(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 046 985**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **81106644.8**

(22) Date of filing: **26.08.81**

(51) Int. Cl.³: **B 41 J 27/20**
B 41 J 11/02, B 41 J 3/10

(30) Priority: **30.08.80 JP 120209/80**

(43) Date of publication of application:
10.03.82 Bulletin 82/10

(84) Designated Contracting States:
DE FR GB

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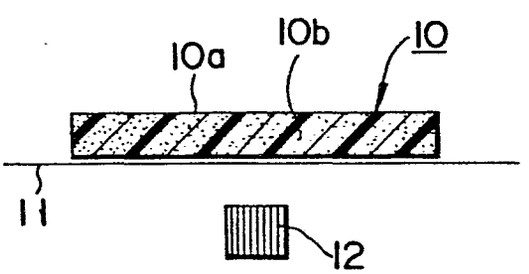
(54) **Ink platen for use in dot printers.**

(57) The ink platen (10) for use in a dot printer is impregnated with ink and is arranged such that printing needles (12) strike the ink platen (10) through a sheet of paper (11) placed in front of the ink platen (10), whereby ink dots are imprinted on the paper (11) at the points of impact of the printing needles (12) to form a character on the paper (11) in a dot-matrix format. The new ink platen (10) comprises a compressed body of a flexible reticulated polyurethane foam, and said compressed body has a surface hardness of at least 45 degrees and an internal hardness of at least 30 degrees on the hardness scale of a spring type hardness tester (type A) when the hardness is measured by using this A type tester with the method defined in Japanese Industrial Standard K 6301-1975, the surface hardness being higher than the internal hardness.

FIG. 7



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SPECIFICATION

BACKGROUND OF THE INVENTION

This invention relates to an ink platen for use in a dot printer.

Recently, with the progress of computers, a great attention has been paid to a dot printing system as one of the promising high-speed printing systems for computer associated machines. The dot printing system is designed such that a plurality of closely arranged printing needles strike plain paper through an ink or carbon ribbon to form characters (including letters, marks and figures) on the paper in a dot-matrix format.

Referring to Fig. 1, a prior art dot printing system is illustrated as comprising a backup plate 1 of iron steel or hard rubber with a sheet of paper 2 placed in front of the backup plate 1, an ink ribbon 3 extending from one reel to the other reel of a ribbon cassette 4 through a path in a parallel facing relationship with the paper sheet 2 or backup plate 1, and a bundle of printing needles 5 disposed opposite to the backup plate 1 with respect to the ribbon path and perpendicular to the backup plate 1. The selected needles of the bundle are actuated to strike the paper, thereby printing a character on the paper with ink. One drawback of this system is that the entire mechanism becomes relatively large in size because an ink ribbon must be continuously fed for ink supply.

For the purpose of dissolving the problem of the above-mentioned prior art, a dot printing system illustrated in Fig. 2 may be employed. The illustrated

system uses an ink platen 6 which comprises a porous nylon or polyolefin body impregnated with ink. A sheet of paper 2 is placed in abutment with the ink platen 6. Printing needles 5 are adapted to strike the paper 2 directly. Ink is supplied from the ink platen 6 to the surface of the paper sheet facing the platen 6, that is, the back surface of the paper sheet at the points of impact of the needles 5 by the impact stress applied to the ink platen 6 by the striking needles 5 through the paper sheet 2, thereby imprinting dots which form a printed character. The mechanism of this system may be of a relatively small size. This system, however, has a shortcoming that the life of the ink platen is short because the porous nylon or polyolefin body of which the ink platen is formed has poor cushioning characteristics such that it may be severely pierced or damaged by the impact of the printing needles.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved ink-impregnated platen for use in a dot printer of the type wherein printing needles strike the ink platen via a sheet of paper placed in abutment with the ink platen to transfer ink from the platen to the paper sheet at the points of impact of the printing needles to imprint dots on the paper.

It is another object of the present invention to provide an improved ink platen for use in such a dot printer which is improved in ink retention, make-up and leaching characteristics and has an optimum elasticity

and rigidity so that excellent dot printing is ensured and surface damage is minimized.

