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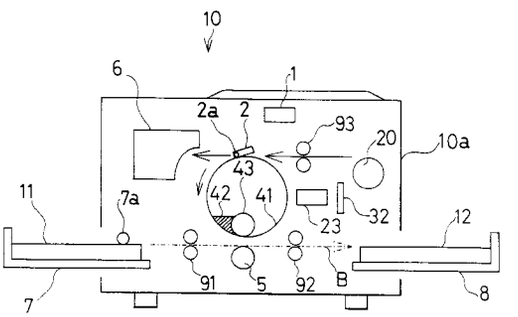
## (54) Stencil printing apparatus

(57) A stencil printing apparatus comprising a drum (41) which is rotationally driven around a central axis of itself with a stencil sheet (20) having a solvent-soluble resin layer (2) wrapped around to an outer circumferential surface of itself, an ink supplying means disposed to the inside of the drum (41) and supplying an ink (42) to an inner circumferential surface of the drum (41) and a solvent supplying means for selectively supplying a solvent (24) dissolving a solvent-soluble resin layer (2) of the stencil sheet (20) in a contactless manner to the stencil sheet (20) attached to the drum thereby perforating the stencil sheet (20).

FIG. 1

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## Description

The present invention concerns a stencil printing apparatus.

A known stencil printing apparatus uses heat sensitive stencil sheet comprising a thermoplastic resin film layer laminated on a porous substrate. For making-up heat sensitive stencil sheet, a heating means such as a thermal head having a plurality of dot-like heat generating bodies has been used for example. The heat generating bodies of the thermal head and the stencil sheet are moved while being in contact relative to each other and character image information is given in the form of electric signals to the thermal head in synchronization with the movement. The heat generating body of the thermal head generates heat selectively to melt and puncture the stencil sheet and form punctured images corresponding to the character image information onto the stencil sheet.

When the stencil sheet has been made-up, this is wound around a drum of a stencil printing apparatus having ink supplying devices disposed to the inside of the drum. The drum is rotated and, at the same time, ink is supplied to the inner circumferential surface of the drum, and, further, printing paper is fed between a roller disposed out of the drum and the drum. The ink transfers passing through an ink passing portion of the drum and the punctured portion of the stencil sheet to the printing paper, by which images corresponding to the punctured image of the stencil sheet are printed on the printing paper. The plate stencil printing method or apparatus as explained above has already be proposed as a digital printing machine and has been popularized as a stencil printing apparatus at a low running cost.

For perforating heat sensitive stencil sheet used in the existent stencil printing apparatus described above, it is necessary that a thermal head and stencil sheet are tightly in contact with each other by sufficiently strong pressure. Therefore a thin stencil sheet is often creased and, in the worst case, it can not be used as the stencil sheet and is waste. If it is used for printing, it often tends to cause printing failure. Further, molten resin remains in the punctured portion of the perforated stencil sheet which inhibits passage of an ink during printing failing to obtain clear printed matters easily.

Upon winding the stencil sheet around the drum, it results in a problem of likely to cause creasing since tension can not be applied. This is because the made-up stencil sheet is wound around the drum and punctured images are deformed when tension is applied.

Embodiments of the present invention overcome the foregoing problems in the prior art and provide stencil printing stencil printing apparatus with no loss of stencil sheet and capable of obtaining clear printed matters.

The present invention is as claimed in the claims.

The stencil printing apparatus defined in the first aspect of the present invention comprises a drum which is driven rotationally around a central axis of itself with a stencil sheet having a solvent-soluble resin layer wrapped around an outer circumferential surface of itself, an ink supplying means disposed to the inside of the drum for supplying an ink to an inner circumferential surface of the drum, and a solvent supplying means for selectively supplying a solvent which dissolves the solvent-soluble resin layer of the stencil sheet in a contactless manner to the stencil sheet attached to the drum thereby making up the stencil sheet.

The stencil printing apparatus as defined in the second aspect of the present invention comprises a stencil sheet holding means for holding the top end of the stencil sheet to the outer circumferential surface of the drum and applying a predetermined tension to the stencil sheet attached to the drum along with the rotation of the drum.

The stencil printing apparatus defined in the third aspect of the present invention comprises a driving control means for driving the solvent supplying means such that the solvent is selectively applied in accordance with image signals in synchronization with the rotation of the drum, to the solvent-soluble resin layer of the stencil sheet attached to the drum.

