **8** illustrate the striking of an intermediary dot. The width **1** of the longitudinal strip **5** of the notches **9** is relative to the movement of a turn between two successive hammer strikes.

FIGS. **11** to **14** illustrate a variation in design of the invention of a type of printer for producing lines in parallel series, i.e. suited for the printing of a text by means of standard characters and symbols. The basic concept, and the operation of this line printer, are substantially similar to that of the above-described mode of embodiment. Particularly, FIG. **1** is applicable without modification to this variant. However, in this case, as shown by FIG. **11**, the drum **2** has a spiral threading consisting of a series of identical spiral-threaded half-turns **16** which are turned alternatingly by 180° corresponding to the previous series around the axis **7** of the drum **2**, the ends **17** facing the two adjoining half-turns **16** separated from each other by a fixed span e all along the drum **2**.

Each printing plate **18** includes two rectangular sections **19** and **20**, parallel and solidly attached to each other. The two sections **19** and **20** are inclined by the same angle α to the axis **7** and their opposite ends are staggered in height by the half-height of a printed dot. At their point of juncture the end of the section **19**, directed to the upstream side of the relative movement (arrow B) of the spiral thread, is higher in comparison to the end of the other section **20**. Each section **19** and **20** is connected with the printing of a character.

The interaction of a section of the plate **19** and **20** with a half-turn **16** corresponds with a possibility of printing successively x dots, while the span e between the sequential half-turns (i.e. between adjoining characters) corresponds with y dots. The total length of a plate **18** is consequently at least equal to $2x + y$ dots, while the span f between sequential plates corresponds at the maximum with y dots.

FIGS. **12, 13,** and **14** show three different strike sections of the plate **18** in relation to the two half-turns **16'** and **16''**, in sequence. In these figures the printed dots are marked by a cross-hatched surface.

FIG. **12** shows the end of the half-turn **16'** positioned in front of the section of the plate **19** in such a manner that, at that moment, the last dot of a row of characters associated with this section of the plate may be printed. The beginning of the half-turn **16''** is approaching the section **20** of the plate **18**. In FIG. **13**, the half-turn **16''** is in position in front of the section **20** corresponding with the first dot which is to be struck by that section. The half-turn **16''** is moving away from the section **19**.

FIG. **14** shows the half-turn **16''** in a position for printing the last possible dot with the section **20** of the plate, while the threading **16'** approaches that section **19** of the plate about to print the first dot corresponding with that threading.

What is claimed is:

1. A mosaic printer, comprising a cylindrical rotating drum, the outer surface of said drum having a raised spiral threading, a number of print hammers in the form of elongated plates located along said drum, a print medium, means to move said print medium between said drum and said hammers at a fixed speed during printing, each of said plates being inclined relative to the axis of said drum in order to compensate for the continuous displacement of said print medium, the length of each of said plates being slightly greater than the pitch of said spiral with the adjoining ends of adjacent plates overlapping longitudinally, said threading having a plurality of identical notches arranged in a row parallel to said drum axis, said notches dividing the threading into consecutive separate turns.

2. A machine according to claim **1**, characterized in that the length of the notches is such that when one of the plate ends is positioned directly above a turn the other end of said plate is located opposite the notch of the corresponding adjoining turn.

3. A machine according to claim **1**, characterized in that the spiral thread consists of a series of identical spiral half-turns which are turned alternatingly 180° in relation to the preceding one around the drum axis, the ends opposite the two adjoining half-turns being separated from each other by a constant span.

4. A machine according to claim **3**, characterized by each half-turn being associated with the printing of a character, while the interval between said half-turns corresponds with the span between characters.

5. A machine according to claim **3**, characterized in that each plate has two parallel rectangular sections extending in opposite directions from a connecting section joining adjacent ends of said rectangular section, the rectangular section positioned on the upstream side of the connecting section relative to movement of the spiral threading having its end joined to the downstream end of said connecting section relative to the direction of movement of said print medium.

6. A machine according to claim **5**, characterized in that the length of said connecting section is roughly equal to half the height of a print dot.

7. A machine according to claim **5**, characterized in that each rectangular section of the plate is associated

with one of two consecutive half-turns rotated by 180°.

8. A machine according to claim **7**, in which each half-turn and plate section are adapted for printing x dots and in which the span between two sequential turns corresponds with the width of y dots, characterized in that the length of a plate corresponds at least with $2x + y$ dots, while the span between two consecutive plates is at the most equal to a distance corresponding with y dots.

* * * * *