

United States Patent

Newman

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[54] FACSIMILE COPYING PROCESS

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[63] Continuation-in-part of Ser. No. 776,811, Nov. 18, 1968, abandoned.

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[51] Int. Cl. **H04n 5/76**, B41m 5/10

[58] Field of Search 117/36.1, 36.4; 178/6.6; 346/74, 74 CH, 135

[56] References Cited

UNITED STATES PATENTS

2,785,039 3/1957 Artzt 178/6.6

2,820,717	1/1958	Newman et al.	117/36.1
2,944,037	7/1960	Clark	117/36.1
3,002,858	10/1961	Newman et al.	117/138.8 F
3,190,956	6/1965	Vaccaro	178/6.6
3,442,681	5/1969	Newman et al.	117/36.4
3,481,761	12/1969	Newman et al.	117/36.4

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[57]

ABSTRACT

An improved facsimile duplicating process of the type employing a pressure-sensitive transfer sheet and a receptive copy sheet. An original is scanned and signals are transmitted to a stylus to actuate it against the transfer sheet to form duplicate images on the copy sheet corresponding to those on the original sheet. The improvement arises from the use of a squeeze-out type transfer sheet which exudes liquid ink and an absorbent copy sheet.

8 Claims, No Drawings

FACSIMILE COPYING PROCESS

This application is a continuation-in-part of parent application Ser. No. 776,811, filed Nov. 18, 1968, now abandoned.

In the well-known facsimile duplication process employing a pressure-sensitive transfer sheet and a receptive copy sheet, a stylus is impressed against the transfer sheet to cause transfer of imaging composition to the copy sheet in areas corresponding to the position of images or other subject matter present on the original sheet being copied. This is accomplished by means of electrical signals which are developed by photocells which scan the original sheet and which are transmitted to the means for actuating the stylus against the transfer sheet with marking pressure. U.S. Pats. Nos. 3,159,710 and 3,190,956 are cited as illustrative of known apparatus for this purpose.

The facsimile duplicating process is quite slow and the copy produced thereby is of poor quality compared to other copying processes. The process is slow because the photocells must scan the original by small increments and the fine tip or edge of the stylus must pass over and/or against the transfer sheet in correspondingly small increments. This generally requires from 4 to 6 or more minutes for a normal letter-size original sheet. The quality of the formed images is poor because the images consist of a number of incremental lines and/or dots of imaging composition transferred to the surface of the copy sheet from the transfer sheet.

Generally the photocells scan increments of the original sheet of about 0.01 inch widths and the stylus has a tip of about 0.002 inch diameter which equals about one-fifth of the width of the corresponding increment of the copy sheet to be marked. The wax transfer composition is generally relatively soft and therefore transfers to the copy sheet as lines or dots which are somewhat wider than the 0.002 inch diameter of the stylus tip. However they do not occupy the entire 0.01 inch width of each increment and therefore the images formed contain "white" or unfilled portions which give the images a spotty appearance.

Obviously the quality of the images can be improved by reducing and/or overlapping the increments but this increases the time necessary to produce each copy. Conversely, the time required to produce each copy can only be reduced at the expense of producing copy images of reduced quality.

It is the principal object of the present invention to improve the quality of the images produced in the facsimile duplicating process without increasing the amount of time required to produce the imaged copy sheet.

It is another object of this invention to reduce the amount of time required to produce an imaged copy sheet without reducing the quality of the images formed.

These and other objects and advantages of this invention will be clear to those skilled in the art in the light of the present disclosure.

The present invention resides in my discovery that a certain type of pressure-sensitive transfer sheet produces unexpected advantages and improvements of the facsimile duplicating process. I have discovered that the use of a solvent-coated squeeze-out type transfer layer in combination with an ink-absorbent copy sheet in the facsimile duplicating process results

in the formation of more uniform and more continuous images of good quality. The improvement in quality relates to the sharpness and clarity of the images as compared to images produced on the same facsimile apparatus and at the same speed but using a frangible wax transfer layer. If speed is more important, then my discovery enables the production of a copy at about twice the speed possible using a frangible wax carbon and having images of equal or better quality.

