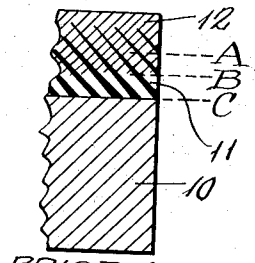
Sept. 11, 1956 D. A. NEWMAN 2,762,715

PRESSURE SENSITIVE HECTOGRAPH TRANSFER ELEMENT

Filed March 30, 1949

Fig. 1




PRIOR ART

Fig. 2

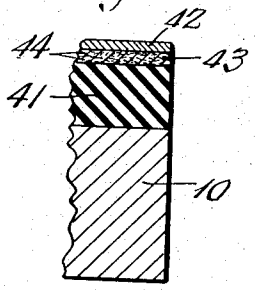
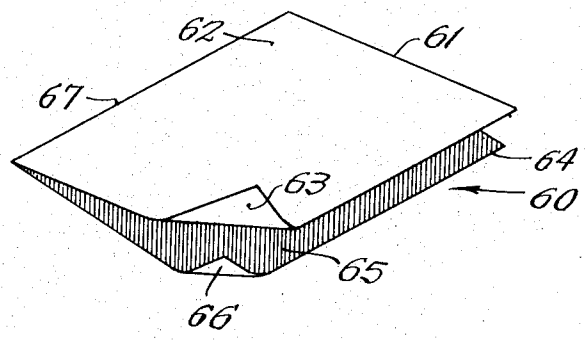



Fig. 3




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2,762,715

# PRESSURE SENSITIVE HECTOGRAPH TRANSFER ELEMENT

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Application March 30, 1949, Serial No. 84,410

2 Claims. (Cl. 117—36)

This invention relates to transfer elements for manifolding and duplicating use and particularly to transfer elements having transfer layers containing soluble dyes such as crystal violet, methyl violet, brilliant green, magenta and the like. Dyes of this character are soluble to some extent in waxes, fatty acids, fatty alcohols used in compounding transfer materials, and are also highly soluble in alcohol and water. When a portion of the transfer layer has been deposited on a receiver or master, usually by pressure, to form an image, the latter is capable of being moistened with a suitable solvent such as alcohol or water, whereby copy sheets which are brought into contact with the image-bearing master receive a portion of the dye in the shape of the image, and a plurality of copies can be obtained in this fashion. This process is commonly referred to as hectographic duplication and the transfer element as hectograph carbon.

One of the most severe drawbacks ordinarily encountered in the use of a hectographic duplication process is the difficulty of handling the hectograph carbon sheets without contaminating the operator's hands and clothing with coloring matter, and without producing smudges on the master either directly from the carbon, or by way of the operator's hands. One main reason for this is that the available dye materials which have sufficiently strong coloring power to provide a plurality of copies, are water soluble and thus migrate readily under the influence of the moisture usually present on the operator's hands. Therefore, under ordinary circumstances, the nuisance occasioned by soiled hands as well as the danger of damaged clothing and spoiled copies is an important factor to be reckoned with.

Various methods are used to attack this problem, one of which has been, particularly where hectograph carbon is concerned, the manufacture of master units, or units consisting of a folded sheet, one-half of which carries the transfer coating, and the other half of which forms a detachable master sheet. This is done in order to avoid such smudging as may be due to unnecessary handling of the hectograph carbon during the typing or inscribing operation. While the handling is in fact minimized in this fashion, additional problems are introduced which make the master unit construction by itself somewhat less than a complete answer to the problem. It is found, for example, that interleaved protective sheets are required to prevent smudging of the master sheet surface by the adjacent transfer layer. The use of these interleaved sheets entails many handlings of the same at every stage in the process which is in itself undesirable. Furthermore, during any period when the interleaving sheet must be removed, for example during the preprinting of forms, a little of the dye material of the transfer coat migrates to the master sheet in response to moisture or chemicals found in the master sheet paper, or by attrition in response to the frictional contact therebetween; or certain oils commonly used in compounding the transfer material, are attracted to the surface of the master sheet and so affect



the same that its suitability for use in the hectograph process is impaired.

Other attempts have been made to correct this condition, or at least to moderate its effects by providing a transfer sheet which has a protective coating of some sort over the transfer layer in order to minimize both the direct mechanical smudging of the surface of the transfer sheet and contamination of the operator's hands due to moisture inspired dye migration. While these have been successful to a degree, in many cases the coating is such as to impair the color-releasing property of the transfer sheet to an undesirable degree, with the result that the purchaser often prefers to dispense with the protective coating and rely primarily on the care and patience of the operator in order to achieve clean masters capable at the same time of producing a full quota of copies.