Briefly stated, the present invention is directed to a dot printer which comprises an ink platen impregnated with ink and printing needles adapted to strike the ink platen through a sheet of paper placed in abutment with the ink platen, whereby ink dots are imprinted on the paper at the points of impact of the printing needles to form a character on the paper in a dot-matrix format. According to the present invention, the ink platen comprises a compressed body of a flexible reticulated polyurethane foam, which has a surface hardness of at least 45 degrees and an internal hardness of at least 30 degrees on the hardness scale of a spring type hardness tester (type A) when the hardness is measured by using this type tester with the method defined in Japanese Industrial Standard (JIS) K 6301-1975, the surface hardness being higher than the internal hardness.

The Japanese Industrial Standard (JIS) K 6301-1975 defines Physical Testing Methods for Vulcanized Rubber. In JIS K 6301, the hardness measurement method by using a spring type hardness tester (type A) is defined as follows.

A test piece having a flat opposed surfaces and a thickness of 12 mm or more is used. A spring type hardness tester (type A) 101 shown in Figs. 3 to 6 has a loading disc 102 and an indentor 103 which is loaded by a spring 104 so as to protrude out of a central hole 105 in the disc 102. The loading disc surface is

a plane at right angles to the indentor 103 and the indentor 103 is fitted correctly at the center of the hole 105 of the disc 102. The tester 101 is designed such that when the loading disc surface of this tester 101 comes into contact with the surface of the test piece, the indentor 103 projecting from the hole 105 in the center of the loading disc surface by means of the spring 104 is pushed back by the surface of the test piece to a distance which is indicated on a scale 106 by a pointer 107 as a hardness. Specifically, the diameter "d" of the tip of the indentor 103 is 0.79 ± 0.02 mm, θ is 35° ± 0.25°, the diameter "D_1" of the cylindrical part of the indentor 103 is 1.3 ± 0.1 mm and the diameter "D_2" of the hole 105 is about 3.2 mm in Fig. 5. The tip of the indentor 103 is projected at a distance of 2.49 to 2.54 mm from the loading disc surface when the pointer 107 indicates the mark of 0 on the scale 106. The tip of the indentor 103 is on the same level with the loading disk surface when the pointer 107 indicates the mark of 100 on the scale 106. The scale 106 is divided evenly from 0 to 100. The relationship among the scale 106, motion of the indentor 103 and force of the spring 104 is shown in Fig. 6 and the following table. Tolerance is ±8 g.

Table

Scale	0	10	20	25	30	40	50	60	70	75	80	90	100
Load (g)	55	135	215	255	295	375	455	535	615	655	695	775	855

In hardness measurement, the tester is kept vertically and the loading disc surface is let contact with the test piece so as to make the indentor vertical to the surface of the test piece to be measured. Then immediately the scale is read and the hardness of the test piece is obtained. In this case the type A tester is vertically pressed with a load of 1000 g and the scale is read.

The hardness measurement in the present invention is carried out in the above-described manner.

The compressed, flexible reticulated polyurethane foam body of which the ink platen of the present invention is composed is a non-brittle, high-impact material which is improved in ink retention, make-up and leaching characteristics. Since the compressed foam body has a surface hardness of at least 45 degrees on the hardness scale of a spring type hardness tester (type A) by the hardness measurement method defined in JIS K 6301-1975, the surface is sufficiently hard to withstand the impact stress of printing needles. Further, since the internal hardness of the compressed body is at least 30 degrees on the same scale and lower than the surface hardness, the interior of the compressed body can retain a substantial amount of ink. The relatively hard surface portion is subjected to minimum damage by printing needles and provides clear printing as it is combined with the interior having good cushioning characteristics.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and

advantages of the present invention will be more fully understood from the following description with reference to the drawings in which:

Fig. 1 is a schematic view of one example of prior art dot printing systems;

Fig. 2 is a a schematic view of another dot printing system using an ink platen;

Figs. 3 to 6 illustrate a spring type hardness tester for use in hardness measurement of platens according to the present invention, Fig. 3 being a front elevation partially cut away, Fig. 4 being a rear elevation, Fig. 5 being an enlarged, partially cut-away bottom view of the tester, and Fig. 6 being a graph showing the relation among the scale, motion of the indentor and force of the spring;

