

[54] **SELECTIVE PRINTER EMPLOYING
INKING SPARK DISCHARGE**

[72] Inventor: **Hans-Jurgen Scheinhutte**, Dietlikon, Zurich, Switzerland

[73] Assignee: **Precisa A.G. Rechenmaschinenfabrik**, Zurich, Switzerland

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Primary Examiner—William B. Penn

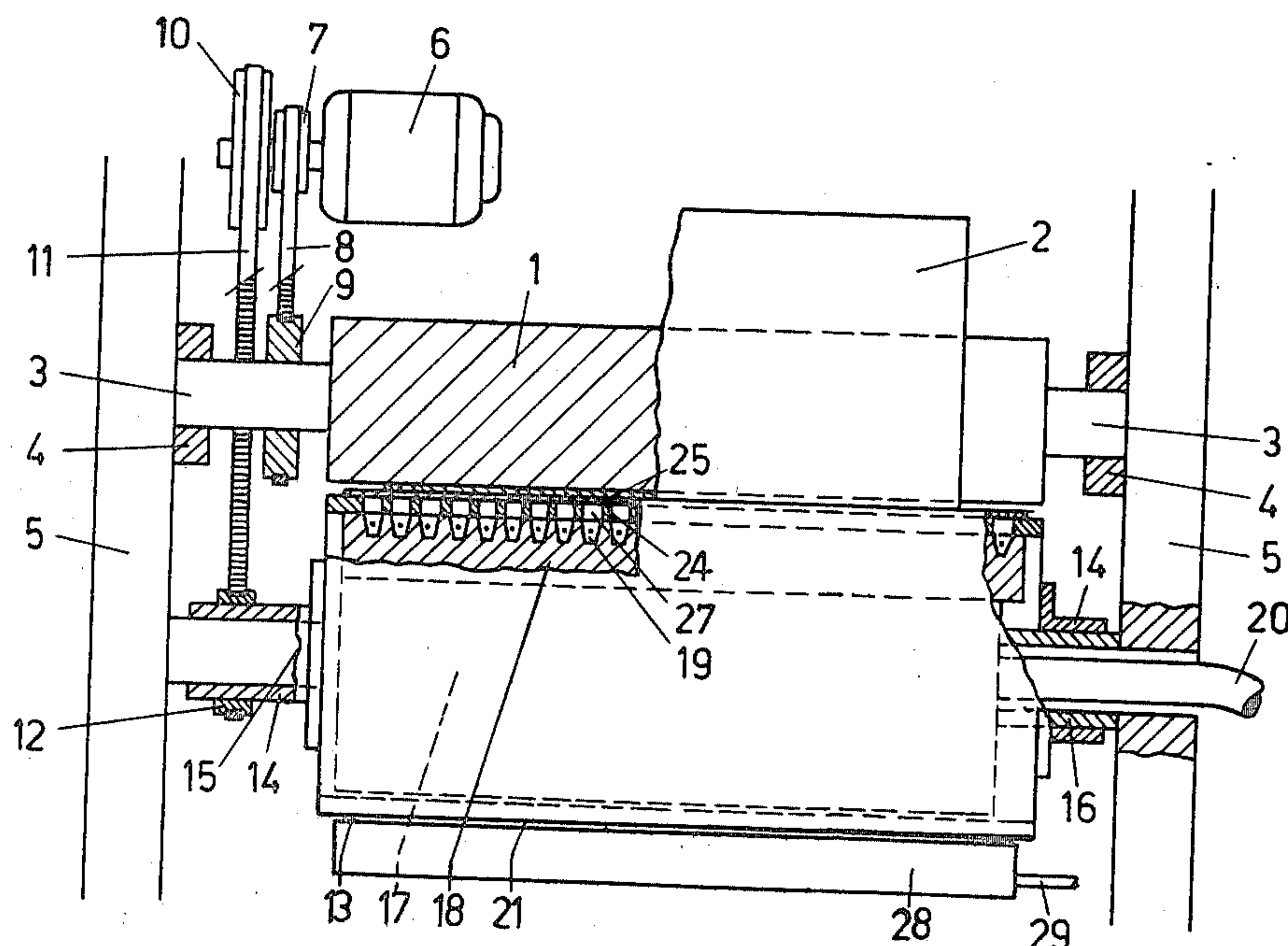
Attorney—Karl F. Ross

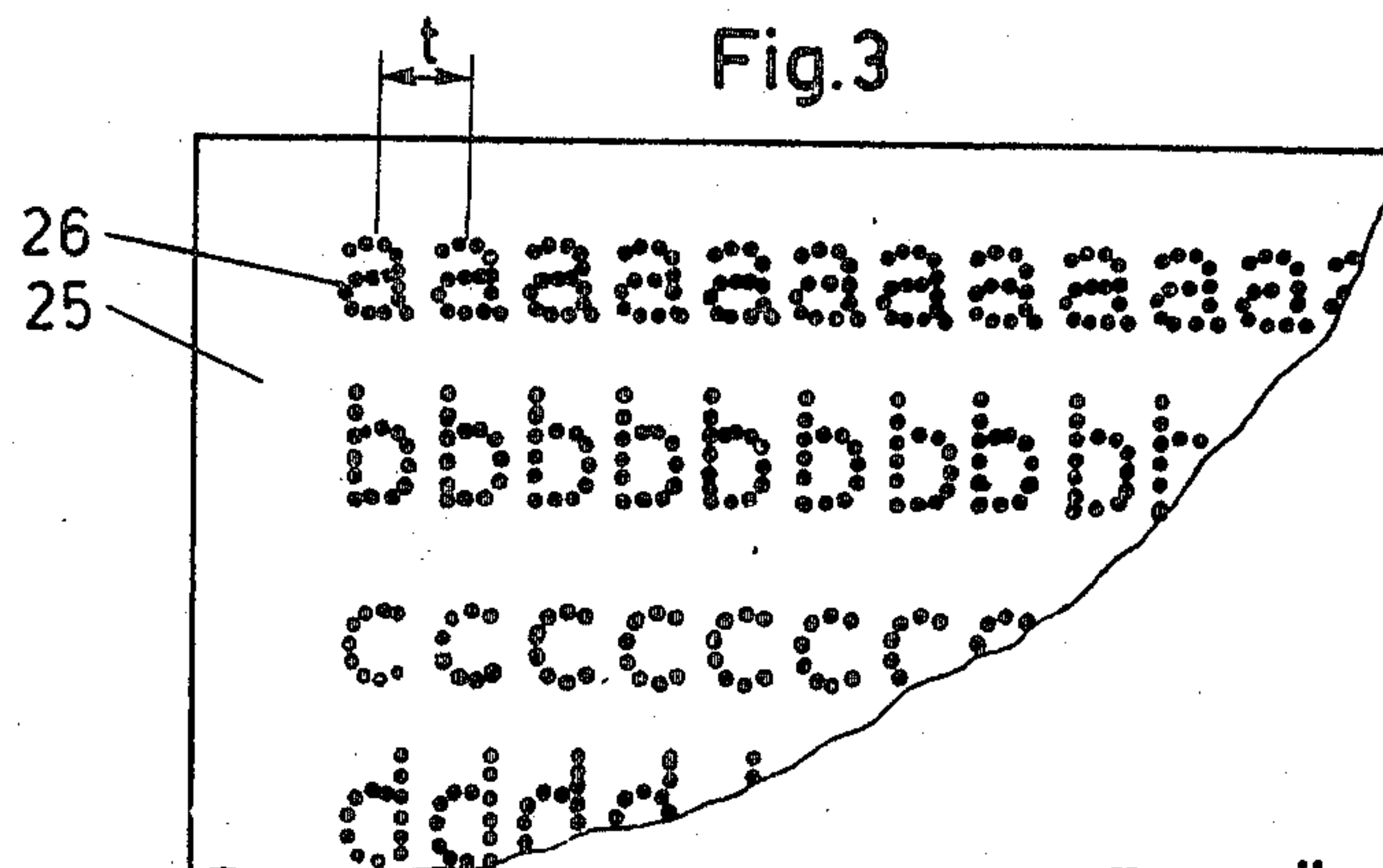