It is an object of the invention, therefore, to provide a transfer sheet, especially for hectographic use, which is adequately protected against smudging, but which at the same time is capable of releasing its color during the transfer operation in such a way that the number or quality of copies obtainable from a master sheet will not be adversely affected.

One manner in which the color-releasing power of the transfer layer is often seriously affected by the presence of a protective overcoat has been discovered to be the partial commingling of the overcoating material with the material of the transfer layer at the interface. This action appears to result either from the dilution of the outermost portion of the transfer layer by the overcoating material, during its liquid stage while undergoing application, or the migration of the dye material from the outer portion of the transfer layer into the under portion of the overcoating layer by reason of the solvents used, or the inherent partial solvent characteristic of the material of the overcoating layer for the dye material of the transfer layer. This phenomenon occurs particularly when the overcoating material used includes a solvent which is a solvent for the dye of the transfer coat, or has a fusion temperature similar to or higher than the binder of the transfer coat. It appears that the effect is to form a relatively thick zone of low color concentration at a critical place in the combined coating so located that when transfer occurs the material of this zone is uncovered for use and becomes the working surface of the master image, whereby copies of unacceptably low color intensity result. Another object of the invention, therefore, is the production of a transfer sheet which can be made without the occurrence of such a low color intensity zone to any serious degree, and the devising of practicable methods for making the same.

In the past various materials have been used as the basis for protective overcoating layers, but waxes or coating compositions consisting for the most part of waxy material have proved particularly practical from several standpoints. For one thing, when a sufficient proportion of wax is used, the overcoating has the most desirable relationship as regards the combined qualities of adhesiveness to the surface of the master sheet, and a degree of frangibility which allows the image to come off readily and with a clean outline. Such a coating furthermore lacks the tendency to provide the barrier against transfer which is noticed with coatings consisting mainly of other materials, provides a consistency and texture which is most readily accommodated by the usual carbon paper coating, handling and surfacing equipment, and is generally more satisfactory except for its unfortunate dilution or commingling tendencies in relation to the usual wax-base transfer layer. The invention, therefore, has for another object the provision of a transfer sheet employing a protective overcoat consisting of layers essentially of waxy material, but wherein commingling between the transfer

layer and the overcoating material is largely inhibited, whereby the beneficial characteristics of a wax coat are taken advantage of, and its drawbacks avoided.

Still another object of this invention is the production of transfer sheets embodying the foregoing improvements in combination with the use in a protective coating of a shielding component of the type consisting of lamelliform particles suspended in the coating composition. This particular feature is disclosed in detail and claimed in my copending application Serial No. 59,120, filed November 9, 1948, now Patent No. 2,729,575.

The invention further includes the arrangements of the features and steps outlined above in various combinations particularly suited to any special use for which the transfer sheet is intended, or to the exigencies of its manufacture.

Additional features and advantages will hereinafter appear.

In the drawing:

Figure 1 is a fragmentary sectional view of a transfer sheet made in accordance with practices followed in the prior art.

Fig. 2 is a fragmentary section of a transfer sheet which has a protective coating in accordance with the present invention.

Fig. 3 is a perspective view of a master unit structure embodying one or more of the improved features and elements illustrated in Fig. 2.

The condition ordinarily achieved when a transfer sheet, such as hectograph carbon, is sought to be protected by an overcoat according to certain known procedures, is illustrated in Fig. 1. In this figure a foundation sheet **10** has had a coating of wax-base transfer material **11** applied thereto. Thereafter a coating **12** usually of wax is applied, normally by reducing the material to molten condition, spreading it on the surface of the transfer layer, and then cooling the same. The line A indicates the approximate level of the transfer layer **11** before application of the coating **12**, and the position at which the interface between the coatings would be expected to occur. However, it is found that the material of coating **12**, due to its temperature, softens the coating **11** and mixes therewith as shown in Fig. 1 with the result that the color concentration in the coating **11** is seriously reduced as far down as the position indicated approximately by the line B, the color being dispersed substantially an equal distance above the line A in the coating **12**. The effect of this condition is apparent when it is considered that the transfer layer will be largely removed to the master sheet in the locality where inscribing pressure is applied, and inverted thereon with the surface C, which is here shown as contiguous to the foundation **10**, exposed for use. It can be seen that the image thus formed consists of a thin initial layer of a thickness B—C which is of substantially full color concentration and capable of operating in an acceptable fashion, backed up by a layer equal to about twice the thickness A—B in which the color strength is severely diluted. This condition is particularly serious where the transfer sheet is being used in the hectographic reproduction process and intense coloring power is required of the master image in order that a substantial number of copies may be made therefrom, for all but the first thin layer B—C will be of inferior if not unacceptable color intensity thus seriously reducing the number of usable copies that can be taken from the image and thus limiting its useful life to a small part of the normal life of such an image.

