United States Patent

Duncan

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[54] METHOD OF SCREEN PRINTING

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[51] Int. Cl. B41l 13/00, B41m 1/12

[58] Field of Search 101/129, 126, 125, 115, 114, 101/31, 27; 401/1, 2

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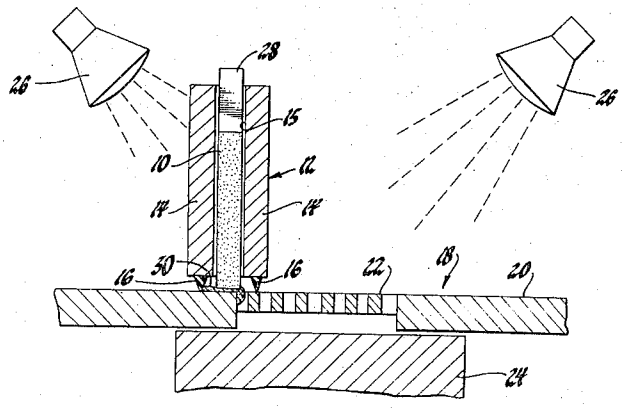
[57] ABSTRACT

The material to be applied by a screen printing technique is mixed with a thermoplastic vehicle which is solid at room temperature and melts at a predetermined elevated temperature. The material is formed into a slab which is then pressed against a screen surface. The screen is heated enough to melt a portion of the slab and the molten material is then forced through the screen by a squeegee.

1 Claims, 2 Drawing Figures



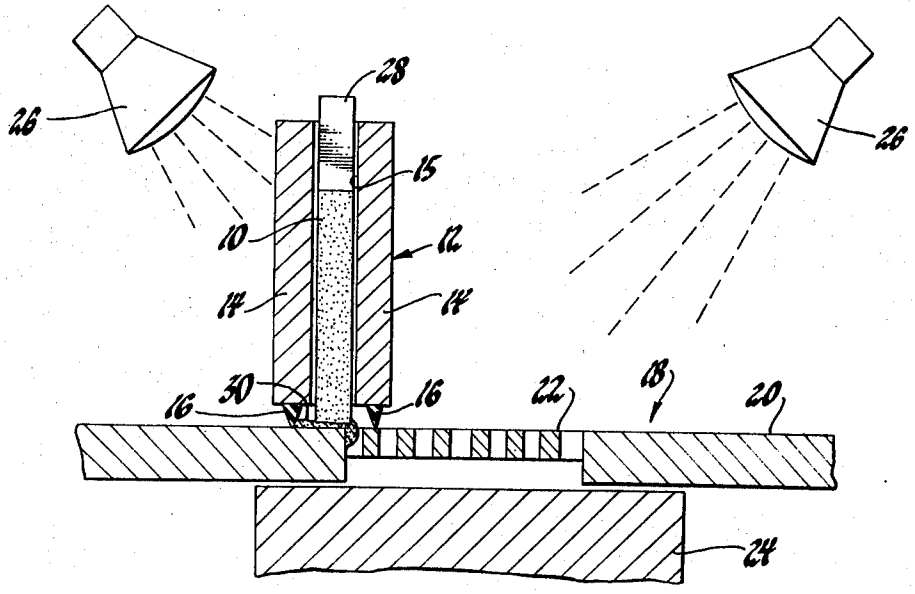


Fig. 1

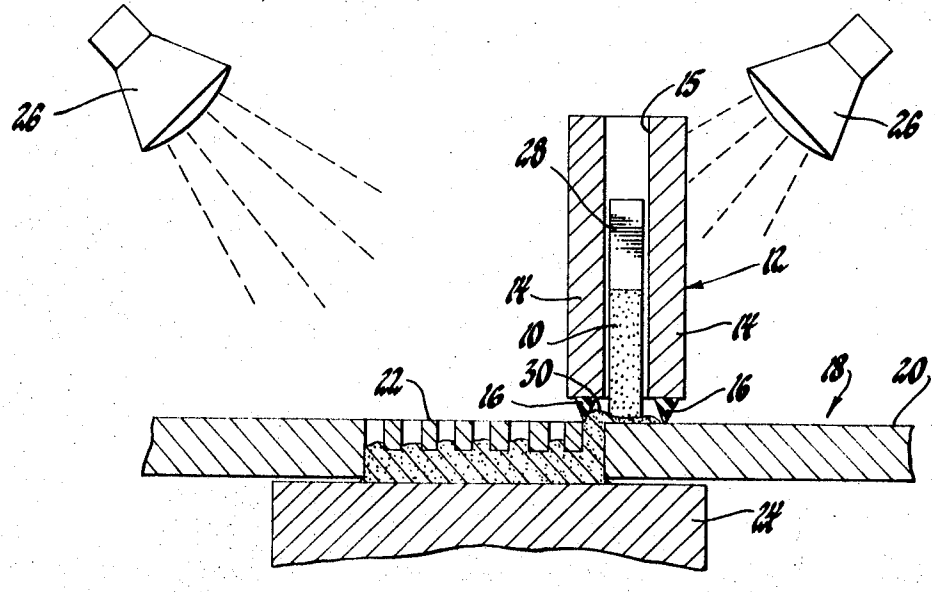


Fig. 2

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METHOD OF SCREEN PRINTING

This invention relates to a method of screen printing and more particularly to a method of screen printing using a printing medium which is in a solid state at normal room temperature.