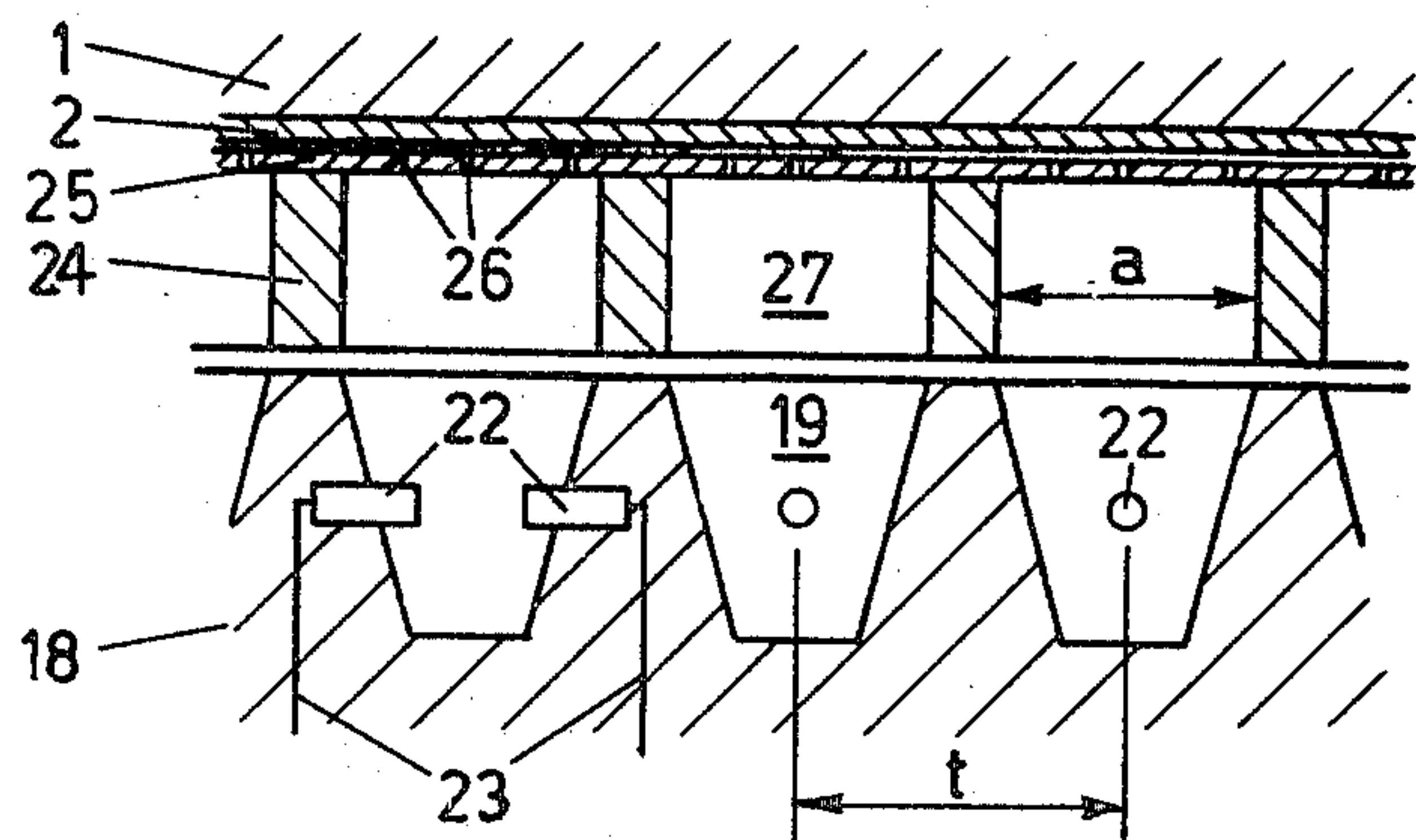
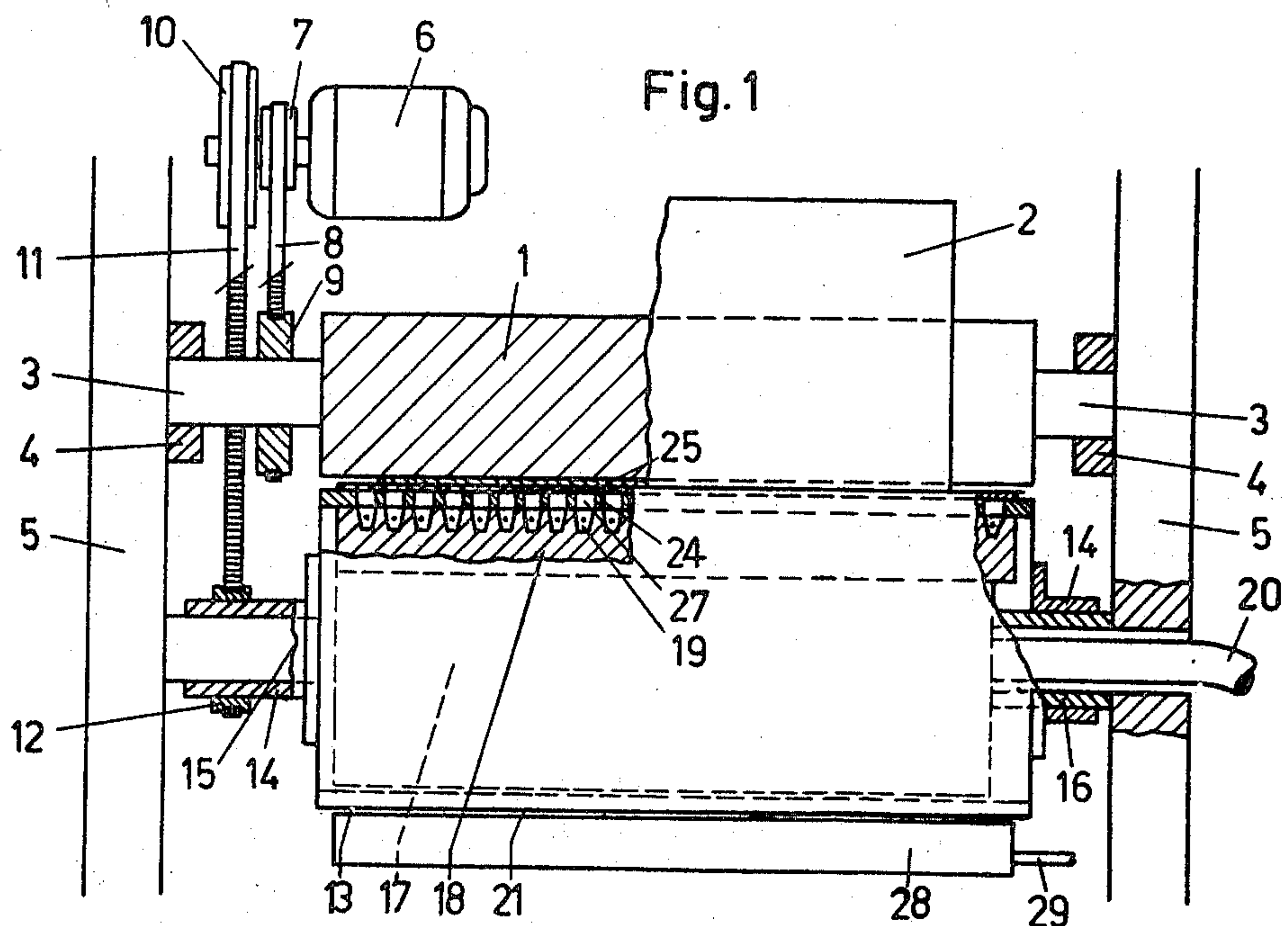
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ABSTRACT