A stencil printing apparatus defined in the fourth aspect of the present invention, comprises a document reading means for reading images of a document to generate image signals and giving the image signals to the driving control means in the stencil printing apparatus defined in the third aspect.

The stencil sheet in the present invention comprises a solvent-soluble resin layer formed to a porous substrate. The top end of the stencil sheet is held to a stencil sheet holding means of the drum. The drum is rotated and the stencil sheet is attached to the outer circumferential surface of the drum under a predetermined tension. The driving control means drives the solvent supplying means being provided with the image signals from the document reading means. The solvent supplying means selectively discharges the solvent in a contactless manner to the solvent-soluble resin layer of the stencil sheet attached to the drum.

In the stencil sheet, the solvent supplied in a contactless manner from the solvent supplying means dissolves the solvent-soluble resin layer. The dissolved ingredient penetrates and diffuses into the porous substrate to form a punctured portion to complete preparation. There are less occurrence of creasing during perforation and less transportation failure. Upon attaching stencil sheet to the drum, if the stencil sheet should run obliquely and is attached obliquely or if creasing should occur since contactless perforation is possible, the stencil sheet is not wasted. Further, since no molten matter remains in the punctured portion, clear printed matter can be obtained.

An embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, of which:

Fig. 1 is a view illustrating an entire constitution of

an embodiment according to the present invention;

Fig. 2 is a cross sectional view of stencil sheet in one embodiment of the present invention; and

Fig. 3 is a view showing a state of perforating stencil sheet by a solvent from a solvent supplying in one embodiment according to the present invention.

The stencil printing apparatus of this embodiment is adapted to attach stencil sheet having a solvent-soluble resin layer to an outer circumferential surface of rotationally driven drum, selectively discharge a solvent dissolving the solvent-soluble resin layer by a solvent supplying means in a contactless manner to stencil sheet and can perforate the stencil sheet. Then, the perforated stencil sheet can be applied to printing paper by using perforated stencil sheet. Explanation is at first made to stencil sheet having the solvent-soluble resin layer and the solvent for dissolving the solvent-soluble resin layer and then a making up mechanism using them is explained.

Fig. 2 is a cross sectional view of stencil sheet 20 used in one embodiment of the present invention. The stencil sheet 20 is formed with a solvent-soluble resin 21 on one surface of a porous substrate 22.

The stencil sheet 20 of the above-mentioned structure can be manufactured, for example, by the following exemplary methods (1)- (4).

(1) A method of appending a solvent-soluble resin film as a solvent-soluble resin layer and a porous substrate by means of a bond, adhesive or the like.

(2) A method of thermo-fusing a solvent-soluble resin film as a solvent-soluble resin layer to a porous substrate.

(3) A method of coating and drying a resin solution dissolved or dispersed in a solvent on a porous substrate to form a solvent-soluble resin layer.

(4) A method of coating and drying a resin solution dissolved or dispersed in a solvent on a peelable support to form a solvent-soluble resin layer and, appending the peelable support having the solvent-soluble resin layer with a porous substrate and, subsequently, peeling the peelable support.

As the porous substrate 22 used in this embodiment, there can be mentioned natural fibers such as Manila hemp, pulp, mitsumata, paper mulberry, Japanese paper, synthetic fibers such as polyester, nylon, vinylon and acetate, nonwoven fabric, metal fibers, tissue paper using glass fibers, etc. alone or in admixture, non-woven fabric and screen silk gauze.

The unit weight of the porous substrate is preferably within a range from 1 to 20 g/m$^2$, more preferably within range from 5 to 15 g/m$^2$. If it is less than 1 g/m$^2$, strength as the stencil sheet is deteriorated. If it exceeds 20 g/m$^2$, ink passage upon printing may be deteriorated. The thickness of the porous substrate is Preferably within a range from 5 to 100 μm and, more preferably, within a range 10 to 50 μm. If it is less than 5 μm, the strength as the stencil sheet is also deteriorated. If it exceeds 100 μm, the ink passage upon printing may be worsened.

