United States Patent

Walker

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[54] **SILK SCREEN STENCIL APPARATUS AND METHOD**

[72] Inventor: **Howard R. Walker**, Aldan, Pa.

[73] Assignee: **Joseph E. Podgor, Inc.**, Pennsauken, N.J.

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[52] **U.S. Cl.** .....**101/38,** 101/115, 101/126, 101/129, 33/18 B, 73/1 F

[51] **Int. Cl.** **B41f 17/08,** B41f 15/00

[58] **Field of Search**.....101/114, 115, 129, 216, 35, 101/38; 33/18 R, 18 B, 20 R, 20 B, 20 C, 20 D, 21 R, 21 C, 21 D, 27 R, 35; 73/1 R, 1 F, 339 R

[56] **References Cited**

UNITED STATES PATENTS

3,316,076	4/1967	Blackman	73/1 F
3,347,161	9/1967	Lenk et al.	101/216
3,026,705	3/1962	Blackman et al.	73/1 R
3,585,839	6/1971	Bollinger	73/1 F
2,866,403	12/1958	Zimmermann et al.	101/115

Primary Examiner—Robert E. Pulfrey
Assistant Examiner—Eugene H. Eickholt
Attorney—Stanley Bilker

[57] **ABSTRACT**

Apparatus and method for silk screening a microscopic pattern on a stencil into precise registration with reference indicia previously incorporated upon a substrate. System includes an optical comparator with a reticle which magnifies the images and after superimposing a reference point in the test pattern with the reticle insures precise registration of a reference point on the substrate with respect to patterns imprinted thereafter.

4 Claims, 2 Drawing Figures

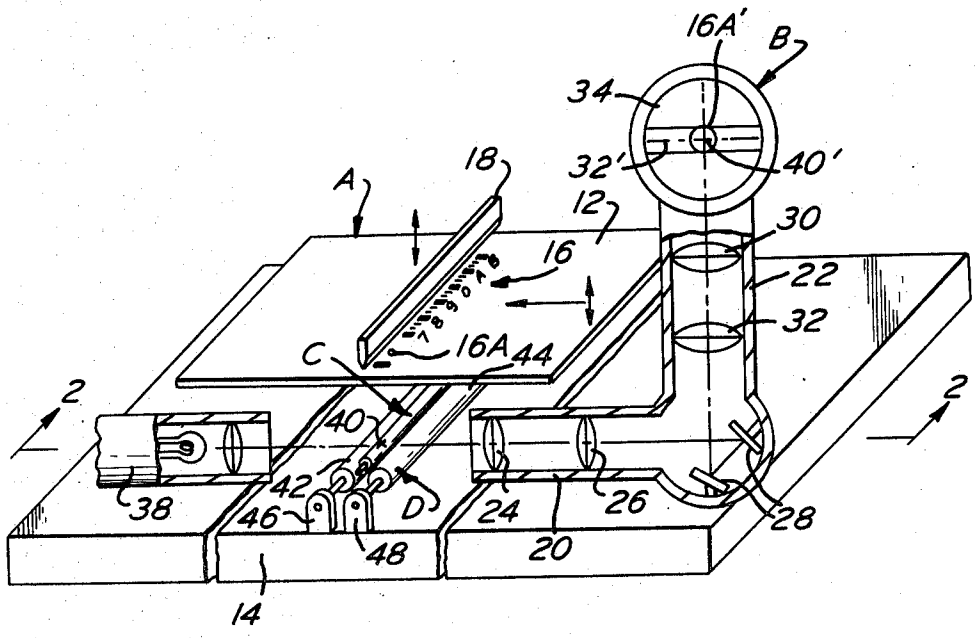
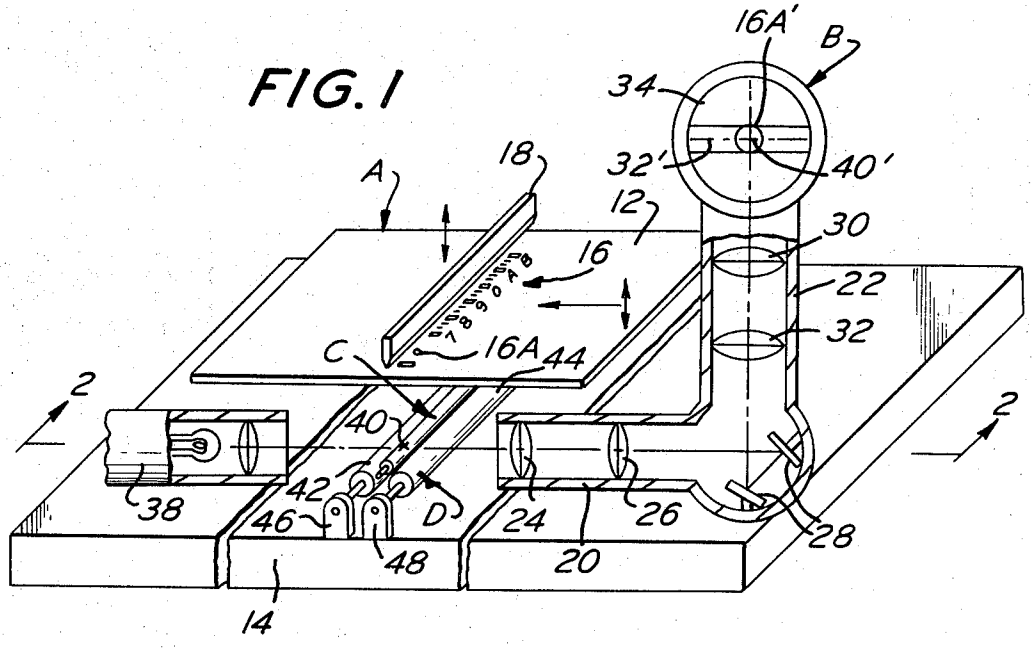


