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(54) **Duplicating stencil assembly and method for its production.**

(57) A backing sheet with the usual punched heading carries a stencil sheet composed of a conventional tissue layer to which an ink-impermeable coating is attached by a layer of adhesive. An electrophotographic toner image formed on the backing sheet is bonded to the impermeable coating of the stencil sheet such that when the assembly is mounted on a duplicating machine and the body of the backing sheet stripped off it forms the stencil by removing parts of the impermeable layer. The stencil sheet is attached to the heading by a line of heat and/or pressure sensitive resin, preferably the toner which also forms the image. The assembly is thus easily produced from preformed backing and stencil sheets in a modified electrostatic copying machine.

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DUPLICATING STENCIL ASSEMBLY

The present invention relates to a duplicating stencil assembly comprising a backing sheet and a stencil sheet attached to the backing sheet, the backing sheet comprising a heading region at one margin of the sheet which is separable from the body of the sheet and to which the stencil sheet is attached.

Such stencil assemblies are conventional and are used for the production of duplicating masters by typing a text onto the stencil sheet while supported by the backing sheet. The stencil sheet is commonly composed of a coated tissue which is flimsy and easily damaged. The backing sheet provides support for the stencil sheet until it is mounted on a duplicating machine. For this purpose the heading region of the backing sheet has punchings to fit on to projections on the duplicating machine. Upon mounting of the stencil sheet on the machine the body of the backing sheet is separated, commonly by tearing along a line of perforations, and removed.

Various methods have been proposed for replacing the typing of the stencil sheet, or the use of a stylus, by a procedure which enables a whole document to be automatically reproduced in the form of a stencil. At present however there are only two systems commercially available for the non-manual production of stencils. The first process involves the electrical cutting of a carbon-loaded layer on a porous stencil sheet. A spark discharge cutting-head is synchronised with an optical head which views the original and directs the cutting-head to cut the stencil, point by point. This system produces good results but is relatively slow, requiring a period of 5 to 15 minutes to complete, and since the process involves burning off the carbon loaded regions it is dirty and produces an unpleasant odour.

The second process is a thermographic process known as "thermal imaging". It uses a stencil master consisting of porous tissue with a thin thermoplastic coating which is placed against the original document and heated by an infra-red lamp. The termperature rise of the coating is greatest in the black image areas and it melts in these areas to expose the porous tissue and thus produce a

stencil. The process is very quick, the exposure time being of the order of 10 seconds, but it requires practice and skill to determine the length of exposure. The resolution is poor and the process is blind to many colours of the original, including some blacks. There is also a risk of damage to the original.

In our co-pending UK application No. 7926290 we have described and claimed a stencil sheet for the production of a stencil from an electro-photographic image by bonding the image to the stencil sheet and then tearing away parts of the stencil sheet adhering to the image, the stencil sheet comprising a porous tissue sheet, an ink-impervious layer comprising a synthetic resin composition containing finely-dispersed zinc oxide, and an adhesive bonding the ink-impervious layer to the porous tissue sheet.

In accordance with the present invention there is provided a duplicating stencil assembly comprising a backing sheet and a stencil sheet attached to the backing sheet, the backing sheet comprising a heading region at one margin of the sheet which is separable from the body of the sheet and to which the stencil sheet is attached, the stencil sheet comprising a tissue layer with an ink-impermeable coating secured to the tissue by an adhesive layer, the body of the backing sheet having a toner image formed thereon which is bonded to the impermeable coating of the stencil sheet in such a manner that upon separation of the stencil sheet from the backing sheet parts of the impermeable layer are removed by the image to form a stencil, and the stencil sheet being attached to the heading region of the backing sheet by a line of heat and/or pressure sensitive resin.