The improvement is the result of the fact that squeeze-out type transfer sheets function extremely well under the effect of the continuous contact-type pressure exerted by the stylus of a facsimile machine, which is quite different from the impact exerted by a type bar driven into contact with a copy sheet. The squeeze-out type sheet exudes a liquid ink to the copy sheet under activated stylus pressure and does not exude or transfer any solid binder material. The exuded ink is absorbed by the copy sheet and therefore spreads or broadens slightly without leaving any solid binder at the paper surface where it can be smudged during handling, as happens with conventional wax transfer layers. I have found that this slight broadening or spreading of the ink on the copy sheet, which is an inherent feature of the absorption of the ink into the paper copy sheet, results in a filling-in or flowing together of the normally spaced increments of the images formed on a pressure-stylus facsimile apparatus so that such images appear more uniform and more continuous to the eye than corresponding images formed by means of a frangible transfer layer such as a colored wax composition.

The transfer sheets found suitable for use in the present process are well-known in the carbon paper field. They comprise a paper or film foundation carrying a layer based upon a synthetic thermoplastic binder material, an oily ink vehicle which is substantially incompatible with the binder material and a pigment and/or dissolved dyestuff. Such layers are applied by means of a volatile solvent for the binder material and ink vehicle, and on evaporation of the solvent, the ink layer comprises a non-transferable porous structure of the binder containing pressure-exudable liquid ink within the pores thereof, the ink comprising the oily vehicle and the pigment and/or dyestuff. U.S. Pat. Nos. 3,037,879 and 2,944,037 are illustrative of suitable squeeze-out type transfer sheets and compositions, and suitable sheets are commercially available under the registered trademark Plastisol.

It is preferred to use transfer sheets having a plastic film foundation since the imaging stylus scans over the rear surface of the transfer sheet and it is important that the movement of the stylus be smooth and unimpeded. A rough paper surface may cause the stylus to vibrate and apply imaging pressures in unintended areas, and may even snag and tear. While plastic films are preferred foundations, it is also possible to use paper foundations which have been provided with a smooth back coating of resin or wax which is sufficiently thin that it fills the roughness of the paper surface without interfering with the flexibility of the paper and its ability to transmit imaging pressure from the stylus to the imaging layer.

The present method may be carried out using any conventional facsimile duplicating machine employing

a pressure stylus adapted for imaging a copy sheet by means of applied pressure. The apparatus disclosed in U.S. Pat. No. 3,190,956 may be taken as illustrative.

The imaged original sheet which it is desired to duplicate is mounted on the apparatus beneath the photocell adapted to scan the original. A sheet of thin 5 pound Kraft copy paper is positioned against the ink layer of a squeeze-out type transfer sheet produced according to Example I of U.S. Pat. No. 3,037,879 having a binder of vinyl chloride-vinyl acetate copolymer, and the superposed sheets are mounted on the apparatus with the stylus against the foundation of the transfer sheet.

When the apparatus is turned on, the photocell scans the original sheet in increments of 0.01 inch. When the photocell senses "white" or unimaged areas, the stylus glides over the transfer sheet with non-marking pressures, and when the photocell senses "black" or imaged areas, the stylus is activated against the transfer sheet under marking pressures. The final copy is of excellent quality since the images thereon appear substantially continuous and uniform to the eye compared to images produced in like manner using a frangible wax carbon paper. The stylus tip is 0.002 inch in diameter, one-fifth the width of each increment, but the ink absorbs into the copy paper to substantially fill the width of each increment. In view of this fact, the width of the increments scanned by the photocell and impressed by the stylus can be increased to 0.015 or 0.02 to reduce the period of time required to make each copy and yet the copies will have equal or better uniformity and clarity than copies produced from a frangible wax carbon paper impressed on the apparatus in increments of 0.01 inch.

The coloring matter present in the squeeze-out ink layers may be varied depending upon the type of copy desired, but it is preferred to use a dyestuff dissolved in the oil phase. Magnetizable infrared radiation-absorbing or luminescent pigments may be used to produce sensible copies, such as magnetic iron oxide and carbon black. Undissolved hectograph dyestuff may be used to produce copies suitable for use as hectograph masters to prepare a small number of copies in the spirit duplicating process.

