

12

EUROPEAN PATENT APPLICATION

21 Application number: 87305096.7

51 Int. Cl.4: **B41F 16/00** , **B41F 17/00**

22 Date of filing: 09.06.87

The title of the invention has been amended
(Guidelines for Examination in the EPO, A-III,
7.3).

71 Applicant: **MASCOPRINT DEVELOPMENTS LIMITED**
Campfield Road
St. Albans Hertfordshire AL1 5LW(GB)

30 Priority: 10.06.86 GB 8614034

72 Inventor: **Dargavel, Geoffrey Thomas**
28 Hill Top Avenue ~~SP~~ **Page Hill**
Buckingham MK18 1YL(GB)

43 Date of publication of application:
13.01.88 Bulletin 88/02

64 Designated Contracting States:
DE ES FR IT SE

74 Representative: **Cullis, Roger**
Patent Department National Research
Development Corporation 101 Newington
Causeway
London SE1 6BU(GB)

54 **Printing on non-flat surfaces, particularly computer keys.**

57 Printing apparatus for printing with sublimation ink upon the keys of an assembled keyboard comprising a support for the keyboard, means for applying sublimation ink in the form of characters to the upper surfaces of the respective keys, a flexible, heat-resistant membrane, vacuum means for drawing by suction the membrane into intimate contact with the upper surfaces of the respective keys over the applied ink and means for applying heat to said upper surfaces through the membrane.

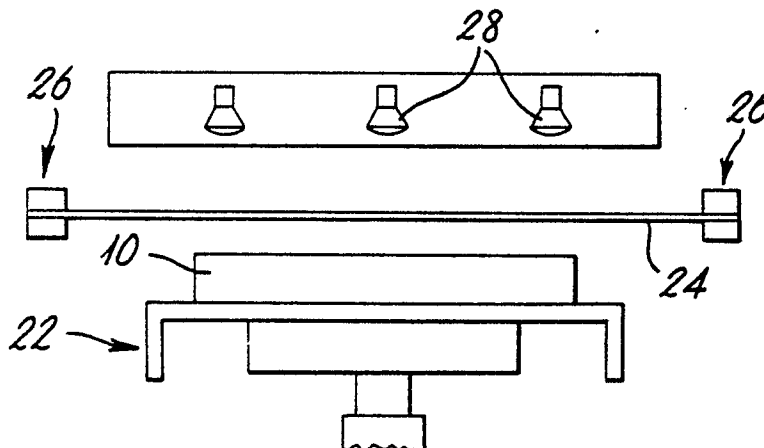


Fig. 2

EP 0 252 610 A1

IMPROVEMENTS IN PRINTING

This invention relates to printing and is concerned in the most important example with printing upon surfaces which are not flat.

In a number of applications, printed matter is required to withstand repeated handling or other forms of wear. With computer keys, for example, it is essential that the character on the key should remain distinct throughout the expected life of the keyboard. Because of this requirement, keys have often been produced in the past, not by a printing process, but by a two-stage moulding procedure. The first stage produces the body of the key in the background colour with the hollowed outline of the character. The second moulding stage forms the character in the chosen colour. As will be apparent, this is an expensive procedure.

In an attempt to overcome this problem, it has been proposed to use sublimation inks. These are applied to the key surface in the form of a transfer and are then heated so that the ink sublimates and enters the substrate in the nature of a dye. A character printed in this manner is indelible and with suitably chosen inks, substrates and process parameters, the desired durability can be achieved.

The upper surface of a computer key is often concave and to ensure that the ink is transferred over the entire character, it is necessary to apply a degree of pressure. It has been proposed for this purpose to use a form of resilient pad. To speed up the printing operation, it is desirable to apply, simultaneously with the application of pressure, the necessary heat for the sublimation process. Considerable difficulties have been experienced hitherto in applying the correct amounts of heat and pressure. With silicone rubber pads, for example, the additives that are necessary to achieve sufficient heat conductivity tend to reduce the resilience of the pad to the point where it can no longer properly conform to curved surfaces or surfaces which depart from predetermined tolerances. These difficulties are experienced not only with computer keys but also with a variety of other applications where the durability of sublimation inks is required.

There is a further problem that arises with computer keys in that once the keys have been printed, they require to be assembled in the keyboard in the correct arrangement. Assembly is therefore extremely labour intensive. There would be considerable simplification of the procedure if printing of the keys could be achieved after assembly of the keys in the keyboard. Some work has already been done to this end. It has been suggested, for example, to employ an array of resilient pads which are aligned one each with the keys of

the keyboard. A printing machine of this type is complicated, however, and thus relatively expensive. Moreover, it is not a straightforward matter to ensure that each and every pad applies the optimum pressure to the associated key.