Fig. 7 is a schematic view of a dot printing system to which the ink platen of the present invention is applicable, the ink platen being shown in cross section;

Fig. 8 is a perspective view of another embodiment of the ink platen according to the present invention;

Fig. 9 is a perspective view of a further embodiment of the ink platen according to the present invention;

Fig. 10 is a schematic cross-sectional view of an apparatus for compressing a polyurethane foam, illustrating one example of a process for producing the platen according to the present invention;

Fig. 11 is a cross-sectional view of a compressed

foam, illustrating another example of the platen producing process; and

Fig. 12 is a cross-sectional view of a still further embodiment of the ink platen according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Fig. 7, an ink platen for use in a dot printer according to the present invention is designated at 10. The ink platen 10 consists of a compressed body of a flexible polyurethane foam having a substantially skeletal reticulated structure in the form of a plate. The surface 10a of the compressed body has a hardness of at least 45 degrees and the interior 10b has a hardness of at least 30 degrees on the hardness scale of a spring type hardness tester (type A) by the hardness measurement method defined in JIS K 6301-1975, with the surface hardness being higher than the internal hardness. The ink platen 10 is impregnated with ink particularly in its interior and is applied to the same system as described in connection with Fig. 2. More particularly, the ink platen 10 of the present invention is placed in the system shown in Fig. 2 instead of the ink platen of porous nylon or polyolefin designated at 6 in Fig. 2. As shown in Fig. 7, a sheet of paper 11 is placed in abutment with the ink platen 10 and a bundle of printing needles 12 is located opposite to the ink platen 10 with respect to the paper sheet 11 and spaced apart from the paper sheet 11. Although not shown in the figure, the system is designed such that suitable drive means, for example,

electromagnetic means drives the printing needles 12 to move them toward and perpendicular to the paper sheet 11. Suitable selection means functions to select those needles which correspond to a character to be printed. The drive means cooperates with the selection means to drive the selected needles toward the paper sheet 11. These needles at their tips strike the paper sheet 11 and the ink platen 10 to transfer ink from the ink platen 10 to the back surface of the paper sheet 11 in front of the ink platen 10, thereby imprinting dots which form the character. It is to be noted that the sheet of paper 11 may be moved laterally in Fig. 7 by any suitable carrying means. Alternatively, the bundle of printing needles 12 may be reciprocated parallel to the sheet of paper 11 and the sheet of paper 11 may be moved perpendicular to the direction of reciprocation for each cycle of reciprocation of the bundle of needles 12.

The dot printer to which the ink platen 10 of the present invention is applicable may be of a well-known design as shown in Figs. 1 and 2. Particularly, the ink platen of the present invention is advantageously compatible with the dot printer of Fig. 1 which has heretofore been widely accepted. Such a conventional dot printer may be operated without any substantial change except that the conventional printing mechanism is simply replaced by a novel printing mechanism according to the present invention. The remaining mechanisms may be of a well-known conventional design including a mechanism for driving printing needles toward and away

from a sheet of paper, a mechanism for selecting the necessary printing needles, and a mechanism for advancing the sheet of paper.

The ink platen of the present invention is illustrated as having an elongated rectangular cross section in Fig. 7. Although the configuration of the ink platen is not particularly limited, the ink platen may advantageously take the form of either a rectangular body 10' as shown in Fig. 8 or a cylindrical body 10" as shown in Fig. 9. It will be understood that the ink platen of the present invention may be of any suitable configuration depending on the type of a particular dot printer to which the platen is applied.

Since the ink platen of the present invention comprises a compressed body of a flexible reticulated or cell membrane-free polyurethane foam, the ink platen is excellent in impregnation, make-up, retention and leaching of ink. On the other hand, usual polyurethane foams have cell membranes. When a compressed body formed by compressing such a usual cell membrane-bearing polyrethane foam is used as an ink platen, not only ink impregnation is poor, but also ink make-up and leaching characteristics are insufficient. Ink is not smoothly leached out when printing needles impact against the platen, often resulting in the formation of unclear dots or character.