It will be seen that the stencil assembly of the present invention can be produced by the use of a stencil sheet similar to that described and claimed in UK application No. 7926290 and reference is made to the specification of that application for further details. The electrophotographic toner image is formed on the backing sheet and remains bonded to the stencil sheet until the latter is to be used. The attachment of the stencil sheet to the heading region of the backing sheet by a line of heat and/or pressure sensitive resin, which may be composed of the same material as the toner image, allows this attachment to be effected in the course of the same process which bonds the toner image to the impermeable layer of the stencil sheet. The production of a stencil assembly from pre-prepared

backing and stencil sheets therefore only involves formation of the toner image on the backing sheet and bonding of the stencil sheet to the backing sheet. The resulting assembly is easily handled for mounting on a duplicating machine and the stripping away of the body of the backing sheet produces the stencil which can then be used immediately for duplicating.

Conveniently the production of the stencil assembly takes place in a modified electrostatic copying machine in which a backing sheet can be fed in place of the normal copy paper and a stencil sheet can be applied to the face of the backing sheet after application of the toner but before passage through the fusing rollers. The fusing rollers then act to fuse the image and simultaneously bond it to the impermeable layer of the stencil sheet. The backing sheet may be provided in advance with the line of resin for attachment to the stencil sheet but conveniently provision is made for incorporating the line in the image formed on the backing sheet, using the same toner which makes the electrostatic image of the original visible. The line may be imaged onto the backing sheet or the backing sheet may have a line which is chargeable to attract the toner during formation of the electrophotographic image.

In carrying out the production of a duplicating stencil assembly in accordance with the invention the image can be formed on the backing sheet by most of the conventional electrophotographic methods. A dry toner powder should be used. In the case of plain paper copying a two-component magnetic toner is preferred. When using paper with a zinc oxide coating for the backing sheet it is possible to use a one component magnetic toner.

Where the backing sheet is a conventional plain white paper for example 100 g.s.m., having the usual punched and perforated heading, the toner image can be produced on commercial plain paper copiers, such as those sold under the trade names TOSHIBA BD-909, AGFA X10, U-BIX Mk.I, XEROX 3103, and SHARP 721. These use a dry two-component magnetic toner which is heat fused, for example by hot rollers. Such a toner image has strong adhesion to the backing sheet and can be made to adhere to the ink-impermeable layer of the stencil sheet sufficiently strongly to tear the layer away when the stencil sheet is removed from the backing sheet.

In the case where the backing sheet has an electrophotographic zinc oxide coating care has to be taken that the adhesion of this coating to the backing sheet is great enough to prevent it tearing away when the stencil sheet and backing sheet are separated. While certain commercially available papers can be used for this purpose, best results are obtained by the production of a special paper, for example with the following formulation:-

PHOTOX 80	-	400 pts	(ex New Jersey Zinc)
E312 (50% nv)	-	132 pts	(ex De Soto Inc)
TOLUENE	-	200 pts	
SENSITIZER SOLN.	-	5 pts	(dyes in Methanol)

Photox 80 is an electrophotographic grade of zinc oxide made by what is known as the French process. E312 is modified acrylic resin and is supplied as a solution containing 50% non-volatile material. The hegman fineness of grind gauge is used to assess the degree of dispersion of pigment in printing inks. It consists of a block with a wedge-shaped groove tapering from a depth of 25 µm or more at one end to zero at the other. The liquid is placed in the deepest part of the groove and spready by a scraper which pulls forward any large particle and creates a scratch in the surface of the liquid. The particle size is assessed by the position at which the scratch starts. A reading of 5 on the gauge indicates that there are no particles of a size greater than about 38 µm, 6 none greater than 25 µm, 7 none greater than 15 µm and 8 that the particles are too small to be measured by this method and certainly less than 10 µm.

The Photox 80 is dispersed in the E312 resin and toluene and ground to a hegman reading of 5 - 5½. The sensitizing dyes are added and stirred and the resulting coating is applied to E226 Electrofax base (ex Felix Schoelle) at coating weight of 20 gsm with a wire wound coating bar. The coating is then dried in an oven. The coated sheet is then kept in the dark for not less than 2 hours and imaged in an Electrostatic copier e.g. Roneo Vickers D.B.6.