It is an object of this invention to provide an improved printing method and an improved printing apparatus which simplify the application of sublimation inks, especially to non-flat surfaces.

Accordingly, the present invention consists, in one aspect, in printing apparatus for printing with sublimation ink upon a rigid surface of an article, comprising a support for the article, means for applying sublimation ink in the required image to the surface, a flexible, heat-resistant membrane, vacuum means for drawing the membrane by suction closely toward the surface over the applied ink to apply pressure thereto and means for applying heat to said surface through the membrane.

Advantageously, the support comprises a chamber adapted to receive at least that portion of the article which is associated with said surface, the chamber having a rim which engages in use said membrane; the vacuum means being adapted to evacuate said chamber.

Preferably, said means for applying heat comprise infra-red heating means.

Suitably, the means for applying ink comprises a transfer.

In one form of the invention, the membrane is formed of silicone rubber.

In another aspect, the present invention consists in printing apparatus for printing with sublimation ink upon the keys of an assembled keyboard; comprising a support for the keyboard, means for applying sublimation ink in the form of characters to the upper surfaces of the respective keys, a flexible, heat-resistant membrane, vacuum means for drawing by suction the membrane into intimate contact with the upper surfaces of the respective keys over the applied ink and means for applying heat to said upper surfaces through the membrane.

Advantageously, the apparatus further comprises an apertured template locatable over the keyboard with the keys received in the apertures of the template so as to restrain movement of the keys and to limit travel of the membrane.

In a further aspect, the present invention consists in a method of printing with sublimation ink upon a rigid surface, comprising the steps of applying the ink to the surface, drawing a flexible heat-resistant membrane towards said surface through suction so as to apply pressure to said ink; and applying heat to effect sublimation of the ink.

Advantageously, the ink is applied by positioning a transfer over the surface.

Preferably, heat is applied radiantly. The invention will now be described by way of example with reference to the accompanying drawings in which:-

Figure 1 is a sectional view through part of the printing apparatus according to this invention,

Figure 2 is a somewhat diagrammatic side view of the printing apparatus according to this invention, and

Figures 3a and 3b are sectional views illustrating stages in the method of this invention.

There is shown in Figure 1 an open box 10 having a port 12 through which it may be connected to a vacuum pump (not shown). The base of the box is provided with suitably shaped and positioned lugs

A template 16 is formed with an array of apertures 18 corresponding exactly with the position of the keys in the keyboard. This template is hinged to the box 10 so that it may be moved to a closed position in which each key projects through and is a reasonably close fit within the corresponding template aperture 18.

It is well known that sublimation inks can be applied in the form of a transfer which has been prepared by a silk screen or other suitable printing process. The transfer is usually formed on paper. For this invention, it is preferred to use a transfer which has been printed by a silk screen technique on to a substrate in the form of a plastics film. The transfer is positioned above the keyboard with accurate location being achieved by means of pins 20 provided on the box engaging within pre-punched holes in the transfer. In the present example, the transfer is intended to lie above the template but the reverse arrangement is also possible.

Referring now to Figure 2, the box 10 containing the keyboard and transfer and with the template in the closed position, is placed on a lift table 22 of a form conventional in the printing industry. A thin sheet of silicone rubber 24 is held in a horizontal plane above the lift table by means of a frame 26 shown schematically in the Figure. Above the membrane 24 there is positioned an array of infra-red heat lamps 28.

Under automatic control, the lift table 22 is raised until the edges of the box 10 contact the membrane 24, as shown in this position, the membrane 24 will be extended through its contact with the keys 30 which project from the box. A vacuum is then applied at port 12 to draw the membrane towards the upper surface of the keys and to force the ink bearing transfer 32 closely toward the keys. In this way, the required amount of pressure can be applied to the transfer 32 and the ink it carries. The template serves the dual purposes in this procedure of minimising sideways displacement of

the keys and limiting the travel of the membrane downwardly into the spaces between the keys. The position reached is that shown in Figure 3b and it will be seen that the transfer 32 closely conforms to the shape of the keys and particularly to the concave upper surface of the key which is to receive the printed character.

After an appropriate time interval, the heat lamps are energised to cause the upper surfaces of the keys to rise in temperature to the level required for sublimation to take place. After a further interval the lift table is retracted and the keyboard withdrawn from the box. With the transfer 32 based on a plastics film, the further desirable effect is seen of a softening and increase in flexibility of the transfer. This further improves the degree of contact between the key and the ink of the transfer.

It will be appreciated that the use of a flexible membrane and suction to apply the required pressure offers considerable mechanical simplification over arrangements of individual pressure pads and the like. This should lead to economies in manufacturing of the apparatus. It is also felt that because of the ability of the heat lamps to reach working temperature very quickly, the cycle time of the apparatus should be reduced. Moreover, it is believed that the upper surface of the keys can be taken to the required temperature without heat damage to the remainder of the keyboard or electronic circuitry contained within the keyboard. There exists the option, of course, of printing the keys before the circuitry is added to the keyboard.