Since a flexible reticulated polyurethane foam of which an ink platen is formed according to the present invention is not brittle unlike nylon or polyolefin foams, the ink platen of the present invention

is desirably unsusceptible to surface damage in this respect too.

The reticulated polyurethane foams may be prepared by any suitable methods as by removing cell membranes from a cell membrane-bearing polyurethane foam with a heat or chemical treatment or by producing a polyurethane foam from a reaction system which are specially formulated so as to prevent formation of cell membranes. Examples of process for the preparation of the reticulated foam are disclosed in U.S. Patent Nos. 3,175,030 and 4,259,452. The polyurethane foams may be either polyether or polyester type although polyester polyurethanes are preferred because of strength. The dimensions of a cell in the initial foam from which a compressed body is formed are not particularly limited. The initial foam may preferably have 2 to 80 cells per linear cm.

Since the ink platen of the present invention has a surface hardness of at least 45 degrees on the above-said hardness scale, it can satisfactorily withstand the impact stress by printing needles in a dot printer where the printing needles strike the ink platen through a sheet of paper at a high speed and stress. The platen is thus substantially free of surface damage and ensures clear character printing. With surface hardnesses below the above value, the platen surface is too soft to provide for clear printing and susceptible to damage. The surface hardness may preferably be 60 degrees or higher on the above said scale in order to further improve the surface characteristics

of the platen. The upper limit of the surface hardness may preferably be 95 degrees on the above-said scale. The surface portion having a hardness of at least 45 degrees may preferably have a thickness of 1 to 30 mm.

Since the ink platen of the present invention has an internal hardness of from 30 degrees on the above-said hardness scale to a value lower than the surface hardness, a substantial amount of ink is retained in the platen interior and the cushioning characteristics of the interior function to minimize damage to the platen surface. The internal hardness may preferably range from 40 to 90 degrees on the above-said scale as long as it is lower than the surface hardness.

It is generally desired that ink platens for use in dot printers are sufficiently hard to provide for clear printing while they have a capacity of retaining a substantial amount of ink. According to the present invention, the surface hardness of the ink platen of at least 45 degrees, preferably at least 60 degrees on the above-said scale ensures clear printing, and the internal hardness of at least 30 degrees, preferably 40 to 90 degrees on the above-said scale, but lower than the surface hardness gives a higher void percentage than that of the surface portion so that a substantial amount of ink is retained in the interior. In the case of a platen which is substantially uniform in hardness from the surface to the interior, ink retention becomes reduced as the hardness is increased to provide for clear printing while printing becomes unclear as the

hardness is reduced to increase ink retention. In either case, the object of the present invention cannot be attained. According to the present invention, as the internal hardness is lower than the surface hardness, the interior of the platen functions as a cushioning layer to attenuate or diminish the impact by the printing needles striking the platen, minimizing surface damage due to impact of needles. With internal hardnesses of less than 30 degrees, the impact of printing needles is too much attenuated so that leaching ink becomes short, resulting in vague printing. In order to more fully attain the above objects, the difference between the surface hardness and the internal hardness may preferably be 15 to 60 degrees.

The ink platen of the present invention may be prepared by placing a flexible reticulated polyurethane foam 13 between a pair of heat press plates 14, 15 and heat pressing the foam therebetween in the direction of an arrow A as shown in Fig. 10. The heat compression results in a compressed felt-like porous body having a relatively high hardness at either surface and a relatively low hardness in the interior. This compressed body is ready for use as an ink platen. It may also be severed by cutting the compressed body along the direction of compression into a shape suitable for a particular ink platen application. The heat compression is carried out so that the surface hardness of the compressed body is at least 45 degrees and the internal hardness of the compressed body is at least 30 degrees.

Alternatively, as shown in Fig. 11, from such a compressed foam 16 which is obtained by heat compressing a flexible reticulated polyurethane foam in the direction of arrow A as mentioned above and has collapsed cells 17 substantially oriented normal to the direction of compression, a three-dimensional rectangular body C whose thickness is perpendicular to the direction of compression or the direction of arrow A may be cut out. This rectangular body C may be moderately heat compressed in its thickness direction or the direction of arrow B so that the body has a relatively high hardness of at least 45 degrees at the surface 10a and a relatively low hardness of at least 30 degrees at the interior 10b, resulting in a bidirectionally compressed body for use as a platen. The platen manufactured by the latter procedure shows satisfactory performance upon use because internal cells elongated along the direction of thickness or perpendicular to a sheet of paper to be printed allow ink to smoothly leach out of the platen, but prevent ink from dripping.