This invention has been made to prevent the condition illustrated in Fig. 1, and one means for accomplishing this result is shown in Fig. 2 which illustrates an arrangement by which commingling of the coatings at the interface between the transfer coat and the protective overcoat is avoided.

Here the transfer coating of usual composition is designated by the character **41**. To the surface of this coating



is applied a barrier layer **43** having a film forming constituent which is rendered liquid by dissolving the same in a suitable volatile solvent. This solution is preferably applied to the transfer layer by spreading in the usual manner and by the ordinary equipment employed in carbon coating machines. For this reason, it is important that the solvent used be one which is ineffective against any soluble dye which may be used in the transfer layer **41**. Since these dyes are normally primarily water and alcohol soluble dyes such as crystal violet and methyl violet, carbon tetrachloride, solvent naphtha and trichlorethylene are examples of suitable solvents for this purpose. One form of the barrier coat **43** may include mainly wax or waxy material, and a certain amount of a synthetic resin, for example chlorinated rubber, as a toughening ingredient. It has also been discovered that a coating material of this character takes on unusual covering power and may be formed with a minimum thickness when a shielding component of lamelliform particles **44** such as powdered aluminum, bronze, or graphite, or ground mica or fish scales is included. The importance of such an ingredient and the manner of its operation is set out at length in my said copending application. One example of a solution which suggests in general the proportions suitable for casting this layer is as follows:

| Ingredients: | Parts by weight |
|---|---|
| Tornesit (chlorinated rubber-Hercules) | 1½ |
| Beeswax | 2½ |
| Carbon tetrachloride | 70 |

When a shielding component is desired, one part by weight of the ingredient, for example aluminum powder may be added to the foregoing formula.

While it has previously been attempted to use a single protective film embodying a proportion of synthetic resin as a smudge preventer for transfer sheets, this has been largely unsuccessful due to its failure to release the color properly when transfer is attempted when applied in a layer thick enough to be considered operative from the standpoint of protection. Here, however, the coating is so composed that its main constituent is wax and the thickness is reduced so that this coating is of itself only a partial smudge protector being not over .0001 inch in thickness. The reduced thickness is also important for the reason that the coating is most easily applied by spreading the same in dissolved condition. While the solvents used are not such as to have a liberating effect on the dye material of the transfer layer, a slight commingling effect between the waxy constituents of layers **41** and **43** may possibly occur. By holding the layer **43** to a nominal thickness, the active solvent present per unit area of the transfer layer **41** is minimized, whereby penetration of the dilution effects of the solvent applied layer **43** upon the transfer layer **41**, if they occur, extend to a depth which is purely nominal and in no way detrimental to the working surface of the image when pressure inspired separation at approximately the level B takes place. Once the solvent barrier layer **43** is in place and hardened by evaporation of the solvents, its character as a barrier may be further improved, if desired, by polishing the surface as by contact with a buffing wheel. This tends to dispose the surface particles of the flaky or lamelliform ingredient, when used, more nearly parallel to the foundation sheet with the result that the protective power of the coating **43** is further enhanced. Thereafter, a coat **42** of waxy material may be spread in any desired manner, and preferably by the convenient and usual method of melting the composition and applying the molten material directly to the surface of layer **43** in an extremely thin coating, of not more than .0002 inch in thickness. However, while the protective layer **42** is conveniently and inexpensively placed by melting and spreading, this results in no commingling of the wax with the transfer layer **41**, for the hardened barrier coat **43** which intervenes provides an insulating layer, and it is found that the period of time required to apply, spread and cool the

melted mixture is short enough that the softening effect will not be able to penetrate the barrier layer **43** when ordinary equipment and procedures are employed.