For use with a coated backing sheet a one-component magnetic toner powder is preferred which comprises a synthetic resin component, a magnetic material such as a ferrite, and a conductive carbon black. Selected commercially available materials with high proport-

ions of synthetic resin with appropriate pressure and heat adhesive properties can be used but again a special formulation of toner is preferred, of which the following is an example:-

SYNOCRYL 4003 (CRAY VALLEY PRODUCTS)	25 parts
VERSAMID 940 (CRAY VALLEY PRODUCTS)	12 parts
MAPICO BLACK (COLUMBIAN)	52 parts
ACETYLENE BLACK (SHAWINIGAN)	11 parts
NIGROSINE (Spirit Soluble) (HOLLIDAY)	1 part

Whichever type of backing sheet is used, the stencil sheet is placed with its ink-impermeable layer in contact with the toner image on the backing sheet and the assembly is passed through a heating zone to bond the image to the surface layer of the stencil sheet. This heating step can be subsequent to the fusing of the toner image or may serve simultaneously to fuse the toner image. Infra-red heating by means of rollers is preferred in the heating zone whereas the initial fusing of the image can be done by cold pressure.

The stencil sheet in each case comprises a tissue layer with an ink-impermeable coating secured to the tissue by an adhesive layer, as described in full detail in application No. 79 26290. The tissue sheet can be a conventional stencil tissue such as Yoshino Type 602 Standard stencil tissue. The impermeable layer preferably comprises finely divided zinc oxide in a resin binder in the proportions by weight of 3 to 12 parts of zinc oxide to one of resin. The resin composition preferably comprises a strong flexible film forming resin of the polyurethane or polyvinyl chloride type combined with a weak-film-forming, low-melting-point resin of the cellulose ester type with a ratio of strong-film resin to weak-film resin between 0.5 to 1 and 3 to 1. The zinc oxide is preferably in the proportion of 10 to 4 parts by weight to one part of resin and very good results are obtained with 8 parts by weight of zinc oxide to one part of resin. All grades of zinc oxide tried have been found to work but the preferred material is Grade 100 supplied by Durham Raw Materials Limited.

The function of the adhesive is to laminate the ink-impervious layer to the tissue but it must selectively release the regions of the layer that have been bonded to electrostatically produced image

on the backing sheet. Thus the bond strength of the adhesive must be sufficient to provide good lamination to the tissue allowing multiple copies to be taken on the duplicator without stencil damage but must be sufficiently weak to be overcome by the bond between the layer and the image on the backing sheet. Various types of adhesive resins can be used such as polyvinyl-acetates, cellulose derivatives, acrylic emulsions, etc. The bond formed between the tissue and the layer depends on the type of adhesive selected but this may be a dry-bond, pressure or heat-sensitive bond. The adhesive is applied to the ink-impervious layer, which has been previously coated onto a release paper, and the tissue is laminated to the adhesive layer in its wet or dry state depending on the type of adhesive employed. The quantity of adhesive applied is that which provides the correct bond strength when tested.

CLAIMS:-

1. A duplicating stencil assembly comprising a backing sheet and a stencil sheet attached to the backing sheet, the backing sheet comprising a heading region at one margin of the sheet which is separable from the body of the sheet and to which the stencil sheet is attached, the stencil sheet comprising a tissue layer with an ink-impermeable coating secured to the tissue by an adhesive layer, the body of the backing sheet having a toner image formed thereon which is bonded to the impermeable coating of the stencil sheet in such a manner that upon separation of the stencil sheet from the backing sheet parts of the impermeable layer are removed by the image to form a stencil, and the stencil sheet being attached to the heading region of the backing sheet by a line of heat and/or pressure sensitive resin.

2. A duplicating stencil assembly as claimed in claim 1 in which the line of resin is composed of the same material as the toner image.

3. A method of producing a duplicating stencil assembly as claimed in claim 1 in which the stencil sheet is attached to the heading region of the backing sheet in the course of the same heat and/or pressure treatment which is used to bond the toner image on the body of the backing sheet to the impermeable layer of the stencil sheet.

4. A method as claimed in claim 3 in which the line of resin for attaching the stencil sheet to the heading region is formed simultaneously with and from the same material as the toner image.