Furthermore, as shown in Fig. 12, the ink platen may be manufactured by covering a relatively soft compressed foam intermediate layer 18 having a hardness of at least 30 degrees at one or two main opposed surfaces or the entire surfaces with a relatively hard compressed foam layer or layers 19 having a hardness of at least 45 degrees and heat fusing them into a laminated product.

As described above, since the ink platen of the

present invention comprises a compressed body of a flexible reticulated polyurethane foam which has a surface hardness of at least 45 degrees and an internal hardness of at least 30 degrees on the hardness scale of the spring type hardness tester (type A) with the surface hardness being higher than the internal hardness, not only ink retention, make-up and leaching characteristics are improved, but also clear dot or character printing is achieved, surface damage is minimized and durability is improved due to an appropriate combination of a rigid surface portion and an elastic interior. The present invention also contributes to the achievement of a small, dot printing mechanism.

It is further understood by those skilled in the art that the foregoing description is a preffered embodiment and that various changes and modifications may be made in the invention without departing from the spirit and scope thereof.

CLAIMS

1. An ink platen for use in a dot printer comprising the ink platen (10; 10'; 10") impregnated with ink and printing needles (5) adapted to strike the ink platen through a sheet of paper (2) placed in front of the ink platen, whereby ink dots are imprinted on the paper at points of impact of the printing needles to form a character on the paper in a dot-matrix format, characterized in that the ink platen (10; 10'; 10") comprises a compressed body (16) of a flexible reticulated polyurethane foam (13), and said compressed body has a surface hardness of at least 45 degrees and an internal hardness of at least 30 degrees on the hardness scale of a spring type hardness tester (type A) when the hardness is measured by using this type tester with the method defined in Japanese Industrial Standard K 6301-1975, the surface hardness being higher than the internal hardness.

2. An ink platen according to claim 1 wherein said compressed body has a surface hardness of at least 60 degrees and an internal hardness of 40 to 90 degrees on said scale.

3. An ink platen according to claim 1 or 2 wherein the surface hardness is higher than the internal hardness by 15 to 60 degrees on said scale.

4. An ink platen according to claim 1 wherein said compressed body is formed by heat compressing a flexible reticulated polyurethane foam so that the surface

hardness of the compressed body is at least 45 degrees and the internal hardness of the compressed body is at least 30 degrees on said scale.

5. An ink platen according to claim 1 wherein said compressed body is formed by heat compressing a flexible reticulated polyurethane foam, cutting out of the compressed foam a rectangular body with its thickness substantially perpendicular to the direction of compression, and further heat compressing the cut-out body in its thickness direction, whereby the resulting bidirectionally compressed body has a high surface hardness of at least 45 degrees and a low internal hardness of at least 30 degrees on said scale with the internal cells being elongated in the thickness direction, and hence, perpendicular to the plane of the paper.

6. An ink platen according to claim 1 wherein said compressed body comprises a compressed soft foam layer (10b; 18) having a hardness of at least 30 degrees and a compressed hard foam layer (10a; 19) having a hardness of at least 45 degrees on said scale laminated on at least one surface of the soft foam layer.