The solvent-soluble resin layer 21 used in this embodiment contains a thermoplastic resin or a thermosetting resin soluble for water or a solvent such as an organic solvent as a main ingredient. As the resin ingredient soluble for water or the organic solvent there can be used, for example, polyethylene, polypropylene, isobutylene, polystyrene, polyvinyl chloride, polyvinylidene chloride, polyvinyl fluoride, polyvinyl acetate, acrylic resin, polyacrylonitrile, polyamide, polyimide, petroleum resin, phenol resin, amino resin, epoxy resin, polyester, polycarbonate, polyurethane, polysulfone, silicone resin, alkyd resin and melamine resin. The resin ingredient may be used alone or in admixture or as a copolymer.

As the water soluble resin ingredient, there can be used a resin soluble to water or water immiscible organic solvent, for example, polyvinyl alcohol, methyl cellulose, carboxymethyl cellulose, hydroxyethyl cellulose, polyvinyl pyrrolidone, polyethylene - polyvinyl alcohol copolymer, polyethylene oxide, polyvinyl ether, polyvinyl acetal, polyacrylamide, starch, dextrine, alginic acid, ascorbic acid or water soluble urethane. The resin may be used alone or in admixture, or may be used as a copolymer.

The solvent-soluble resin layer 21 may contain, in addition to the resin ingredient, dye, pigment, filler, binder, curing agent and the like.

The thickness of the solvent-soluble resin layer is desirably within a range from 0.1 to 100 μm, preferably, within a range from 0.5 to 50 μm. If the thickness is less than 0.1 μm, the strength of the resin layer is insufficient. If it exceeds 100 μm, it requires a great amount of solvent or water for dissolving the resin layer possibly bringing about insufficient dissolution.

Explanation will next be made to the solvent for dissolving the solvent-soluble resin layer 21 of the stencil sheet 20. As the solvent for dissolving the solvent-soluble resin layer 21, there can be mentioned, for example, aliphatic hydrocarbon type, aromatic hydrocarbon type, alcohol, ketone type, ester type, ether type, aldehyde type, carbonic acid type, amine type, low molecular heterocyclic compound, oxide type and water. For example, there can be mentioned, hexane, heptane, octane, benzene, toluene, xylene, methanol, ethanol, isopropanol, n-propanol, butanol, ethylene glycol, diethylene glycol, Propylene glycol, glycerine, acetone, methyl ethyl ketone, ethyl acetate, propyl acetate, ethyl ether, tetrahydrofuran, 1,4-dioxane, formic acid, acetic acid, propionic acid, formaldehyde, acetoaldehyde, methyldiamine, dimethyl formamide, pyridine and ethylene oxide. They may used alone or in combination. The solvent contains a colorant such as a dye or pigment for forming images on the printing paper. Further, the solvent may optionally

be incorporated with filler, binder, curing agent, corrosion inhibitor, wetting agent, surfactant and Ph controller.

The solvent is discharged in the form of droplets by a solvent supplying means. As the solvent supplying means there can be used a nozzle having 10 to 2,000 (10 to 2,000 dpi) apertures per one inch, slit, injector, porous member, porous film connected to piezoelectric device, heat generating device, electric field device or liquid feeding pump. The solvent can be discharged intermittently or continuously in accordance with character image signals.

Fig. 3 shows a schematic view of making-up the stencil sheet 10 in this embodiment. A solvent 24 discharged selectively in a contactless manner in accordance with image signals from the solvent supplying means is supplied on a solvent-soluble resin layer 21 of stencil sheet 20. The supplied solvent 24 dissolves and punctures the solvent-soluble resin layer 21 and a solution 26 is Penetrated and diffused into the porous substrate 22 and a punctured portion 25 is formed to the solvent-soluble resin layer 21 at a portion in contact with the solvent 24 to perforate the stencil sheet 20.

Then, the stencil printing apparatus 10 according this embodiment is to be explained with reference to Fig. 1. The stencil printing apparatus 10 has a perforating function for Perforating the stencil sheet 20 by dissolving the solvent-soluble resin layer 2 thereof with a solvent and a function of conducting stencil printing by using the made-up stencil sheet 20.