It is known to use a printing medium which is in a solid state at room temperature and which melts at a higher temperature. The advantage of such a medium is that upon being applied to a substrate at room temperature, it congeals and may be readily handled or processed prior to being fixed or fired. The usual practice in the use of such material is to melt the printing medium and store it in a reservoir held at an elevated temperature and then discharge the molten material onto a heated screen where the medium is then applied to a substrate in the conventional manner.

It is a general object of this invention to provide a method of printing with a thermofluid medium which does not require the use of a heated reservoir.

It is a further object of the invention to provide a method of screen printing in which the printing medium is in a solid state until application of the medium to the screen.

The invention is carried out by casting slabs of material from a thermofluid composition, providing heated screens carrying a desired pattern configuration, placing a solid slab in contact with the heated screen to melt a portion of the slab and finally, to force a portion of the molten material through the screen onto a substrate.

The above and other advantages of the invention will become more apparent form the following description taken in conjunction with the accompanying drawings wherein like reference numerals refer to like parts and wherein:

FIGS. 1 and 2 are cross-sectional elevational views of screen printing apparatus illustrating the practice of the subject invention.

Thermofluid screen printing medium is available, for example, for the purpose of printing labels on glass bottles. The medium comprises a mixture of a colored pigment, a glass binder and a vehicle comprising a wax-like thermoplastic material which is solid at room temperature and melts at about 80° C. Similar materials are available for screen printing electrical conductors and resistors for the formation of thick film printed circuits. These latter media comprise a silver paladium mixture with a glass binder and a thermoplastic vehicle. The media is generally available in small hard fragments. It is well known to apply such thermofluid printing media to substrates by melting the thermofluid material, holding it in a reservoir and then applying it to a heated screen and forcing the molten material through the screen by a squeegee. The screens are heated directly or indirectly. The directly heated screens are heated by passing electrical current through the screens and heat is generated therein by the electrical resistance of the screen. The indirectly heated screens are heated externally as by infrared lamps.

According to the present invention and referring to FIGS. 1 and 2 of the drawings, the thermofluid media is first melted and then cast into a slab **10**. A slab **10** is placed in a squeegee

holder **12** which comprises a pair of vertical walls **14** spaced to define a feed channel **15** which receives the slab **10**. The squeegee holder carries at its lower end a pair of squeegees **16**, one on either side of the solid slab **10**. It is the usual practice to form a squeegee **16** of rubber, metal, Teflon or the like. A screen **18** comprises a masked portion **20** and an open mesh pattern portion **22** which is shaped in the configuration of the desired pattern of deposit to be laid on the substrate **24**. The screen **18**, of course, is held adjacent to the substrate and is either in contact with or slightly spaced therefrom. The screen is heated as shown in the drawings by infrared lamps **26**. As explained above, however, the screen may be heated directly by passing electrical current therethrough.

In operation, the screen **18** is heated above the melting point of the slab **10** of thermofluid printing medium or about 90° C. The slab **10** is urged against the screen **18** by its own weight. If additional pressure is desired, then the slab may be spring-loaded, a weight **28** may be added to the top of the slab or a second slab may be stacked in the holder **12** atop the slab **10**. When the edge of the slab **10** engages the screen **18**, a portion of the slab melts to form a molten pool **30**. Then as the slab holder **12** traverses the screen **18**, the molten media is forced through the screen by a squeegee **16** onto the substrate, newly molten material from the slab replenishes that material which is used and the slab **10** continuously feeds down to maintain contact with the screen. By using a squeegee on each side of the slab **10** it is possible to print during both forward and reverse motion of the squeegee holder **12**. The amount of material deposit on the screen is a function of the screen temperature and the traverse speed of the squeegee. Hence, it is possible to deposit very close to the necessary amount of printing medium.

While the method of this invention was specifically intended for the deposition of conductive and resistive thermofuid materials for use in thick film microelectronics, the method is adaptable to general usage.

The embodiment of the invention described is for the purpose of illustration and the scope of the invention is intended to be limited only by the following claims:

1. The method of screen printing a pattern onto a substrate comprising

casting a slab of thermoplastic material which is solid at room temperature and which becomes molten at a predetermined temperature,

providing a screen having the desired pattern configuration adjacent the substrate,

heating the screen to a temperature above the predetermined temperature,

melting a portion of the slab onto the heated screen by moving the slab along the screen in contact therewith,

and forcing the molten material through the screen by passing a squeegee positioned behind the slab across the screen surface conjointly with slab movement to form on the substrate a pattern according to the screen configuration.

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