A metal foil containing capillary holes filled with ink and defining the character to be printed is placed so that the holes cover the opening of a chamber having two electrodes which are sparked to raise the pressure in the chamber and so to push the ink out of the holes and against an adjacent web of paper.

8 Claims, 3 Drawing Figures





HANS-JÜRGEN SCHEINHÜTTE
INVENTOR

BY

Karl F. Ross

ATTORNEY

SELECTIVE PRINTER EMPLOYING INKING SPARK DISCHARGE

BACKGROUND OF THE INVENTION

Up to the present time, electromagnetically operated hammers have been chiefly used to print characters in response to electrical signals, at the input of a news transmission unit or at the output of a data-processing system or of a computer. These hammers press the paper web, or other object to be printed on, against a continuously rotating type wheel with raised characters, there being an ink ribbon positioned between the web and the type wheel. That character is printed which is positioned opposite the hammer at the moment a signal is received. The speed of a printer of this kind is very low compared to the possible speed of the electrical signals operating the hammer.

SUMMARY OF THE INVENTION

The object of the invention is to provide a method and apparatus which avoid this disadvantage of the prior art.

The invention relates to a method of and to apparatus for printing using sparks to raise the pressure in a chamber to cause ink held in capillary holes defining the character and placed over the chamber to be pushed, or sprayed, against a paper web or other object to be printed on.

BRIEF DESCRIPTION OF THE DRAWING

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

FIG. 1 is a schematic top view partly broken away, of an apparatus embodying the invention;

FIG. 2 is a longitudinal section, on an expanded scale, of three pressure chambers of a row of such chambers in the apparatus of FIG. 1; and

FIG. 3 shows part of a foil provided with capillary-hole characters.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The high-speed printer shown in the drawing comprises a feed roller 1 for a paper web 2 led around the roller. The roller 1 has a gudgeon 3 that turns in a bearing 4 fixed to a frame 5. The roller 1 is driven by a motor 6 connected with it by a toothed wheel 7, an endless toothed belt 8 and a toothed wheel 9. The motor 6 also turns, through a toothed wheel 10, a toothed belt 11 and a toothed wheel 12, a drum 13 whose hollow gudgeons or trunnions 14 turn in two bearings 15 and 16 fixed to the frame. The bearings 15 and 16 are also fixed to an electrical signal converter 17, which mounts a selector member 18 having a row of pressure chambers 19. The bearing 16 is also hollow to permit the introduction of a cable 20 containing the signal input wires (not shown) and the power supply wires (also not shown) for the signal converter 17.

In order to enable the printing of 80 characters (letters, numbers, punctuation signs etc.) per line, an equal number of pressure chambers 19 are provided in the side of the essentially rod-shaped selector member 18 opposite the drum surface 21. The pressure chambers 19, which can have centers spaced apart a distance t equal to 2.5 mm., for example, have a rectangular opening measuring 2×5 mm., the shorter side $a=2$ mm., extending in the longitudinal direction of the member 18. Each pressure chamber has a pair of oppositely positioned electrodes 22 connected by leads 23 to as many pairs of output terminals (not shown) of the signal converter 17. In FIG. 2 only one pair of leads 23 is shown, the two electrodes in the leftmost chamber 19 being turned 90° from their actual positions for the purpose of making both electrodes visible. Since the wall 24 separating two neighboring chambers 19 is very thin, it would be virtually impossible to have the electrodes project into the chambers along a generatrix of the cylindrical member 18. Each pair of electrodes 22 is assigned to an input lead of the cable 20. The signal converter 17 is so designed that each time a pulse is conducted by the

input lead, a high voltage of 5,000 volts, for example, appears across the corresponding pair of electrodes 22, causing a spark between the electrodes. This spark suddenly increases the air pressure in the chamber 19, thereby printing a character in a manner to be described.

Stretched over the drum surface 21 is a foil 25 made of brass, tombac or bronze, e.g., 0.2 mm. thick, carrying 45 lines of character, for example, each line containing 80 similar characters spaced apart a distance t , as measured between their central lines, as shown in FIG. 3. The 45 characters can consist, for example, of 24 letters, 10 numerals, and 11 punctuation signs and mathematical symbols. The foil can also be composed of materials other than those just mentioned, particularly corrosion-resistant and easily wetted metals, the foil thickness usually being less than 0.4 mm.

Each character is composed of a certain number of capillary holes 26 having a diameter of, say, 0.1 to 0.2 mm. (preferably not exceeding 0.4 mm.) and traversing the foil. Each character lies above an opening or perforation 27 formed in the drum surface 21 and also having a 2×5 mm. cross section. The outer face of the foil 25 is covered with a highly fluid ink by an inking roller 28. The word *ink* as used here means any kind of liquid used for printing. The conventional inking roller 28, shown schematically as a rectangle, is fixed to the frame outside of the drum 13. Preferably, it does not lie diametrically opposite the member 18 (as, for reasons of illustration, it is shown in FIG. 1) but, instead, next to the member 18 so that the letter immediately follows the drum 13 in the direction of rotation thereof. A conduit 29 furnishes ink to the inking roller 28.