The stencil printing apparatus 10 has a cylindrical drum 41 as a stencil printing apparatus. The drum 41 is rotatable around a central axis of its own, and rotationally driven by a motor as a driving means not illustrated in a counterclockwise direction in the drawing. A portion of a circumferential wall of the drum 41 is an ink permeable region. An ink supplying means is disposed in the drum 41. The ink supplying means supplies an ink 42 to the inner surface of the circumferential wall of the drum 41. The ink 42 supplied to the inner surface of the circumferential wall of the drum 41 is squeezed from the ink Permeable region of the circumferential wall to the outside by a squeezing roller 43 disposed in the drum 41. The squeezed out ink 42 is externally squeezed by way of punctured images of the stencil sheet 20 wound around the drum 40 and deposited to the supplied printing paper 11 to form images. As the ink 42, an ink used generally for mimeograph, for example, oily ink, aqueous ink, water-in-oil droplet (W/O)type emulsion ink, oil-in-water (O/W)type emulsion ink can be utilized.

A clamp plate 40 as a stencil sheet holding means is disposed to the outside of the circumferential wall of the drum 41. A shaft 40a is disposed in parallel with one of generators of the drum 41 at a portion other than the ink permeable region of the circumferential wall of the drum 41. The clamp plate 40 is rotatable around the shaft 40a as the center. As shown in Fig. 1, when the clamp plate 40 reaches the topmost position of the drum 41, the clamp plate 40 holds the top end of the stencil sheet 20 supplied to the drum 41 by sandwiching it relative to the outer surface of the drum 41.

As shown in Fig. 1, the stencil sheet 20 rolled cylindrically is disposed to the upper right of the drum 41. The stencil sheet 20 is supplied by a conveyor roller 93 to the topmost portion of the drum 41.

The stencil sheet 20 is supplied to the drum 41 and the top end of the supplied stencil sheet 20 is held by the clamp plate 40. In this state, the drum 41 rotates in a counterclockwise direction in Fig. 1 and when the conveyor roller 90 continuously delivers the stencil sheet 20 at an appropriate conveying speed, the stencil sheet 20 is wound around to the outer circumferential surface of the drum 41 under a predetermined tension.

As shown Fig. 1, a plate discharge portion 6 is disposed to the upper left of the drum 41 for discarding the stencil sheet 20. The plate discharge portion 6 has a function of stripping off the used stencil sheet 20 from the drum 41, introducing it into a containing box and compressing it.

As shown in Fig. 1, a paper feed tray 7 is disposed to the lower left of the drum 41 for supplying the printing paper 11. A plurality of printing paper 11 stacked on the paper feed tray 7 are sent orderly from upper one by a pick-up roller 7a to the drum 41.

As shown in Fig. 1, a press roller 5 is disposed below the drum 41 with a predetermined spacing from the drum 41. The press roller 5 in this embodiment is vertically movable and moves vertically in synchronization with the rotation of the drum 41 and the conveyance of the printing paper 11 by the conveyor roller 91. That is, when the printing paper 11 is supplied between the drum 41 and the press roller 5 in synchronization with the rotation of the drum 41, the press roller 5 raises to sandwich the printing paper 11 relative to the drum 41 and conveys the printing paper 11 rightwardly in the drawing. The printing paper 11 is subjected to stencil printing.

As shown in Fig. 1, a conveyor roller 92 as a conveying means for conveying the printed printing paper 12 rightwardly in the drawing and a paper discharge tray 8 for receiving the printing paper 12 conveyed to the conveyor roller 92 and containing by successively stacking them.

As shown in Fig. 1, an image sensor 1 as a document reading means is disposed substantially above the drum 41. The image sensor 1 reads image of a document and outputs the image information as electric signals. The images referred to herein should be considered in a most broad meaning containing not only pictures, photographs, graphics and patterns but also characters and they include all objects that can be recognized visually irrespective of colors.

As shown in Fig. 1, a solvent supplying means 23 is disposed to the light of the drum 41. The solvent supplying means 23 selectively supplies a solvent for dissolving the solvent-soluble resin layer of the stencil sheet 20 in a contactless manner to the stencil sheet 20 attached to the drum 41 to perforate the stencil sheet 20.

As shown in Fig. 1, a driving control means 32 is disposed to the right of the solvent supplying means 23. The driving control means 32 of this embodiment drives the solvent supplying means 23 in synchronization with the rotation of the drum 41 in accordance with image signals outputted from the image sensor 1. The solvent supplying means 23 driven by the driving control means 32 discharges the solvent 24 selectively to the solvent-soluble resin layer 21 of the stencil sheet 20 attached to the rotating drum 41 and forms punctured images corresponding to the document image to the stencil sheet 20 to conduct make-up.