The ability to print the keys in situ offers considerable advantages. Firstly, a large number of keys are printed at the same time leading to reductions in manufacturing time. Secondly and perhaps more importantly, the majority of keys in the original assembly of the keyboard are indistinguishable and can be supplied from a single feed. This represents a considerable simplification over the conventional technique where each keyboard must be provided with the correct key character at the correct position.

Whilst the apparatus and method according to this invention offer considerable advantages in the particular application which has been described by way of example, there are many other instances where the technique could offer important advantages. Examples are the printing of plastics containers, housings for electronic apparatus household goods or novelty items. These are of course taken from a very large list of possibilities.

The invention has been described by way of example only and numerous modifications are possible without departing from the scope of the invention. The membrane could for instance be supported in other ways and different techniques employed for drawing the membrane closely toward

the surface to be printed. Whilst the use of transfers is felt to be preferable, the sublimation ink could be applied in other ways. The ink might for example be in powdered form. The use of radiant heat has the mentioned advantage of simple and fast acting control but alternatives will suggest themselves to one skilled in the art.

Claims

1. Printing apparatus for printing with sublimation ink upon a rigid surface of an article, characterised in that it comprises a support for the article, means for applying sublimation ink in the required image to the surface, a flexible, heat-resistant membrane, vacuum means for drawing the membrane by suction closely toward the surface over the applied ink to apply pressure thereto and means for applying heat to said surface through the membrane.

2. Printing apparatus for printing with sublimation ink upon a rigid surface of an article as claimed in claim 1 characterised in that the support comprises a chamber adapted to receive at least that portion of the article which is associated with said surface, the chamber having a rim which in use, engages said membrane.

3. Printing apparatus for printing with sublimation ink upon a rigid surface of an article as claimed in either claim 1 or claim 2 characterised in that said means for applying heat comprises infra-red heating means.

4. Printing apparatus for printing with sublimation ink upon a rigid surface of an article as claimed in any one of the preceding claims characterised in that the means for applying ink comprises a transfer.

5. Printing apparatus for printing with sublimation ink upon a rigid surface of an article as claimed in any one of the preceding claims characterised in that the membrane is formed of silicone rubber.

6. Printing apparatus for printing with sublimation ink upon the keys of an assembled keyboard comprising a support for the keyboard, means for applying sublimation ink in the form of characters to the upper surfaces of the respective keys, a flexible, heat-resistant membrane, vacuum means for drawing by suction the membrane into intimate contact with the upper surfaces of the respective keys over the applied ink and means for applying heat to said upper surfaces through the membrane.

7. Printing apparatus for printing with sublimation ink upon the keys of an assembled keyboard as claimed in claim 6 characterised in that the apparatus further comprises an apertured template locatable over the keyboard with the keys received

in the apertures of the template so as to restrain movement of the keys and to limit travel of the membrane.

8. A method of printing with sublimation ink upon a rigid surface, characterised in that it comprises the steps of applying the ink to the surface, drawing a flexible heat-resistant membrane towards said surface through suction so as to apply pressure to said ink; and applying heat to effect sublimation of the ink.

9. A method of printing with sublimation ink upon a rigid surface as claimed in claim 8 characterised in that the ink is applied by positioning a transfer over the surface.

10. A method of printing with sublimation ink upon a rigid surface as claimed in claim 9 characterised in that the heat is applied radiantly.

11. A method of printing with sublimation ink upon a rigid surface as claimed in either claim 9 or claim 10 characterised in that said transfer is printed by a silk screen technique on to a substrate in the form of a plastics film.

12. A method of printing with sublimation ink upon a rigid surface as claimed in claim 11 characterised in that said transfer is a thin sheet of silicone rubber

13. A method of printing with sublimation ink upon a rigid surface as claimed in any one of the preceding claims 8 to 12 characterised in that the heat is provided by means of an array of infra-red heat lamps

14. An item having an uneven surface or a plurality of non-co-planar surfaces characterised in that said surface or surfaces bear a marking has been printed using apparatus as claimed in any one of the preceding claims 1 to 7.

15. An item having an uneven surface or a plurality of non-co-planar surfaces characterised in that said surface or surfaces bear a marking has been printed by the method claimed in any one of the preceding claims 8 to 13.

16. A keyboard characterised in that it contains a plurality of keys printed using apparatus claimed in any one of the preceding claims 1 to 7 or by a method as claimed in any one of the preceding claims 8 to 13.