Although the reasons for the extremely beneficial results obtained when the transfer sheet is constructed as described in connection with Fig. 2 are not entirely understood, it appears that the waxy layer **42** acts somewhat as a primary armor for turning aside normal friction and abrasive attacks and combines with the armor formed by the surface of barrier layer **43** to prevent mechanical smudging as well as inhibiting any effects in the nature of migration of the dye or oils of the dye-bearing layer due to moisture or the proximity of any oil-receptive surface. It appears that the protective effect may be due in part to the presence of distinct surfaces in the overcoat, in which case the presence of a plurality of layers with well-defined interfaces between them is probably responsible at least in part for the protective effectiveness of the structure described. On the other hand, the adhesiveness of layer **42** for both the layer **43** and for the surface of the paper to which the image is applied is very high under the values of pressure normally used in transfer so that the color released to the image is found to be a substantial improvement over that which is released when a single, thick coating made substantially in accordance with the disclosure pertaining to coating, **43**, is used. In fact the color release value for the combination disclosed above is equal to or even greater than that for the usual transfer layer alone in the absence of any protective film. This procedure is so effective, in fact, that a thoroughly practical protection can be achieved, even without benefit of the particles **44**, when the combined thickness of the coatings **43** and **42** does not exceed .0002 inch. The fact that a useful protective covering of such restricted dimensions can be cast, is in itself a substantial contribution to the power of the sheet to release its color under pressure. Another aspect of the thickness of the protective coat is expressed by the statement that with average materials and papers of ordinary character, clear transfer of an image can not be expected when the combined thickness of the layers on the transfer sheet exceeds a certain determinable value which, using coating materials and papers ordinarily employed, is approximately .0011 inch. This relationship is one which can be readily determined empirically and its significance lies in the fact that the thinner a protective coating can be made and still operate effectively, the more room that remains for color bearing or transfer material.

Fig. 3 represents the invention embodied in the form of a master unit **60**. This unit comprises a paper sheet folded to form the portions **61** and **64**. The former serves as a detachable master while the latter acts as the transfer element. The unit **60**, due to the connection of the parts at fold **67**, can be placed in a typewriter, or otherwise prepared for inscription without unnecessary handling of the transfer sheet.

The portion **64** has on its inner surface a deposit **65** of transfer material which has been protected by the method described above. The protection thus afforded is sufficient to prevent smudging of the inner surface **63** of the master sheet, or the migration of coloring matter or oils thereto which would impair its operation as a master. The usual interleaving normally employed with such units is consequently unnecessary. As a result, inscription by printing, writing or typing on the surface **62** to form a reverse reading image on the master surface **63**, or on surface **66** when a direct reading image on surface **63** is desired, may proceed directly without the necessity for removing and replacing any separating sheet.

It will be seen, therefore, that this invention provides a transfer sheet having an effective protection against surface smudging either due to mechanical abrasive action or to moisture, or both, and which is an effective bar to migration of oils from the transfer layer to an adjacent oil-absorptive sheet, but which is at the same time so constructed that the character of the coloring matter deposited as an image in response to pressure is not impaired.

Variations and modifications may be made within the scope of this invention and portions of the improvements may be used without others.

I claim:

1. A pressure sensitive hectograph transfer element comprising a foundation sheet; a pressure or impact transferable dye-carrying coating thereon; an intermediate protective layer composed essentially of wax superposed and adhered on said coating at a well-defined interface; and a surface protective layer of waxy material superposed on said intermediate layer, the combined thickness of said layers being approximately .0002 inch, said transfer coating, intermediate and surface layers being adhesively attached to their respective contacting surfaces to form a composite layer and being frangible under inscribing pressure or impact to separate in image form from the foundation and surrounding composite layer and transfer to a copy medium, and said surface layer forming the adhesive to bond the image to the copy medium.

2. A pressure sensitive hectograph transfer element comprising a foundation sheet; a wax-base dye-carrying transfer coating thereon; an intermediate layer composed primarily of waxy material and including a shielding component of lamelliform particles superposed on said transfer coating; and a surface protective layer comprising essentially waxy material superposed on said intermediate layer, said transfer coating, intermediate layer and surface layer being adhesively attached to their respective contacting surfaces to form a composite layer and being frangible under inscribing pressure or impact to separate in image form from the foundation and surrounding composite layer and transfer to a copy medium, and said surface layer forming the adhesive to bond the image to the copy medium.

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