FIG. 1

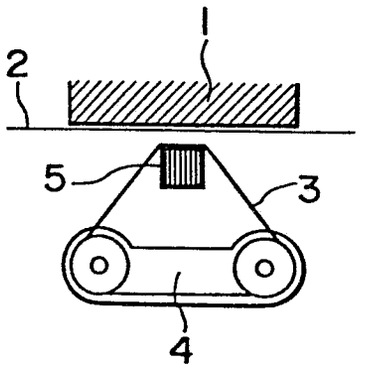

FIG. 2

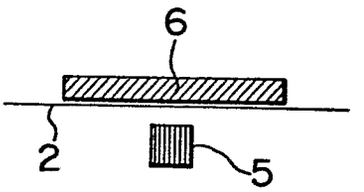

FIG. 7

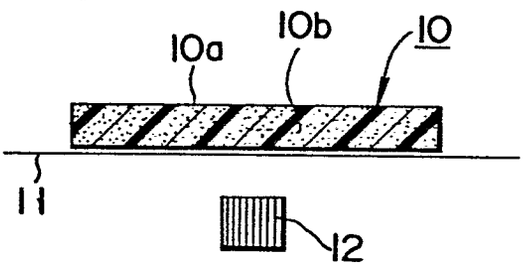

FIG. 8

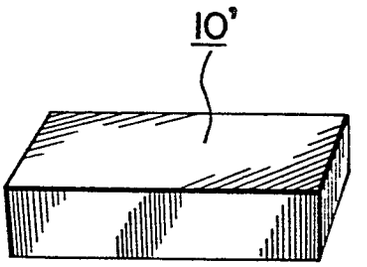

FIG. 9

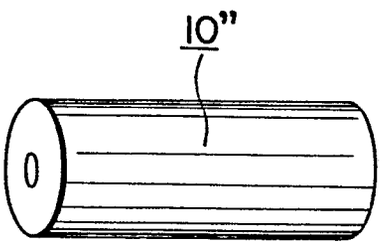

FIG.3

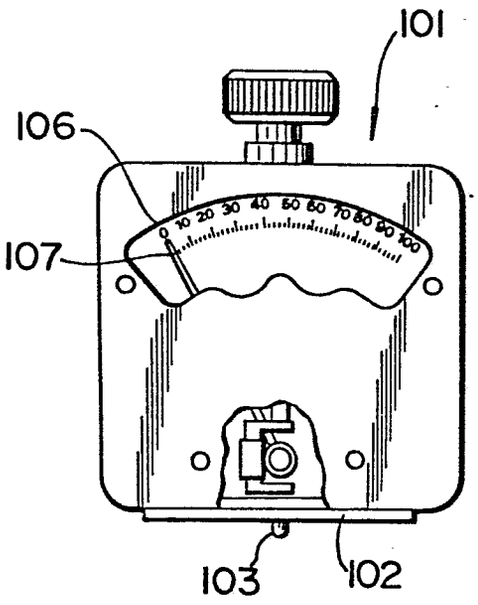

FIG.4

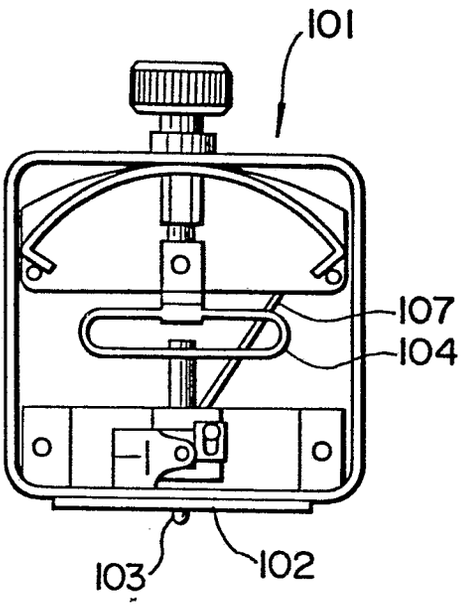

FIG.5

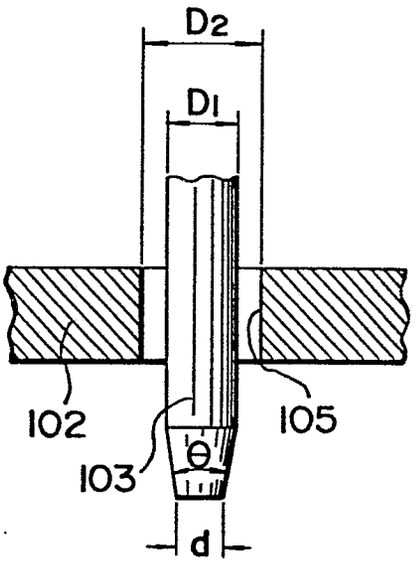

FIG.6

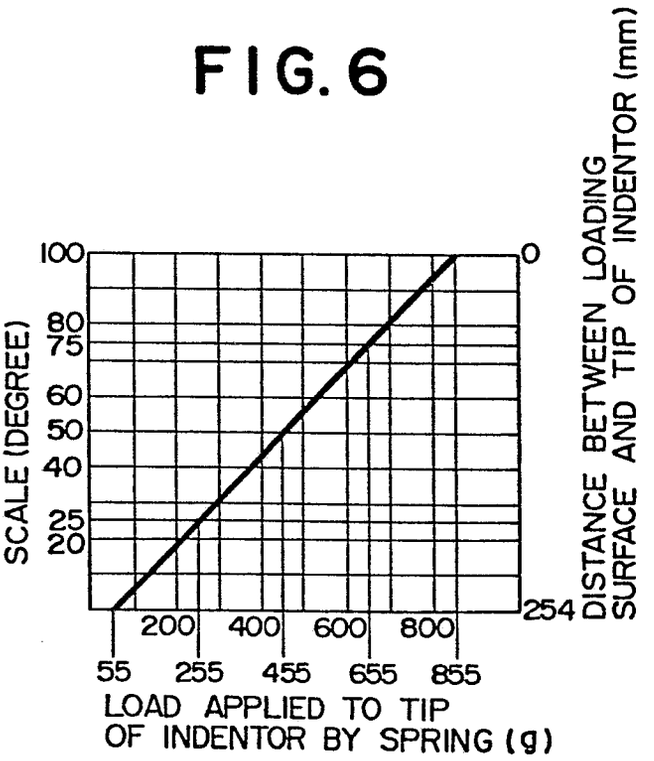

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FIG.10

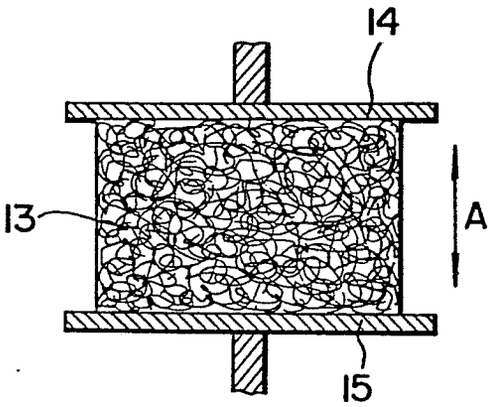


FIG.11

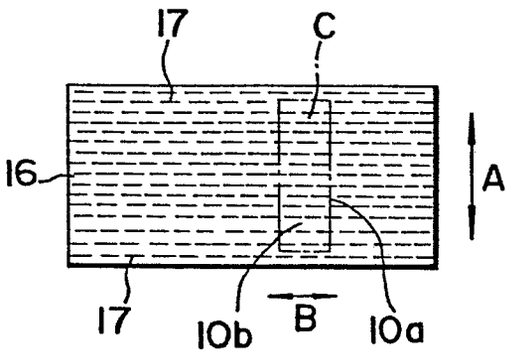
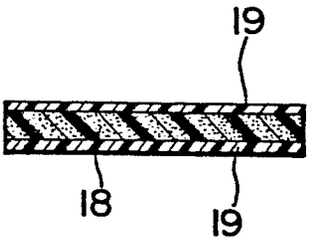


FIG.12



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EUROPEAN SEARCH REPORT

Application number

EP 81 10 6644.8

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	US - A - 3 918 567 (E.D. KITTREDGE) * page 1 * --	1
	Patents Abstracts of Japan, Vol. 4, No. 94, 8 July 1980 page 64M19 & JP - A - 55 - 51576 --	
D,A	US- A - 3 175 030 (H.C. GEEN) * complete document * --	
A	IBM TECHNICAL DISCLOSURE BULLETIN Vol. 19, No. 5, October 1976 New York R.G. CROSS "Self-Inking Matrix Printer" page 1538 * page 1538 * ----	

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

B 41 J 27/20
B 41 J 11/02
B 41 J 3/10

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

B 41 J 3/00
B 41 J 11/02
B 41 J 27/20
B 41 J 31/02

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
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L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	20-11-1981	ZOPF