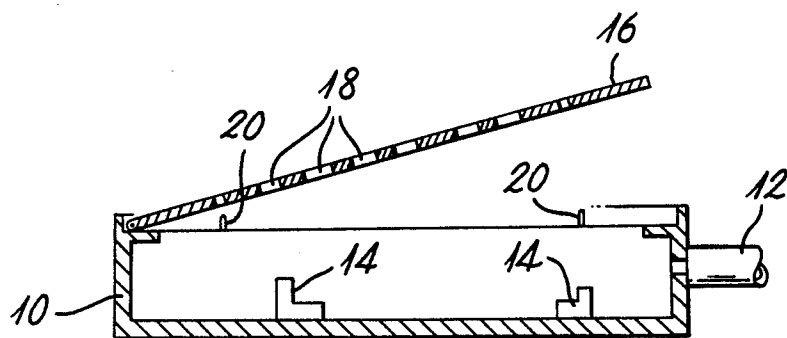


Fig. 1

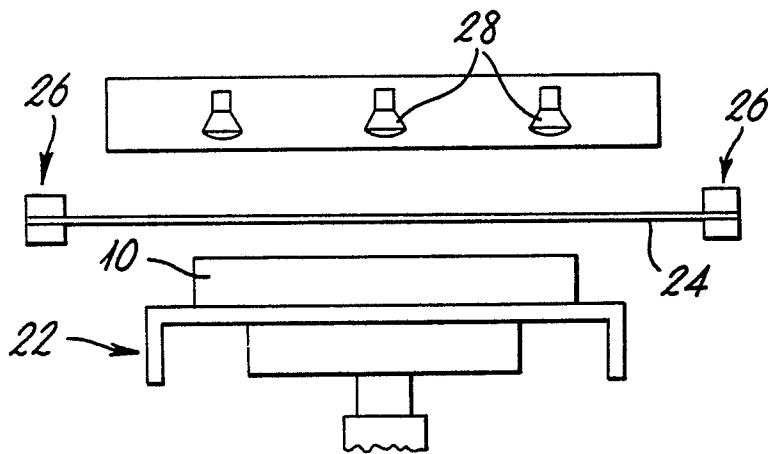


Fig. 2

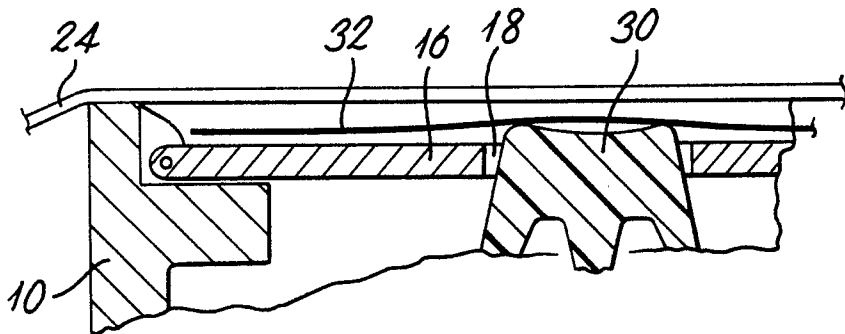


Fig. 3a

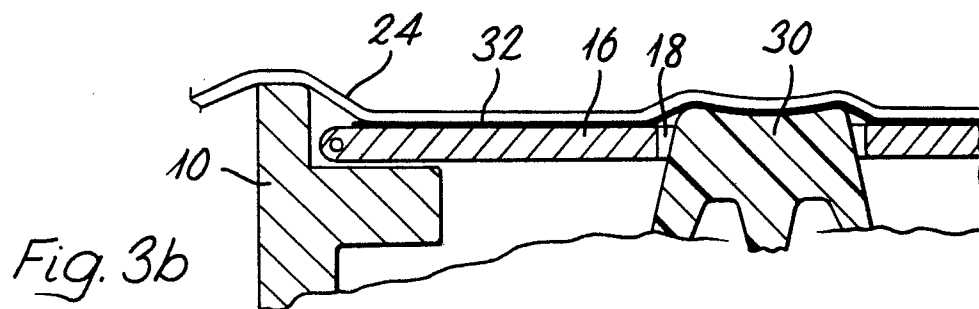


Fig. 3b



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.4)
X	EP-A-0 129 023 (DAVID DURAND et al.) * Page 1, line 1 - page 5, line 21; claims 1-14; figures 1-3,7 *	1-16	B 41 F 16/00 B 41 F 17/00
X	--- EP-A-0 014 615 (ESSILOR INTERNATIONAL CIE.) * Claim 1; figures 4,5; page 7, lines 8-11,22-29 *	1,2,4-6,8-12,14-16	
A	--- EP-A-0 175 806 (NISSHA PRINTING CO. LTD) * Claims 1-14; figures 1,2,5 *	1,6,8	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			B 41 F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 18-09-1987	Examiner WEBER P.L.P.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons</p> <p>& : member of the same patent family, corresponding document</p>			