Suitable copy sheets are those which are capable of absorbing the liquid ink from the transfer layer. Preferred copy sheets are the conventional quality copying papers which are not coated with resinous sealing layers. Such papers generally have a weight of from 5 to 10 pounds per ream of 500 sheets, 25 inches by 38 inches in dimension. Use may also be made of sheets, including plastic films, having an ink-absorbing surface or coating thereon. Such coatings generally comprise a resinous binder material and may include an ink-absorbing porous filler such as calcium carbonate, zinc oxide, or the like. Plastic films coated with a blushed, porous layer of resinous binder material such as ethyl cellulose are suitable copy sheets, and reference is made to my U.S. Pat. No. 3,002,858 for its disclosure of sheets of this type. Also suitable are thin films of expanded or foamed synthetic thermoplastic materials such as polystyrene. Such films have a rough absorbent surface due to the rupture of some of the expanded cells at the film surface and/or due to the surface porosity produced in the film as a result of the expand-

ing process. A preferred material in this regard is obtainable under the trademark Q-Per from Nippon Art Paper Company, Japan. A related material from the same source under the trademark Q-Kote is very suitable as a foundation for the present transfer sheets since it carries a smooth back coating to accommodate the imaging stylus and has a rough absorbent expanded surface which provides a good anchor or bond with the imaging layer.

Of course it should be understood that some papers, films and coatings are more absorbent of liquid ink than others and therefore the proper copy sheet should be selected depending upon the degree of spreading desired. For instance, more absorbent copy sheets should be used when the width of the increments being impressed is increased, thus permitting more complete fill-in.

According to a preferred embodiment, the squeeze-out transfer sheet is provided with an ink-pervious porous supercoating which is not pressure-transferable and which serves to space the ink layer from the copy sheet so that absolutely no transfer of ink is possible while the stylus is pressing against the transfer sheet with non-marking pressures. Otherwise some faint transfer may occur in unintended areas, particularly if the squeeze-out layer is of the softer and more sensitive type. The supercoating may comprise a very fine screen of synthetic thermoplastic resin printed onto the ink-exuding surface of the transfer layer, or may comprise a very thin wash coating comprising a dilute solution of a synthetic thermoplastic resin, which is incompatible with the oily ink vehicle of the transfer layer, in a volatile organic solvent. The wash coating sheds from the exposed ink pores of the transfer layer and thus becomes porous on hardening through evaporation of the solvent. Reference is made to copending U.S. Pat. No. 3,481,761 for its disclosure of suitable wash coatings.

If desired, the transfer sheet may also be used as a self-supporting element without any paper or film foundation. Elements of this type may be produced according to Canadian Pat. No. 672,037 and produce excellent results because there is no foundation interposed between the stylus and the ink layer to interfere with the transmission of the imaging pressure. However the ink layer is preferably provided with a thin ink-impervious smooth sealing layer on the back surface to prevent transfer of ink to the stylus and to provide a smooth surface to accommodate the stylus, and with a porous ink-pervious supercoating over the ink-exuding front surface of the ink layer, if desired.

It should be understood that the present invention applies to the use of facsimile duplicating apparatus and styli of various types. Some apparatus employ pointed styli while others employ bar styli in association with a helical rib present on the surface of the drum rotating behind the copying sheets.

I claim:

1. In the process of producing a copy of an imaged original sheet by means of a pressure-sensitive transfer sheet and a copy sheet positioned thereagainst and a stylus which scans regular spaced increments of such sheets and presses the sheets together in response to electrical signals received from a source scanning said original sheet to cause transfer of spaced increments of

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imaging composition from said transfer sheet to said copy sheet in areas corresponding to the location of the images on the original sheet, the improvement which comprises using as the transfer sheet one on which the imaging composition is a liquid ink comprising an oily vehicle and coloring matter, said ink being present in pressure-exudable condition within the pores of a layer of porous synthetic thermoplastic resin binder material which is not transferable to the copy sheet under the effects of the pressure exerted by said stylus, and using a copy sheet which is capable of absorbing said liquid ink, whereby ink transferred to said copy sheet is absorbed by the areas between said spaced increments to provide a more continuous copy.

2. The process according to claim 1 in which the transfer sheet comprises a flexible foundation carrying said ink-exuding layer of porous binder material, said foundation having a smooth back surface which per-

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mits the stylus to glide thereover.

3. The process according to claim 1 in which said binder material comprises a copolymer of vinyl chloride and vinyl acetate.

4. The process according to claim 1 in which a porous, ink-permeable supercoating is present on the ink-exuding surface of said porous layer of binder material.

5. The process according to claim 1 in which the copy sheet is a thin sheet of ink-absorbent paper.

6. A process according to claim 1 in which the copy sheet is a plastic film having a surface which is absorbent of said liquid ink.

7. A process according to claim 6 in which the plastic film is a film of expanded polystyrene.

8. The process according to claim 1 in which said coloring matter comprises a sensible pigment.

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