FIG. 1



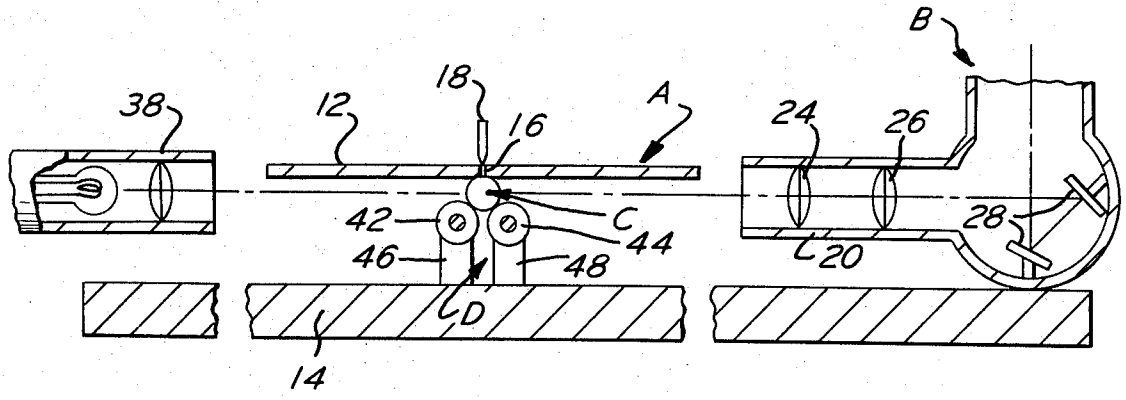


FIG. 2

INVENTOR
HOWARD R. WALKER
BY
ATTORNEY

SILK SCREEN STENCIL APPARATUS AND METHOD

This invention relates to silk screen stencil apparatus, and more particularly relates to a method and apparatus in which the indicia to be imprinted is microscopic or macroscopic in character and must be transferred to the substrate with extreme precision and accuracy.

In the manufacture of miniature components or articles with very fine information, such as printed circuit boards, integrated and microcircuit chips, and even precision thermometry apparatus, it is frequently necessary to apply macroscopic or microscopic indicia in exact registration with other marks, symbols or geometry previously incorporated on the substrate component. The present invention is directed to the alignment of the silk screen stencil with respect to the underlying substrate such that the printed indicia may be transferred at high production rates into precise registration with minute reference points already incorporated on the substrate. The present invention relies on an optical comparator or projecting microscope for magnifying the indicia and orienting the existing reference characters or symbols with respect to the silk screen stencil such that the transfer of printed indicia may be accomplished with great speed and accuracy.

It is therefore an object of this invention to provide a silk screen apparatus and method for permitting transfer of miniature patterns and information into exact, precise registration with reference indicia on underlying substrates at high speed.

Another object of this invention is to provide an apparatus and method for magnifying and optically orienting microscopic and/or macroscopic patterns on a silk screen stencil with respect to pre-existing reference indicia on the surface of underlying substrates.

Other objects of this invention are to provide an improved device and method of the character described which is easily and economically produced, which is sturdy in construction, and both highly efficient and effective in operation.

With the above and related objects in view, this invention consists of the details of construction and combination of parts as will be more fully understood from the following detailed description when read in conjunction with the accompanying drawing in which:

FIG. 1 is a front perspective view, and partly in section, of a silk screen optical registration device embodying this invention.

FIG. 2 is a sectional view taken substantially along lines 2—2 of FIG. 1, but with the silk screen stencil lowered into contact with the underlying substrate component.

Referring now in greater detail to the drawing in which similar reference characters refer to similar parts, there is shown a silk screen stencil apparatus, generally designated as A, which employs an optical comparator, generally designated as B, for accurately aligning a minute pattern on the stencil with respect to reference indicia already existing on an underlying substrate, in this case a thermometer, generally designated as C.

The stencil apparatus A is generally conventional and comprises a screen **12** which is mounted above a

base plate **14** by means of a supporting frame (not shown). The screen **12** by way of example has a pattern **16** of transversely extending stripes arranged longitudinally and spaced with respect to each other, including pertinent reference numerals and symbols adjacent major stripes. Means (not shown) is adapted to reciprocate the screen **12** vertically into contact with the underlying thermometer substrate C. A print squeegee **18** is suspended above the silk screen **12** and is adapted also to be vertically reciprocated by a support linkage (not shown) into contact with the upper surface of the screen. In the present illustration, the squeegee **18** is oriented directly over the thermometer C and in alignment therewith after adjustable horizontal positioning. Thus, when the screen **12** is lowered into contact with the thermometer C and then moved to the left, as shown in FIGS. **1** and **2**, the squeegee **18** forces ink spread on the upper surface of the screen through the open pores thereof defined by the pattern **16** upon the thermometer substrate therebelow.