When a spark springs from one to the other of the electrodes 22 in a chamber 19, the resulting pressure wave sprays the ink contained in the capillary holes 26 of the character for that chamber 19 against the paper web, causing the character to be printed. Test have shown that the printed character is very sharp. Depending on the size and number of the holes 26, and on the characteristics of the ink, the printed dots corresponding to the holes 26 are or are not visible in the printed character, the invisibility of the dots generally being preferable. The capillary holes 26 need not be round, but can be short slits if this facilitates the desired reproduction of the character. The slits are preferably not wider than 0.4 mm.

The speed of the feed roller 1 and of the drum 13 are so chosen that the drum undergoes one complete revolution while the roller 1 moves the web of paper 2 through one line. The roller 1 can turn stepwise, the paper web remaining still while the drum 13 makes one complete revolution. If each input lead is energized by a timing chosen from a train of such pulses, whose repetition period and phase are such that the pulse can appear only when a character of the foil 25 precisely registers with the corresponding chamber 19, it is apparent that all characters will be printed exactly on the correct line of the stationary web.

Should the feed roller rotate continuously, the consequence would be—unless suitable measures were taken—that, for a given line, all b 's would be slightly higher or lower than the a 's (depending on the direction of rotation of the drum 13), all c 's slightly higher or lower than the b 's, etc. The lines would not be straight but irregularly wavy. To prevent this it is only necessary, depending on the direction of rotation of the drum 13, to shorten or lengthen the repetition period of the aforesaid train of pulses, as compared to the pulse period required when printing with a stepped roller 1 that is stationary during the actual printing. The character in the foil 25 is no longer exactly centered over the chamber 19 when the spark flashes, but rather is sufficiently shifted from the center position so that it is printed along the same straight line as the other characters printed before and afterwards.

In order to ensure the desired separation between lines of characters, the foil 25 can be left free of characters over a certain arcuated area of the drum 13.

The high-speed printer according to my invention is capable of extremely high output and can, for example, print 40 lines

of 80 characters each on a web in about 1 second. The cost of manufacturing the printer according to the invention is appreciably less than for conventional printers incorporating electromagnetic hammers.

Although only one preferred embodiment of my improved printer has been described, the scope of my invention, and the breadth of protection afforded thereto are limited solely by the appended claims.

I claim:
1. An apparatus for printing characters on a web, comprising:
a rotatable hollow drum provided along its peripheral surface with a multiplicity of perforations;
a foil carried on said peripheral surface and provided with a multiplicity of characters respectively registering with said perforations, said characters being constituted by combinations of capillary holes in said foil communicating with the respective perforations;
a stationary selector member within said drum provided with at least one pressure chamber positioned to register with different perforations in different positions of said drum;
drive means for successively rotating said drum through said different positions;
a web support adjacent said drum confronting the exposed side of said foil in the region of said pressure chamber;
inking means adjacent said drum for spreading a layer of fluid ink over the exposed side of said foil ahead of said web support, with retention of part of the ink in said

holes; and
pressure-generating means in said selector member operable to produce a sharply increased air pressure in said chamber at an instant of registration of said chamber with a selected character on said foil for expelling the retained ink from the holes thereof onto a confronting web surface on said support.
2. An apparatus as defined in claim 1 wherein said pressure-generating means comprises a spark gap in said chamber.
3. An apparatus as defined in claim 2 wherein said spark gap is formed by a pair of spaced-apart electrodes, further comprising a signal converter in said drum responsive to incoming timing pulses for energizing said electrodes.
4. An apparatus as defined in claim 1 wherein said characters and perforations are arrayed in a plurality of rows parallel to the drum axis, said selector member being provided with a multiplicity of pressure chambers in a row extending along a generatrix of said peripheral surface.
5. An apparatus as defined in claim 4 wherein said inking means and said web support are a pair of rollers with axes parallel to the drum axis.
6. An apparatus as defined in claim 1 wherein said foil consists of corrosion-resistant material.
7. An apparatus as defined in claim 6 wherein said foil has a thickness not exceeding 0.4 mm.
8. An apparatus as defined in claim 7 wherein said holes have a width not exceeding 0.4 mm.

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