Further, the driving control means 32 of this embodiment may have a function of controlling the operation other than perforating the stencil sheet 20, for example, an operation of winding the stencil sheet 20 around the drum 41, printing operation after perforation and, further, plate discharging operation after printing.

The driving control means 32 of this embodiment can drive the solvent supplying means 23 by the image signals from the image sensor 1 and it can also drive the solvent supplying means 23 by image signals supplied from the outside of this stencil printing apparatus 10. For example, the document may be read by an image processing device disposed to the outside of the stencil printing apparatus 10 and the image information obtained therefrom may be supplied to the driving control means 32 of this stencil printing apparatus 10 to conduct perforation by the solvent supplying means 23.

Each of the constituent portions of the stencil printing apparatus 10 described above is assembled to a not illustrated substrate and the entire portion is substantially covered with a casing 10a. The paper feed tray 7 and the paper discharge tray 8 can easily be attached and detached to the casing 10a manually by an operator. Accordingly, the size of the printing paper 11 can optionally be selected as required.

Then, operation of the foregoing constitution will be explained. In Fig. 1, when a document is present, image signals read by the image sensor 1 are sent to the driving control means 32. Alternatively, image signals from other image signal supplying means such as personal computer (not illustrated) at the outside of the stencil printing apparatus 10 are sent to the driving control means of the stencil printing apparatus 10.

As shown in Fig. 1, the stencil sheet 20 is delivered by the conveyor roller 93. The top end of the stencil sheet 20 is held by the clamp plate 2, and the stencil sheet 20 is wound around the outer circumferential surface of the drum 41 while undergoing tension along with the rotation of the drum. Accordingly, the stencil sheet 20 can be wound around the drum 41 with no creasing.

Then, the driving control means 32 drives the solvent supplying means 23 in accordance with the image signals sent to the driving control means 32 and in synchronization with the rotation of the drum 41. The solvent 24 is discharged from the solvent supplying means 23 in a contactless manner to a portion of the stencil sheet 20 to be dissolved. The stencil sheet 20 having the solvent-soluble resin layer 21 formed on the porous substrate 22 is prepared.

Then, the printing paper 11 on the paper feed tray 7 is conveyed by the conveyor roller 91, put between the press roller 5 and the drum 41 and kept in close contact with the stencil sheet 20. The ink 42 passing through the punctured portion of the perforated stencil sheet 20 transfers to the printing paper 11 to conduct stencil printing. The printed paper 12 is conveyed by the conveyor roller 92 to the paper discharge tray 28 and then stocked. Arrow B in Fig. 1 shows the route of printed paper 11, 12.

Since the stencil printing apparatus according to the present invention utilizes stencil sheet having a solvent-soluble resin layer and conducts perforation by the solvent from the discharging means in a contactless manner after winding the stencil sheet to the drum , no creasing occurs to the stencil sheet. Further, upon attaching to the drum, even if the stencil sheet runs obliquely and is attached obliquely or even if creasing should occur, since make-up can be applied in a contactless manner to the stencil sheet, the stencil sheet is not wasted. Further, no molten matters remain punctured portion of the stencil sheet, passage of the ink is not hindered and clear printed matters can be obtained.

## Claims

1. A stencil printing apparatus comprising:

   a drum which is rotationally driven around a central axis of itself with a stencil sheet having a solvent-soluble resin layer wrapped around an outer circumferential surface of itself,

   an ink supplying means disposed to the inside of the drum and supplying an ink to an inner circumferential surface of the drum, and

   a solvent supplying means for selectively supplying a solvent dissolving a solvent-soluble resin layer of the stencil sheet in a contactless manner to the stencil sheet attached to the drum thereby making-up the stencil sheet.

2. A stencil printing apparatus as defined in claim 1, comprising stencil sheet holding means for holding top end of the stencil sheet to the outer circumferential surface of the drum and applying a predetermined tension to the stencil sheet attached to the drum along with the rotation of the drum.

3. A stencil printing apparatus as defined in claim 2, comprising a driving control means for driving the solvent supplying means so as to selectively apply a solvent in accordance with image signals, in synchronization with the rotation of the drum, to the solvent-soluble resin layer of the stencil sheet attached to the drum.

**4.** A stencil printing apparatus as defined in claim 3, comprising a document reading means for reading images of a document to generate image signals and providing the driving control means with the image signals.