The optical comparator B is also essentially conventional and includes a pair of substantially tubular frame members **20** and **22** oriented at right angles to each other. Objective lenses **24** and **26** direct a collimated beam of rays upon a pentaprism or pentamirror **28** which then bends the beam through a right angle. Lens **30** then focuses the ray image upon a ground glass plate **34** after the beam is deflected through another right angle by a front surface mirror at the rear of the upper tubular member **22** but which is not shown. A reticle or cross hair **32** is utilized for superimposing an image from the target or object upon a predetermined portion of the ground glass plate **34**. The comparator B is supported on the base plate **14** in any suitable manner and is adjustable to accommodate the orientation of the thermometer in appropriate disposition. A lamp **38** is also mounted on the surface of the base plate **14** and illuminates both the surface of the thermometer as well as the ground glass plate **34**.

The thermometer C has a reference symbol or cross **40** etched or scribed at a predetermined position thereon, as an example, in a position determined by its mercury level or volume during filling. The thermometer C is laid in a jig D which constitutes a pair of adjacent rollers **42** and **44** arranged side by side in suitable end bearings **46** and **48**. The axis defined by the line bisecting the longitudinal axes of the rollers **42** and **44** is aligned with the pattern **16** and the squeegee **18** axes during the preliminary set-up operations.

In order to align the reference cross **40** on the thermometer C with respect to the pattern **16** on the stencil **12**, the thermometer is laid in a nominal position within the rollers **42** and **44** and a test printing made by lowering the stencil **12** and the squeegee **18** and then drawing the screen **12** to the left while in contact with the thermometer C. As the ink is pressed through the pattern **12**, the thermometer is rolled in its jig D. A reference point **16A** in the pattern is imprinted on the thermometer along with the remainder of the indicia. The comparator is then adjusted until the image **32'** of its reticle crosshairs **34** exactly bisects the image **16A'** which has just been printed on the thermometer and focussed upon the ground glass plate **34**. The optical comparator is now collimated and trued with respect to the pattern. Thereafter, the next thermometer C is

placed in the jig D such that the image **40'** of the cross **40** is exactly superimposed upon the image **32'** of the crosshair **32**. Longitudinal and rotational registration of the stencil pattern **16** upon the thermometer C is now assured. Precise transfer of the pattern **16** is obtained by laying the thermometer C in its jig D and manipulating the image of its reference cross **40** longitudinally and rotatably until its image is exactly superimposed upon the crosshair **32** of the optical comparator. When the screen **12** is lowered into contact with the thermometer with the squeegee **16** in contact with the screen, drawing the screen to the left results in a perfect transfer.

Although this invention has been described in considerable detail, such description is intended as being illustrative rather than limiting since the invention may be variously embodied, and the scope of the invention is to be determined as claimed.

What is claimed is:

1. A method for silk screening a microscopic pattern on a stencil into precise registration with a reference indicia previously incorporated upon a substrate comprising the steps of (1) mounting the substrate in a jig such that one dimension of the reference indicia is in substantial alignment with a corresponding dimension of the pattern on the silk screen stencil, (2) imprinting a test pattern on the substrate by lowering the stencil into contact with the surface thereof and drawing the squeegee across the pattern, (3) using a magnifying optical comparator having a reticle therein, superimposing a reference point transferred during the test silk screening of the substrate with the reticle of the optical comparator, and (4) orienting subsequent substrates within the jig so that a predetermined point in the reference indicia on the substrate is superimposed as an image upon the reticle.

2. Apparatus for silk screening a microscopic pattern upon a substrate in precise registration with reference indicia thereon, comprising: a silk screen including a stencil pattern, a jig for supporting the substrate such that one dimensional axis of the reference indicia is in alignment with a corresponding dimensional axis of the stencil pattern, an optical magnifying device mounted with respect to said jig so as to project an image of the area circumjacent the reference indicia, a reticle in said optical magnifying device including means for adjusting said reticle along an axis perpendicular to the first mentioned axis of the reference indicia, said jig including means to orient said substrate along a second axis perpendicular to the first mentioned axis, and means for moving said silk screen stencil with respect to said jig so as to imprint the substrate with the pattern, whereby orienting the reticle with respect to an image of a reference point within a test pattern imprinted upon a first substrate and then orienting subsequent substrates such that the image of the reference indicia thereon is superimposed upon said reticle will insure precise registration of patterns imprinted on such subsequent substrates.

3. The apparatus of claim **3** wherein said optical magnifying device constitutes an optical comparator.

4. The apparatus of claim **4** wherein said substrates are cylindrical tubes, and said jig comprises a pair of adjacently mounted parallel rollers.

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