FIG. 1

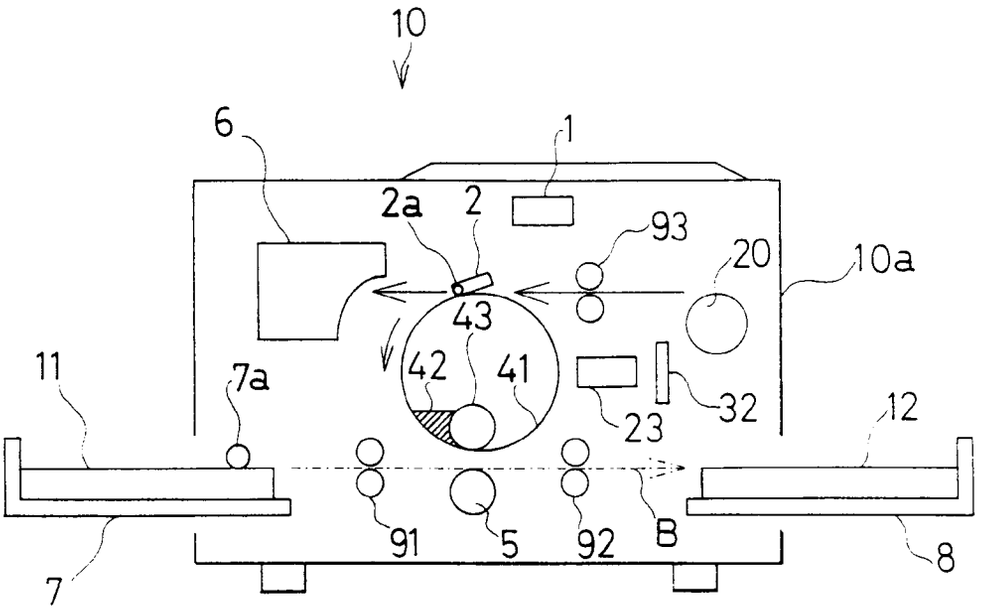


FIG. 2

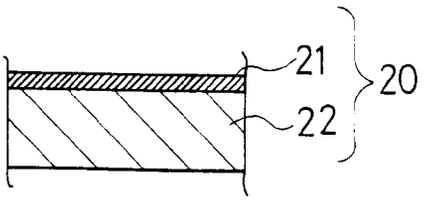
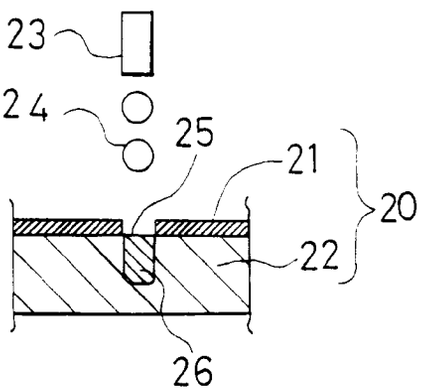



FIG. 3



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# EUROPEAN SEARCH REPORT

Application Number
EP 95 30 6279

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.6) |
|---|---|---|---|
| A | DE-A-40 38 675 (RISO KAGAKU CORP) 6 June 1991<br>* the whole document * | 1-4 | B41L13/06 |
| A | PATENT ABSTRACTS OF JAPAN<br>vol. 008 no. 274 (M-345) ,14 December 1984<br>& JP-A-59 143679 (RISOU KAGAKU KOGYO KK) 17 August 1984,<br>* abstract * | 1-4 | |
| A | GB-A-2 209 018 (BICC PLC) 26 April 1989<br>* the whole document * | 1-4 | |
| A | GB-A-707 160 (A. B. DICK COMPANY) 14 April 1954<br>* the whole document * | 1-4 | |
| T | EP-A-0 642 930 (RISO KAGAKU CORP) 15 March 1995 | | |
| T | EP-A-0 637 512 (RISO KAGAKU CORP) 8 February 1995 | | TECHNICAL FIELDS SEARCHED (Int.Cl.6)<br>B41L<br>B41N |
| T | EP-A-0 670 227 (RISO KAGAKU CORP) 6 September 1995 | | |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 12 January 1996 | Madsen, P |

CATEGORY OF CITED DOCUMENTS

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