This invention relates to a dry transfer sheet of the type having a plurality of pigmented release film portions on one side of a supporting sheet with a film of pressure-sensitive adhesive material superposed on said release film. One characteristic of previous dry transfer sheets of this type is that the transferred letters have a glossy surface, appearance and texture, which is not always ideal for the intended application. Up to now there has been no effective way to adjust the surface characteristics of the letters (e.g., from one which is glossy to one which is more dull or matte). It is accordingly an important object of the present invention to provide a novel dry transfer sheet which makes possible the transfer of images having varied surface characteristics.

It is another important object of the present invention to provide a dry transfer sheet employing a pressure-sensitive adhesive material containing therein a solvent which is capable of penetrating through a release film interposed between it and a supporting sheet without dissolving the release film and which solvent is capable of chemically attacking the surface of the supporting sheet, as a result of which the texture of the surface of the image to be transferred is modified.

Further objects and advantages of the present invention will become more apparent upon reference to the ensuing description and claims, and drawings, wherein:

FIGURE 1 represents a fragmentary front elevation of the novel dry transfer sheet of the present invention looking at such sheet from the side opposite that containing the images to be transferred; and

FIGURE 2 illustrates a vertical section through lines 2-2 of FIGURE 1 greatly enlarged to show the discrete film portions forming the images on the dry transfer sheet.

The present invention may best be described by reference to the drawings. FIGURE 1 illustrates a typical form of a dry transfer sheet made in accordance with the present invention viewed from the side of the sheet opposite that on which the image to be
transferred is positioned. As illustrated therein, a plurality of discrete images 12 are positioned in spaced relation to one another on a backing of a supporting sheet 10.

These discrete images 12 take the form of upper and lower case letters of the alphabet, Arabic numerals and various symbols of punctuation and the like, though it will be obvious that the present invention would apply to any symbols taking the form of separate-discrete images. When viewing the discrete images from the side of the transfer sheet opposite that on which they are positioned (as in FIGURE 1), one sees such images as they are intended to appear on the final receiving surfaces after the transfer process. As will be readily apparent, such images appear in reverse form when looking at the sheet from the reverse side on which said images are positioned, as in the case with the type used in a conventional printing process.

Supporting sheet 10 must be fabricated from a light transmissive material which is capable of supporting discrete images 12. The preferred material for use as the supporting sheet is a polystyrene material. While polystyrene is highly preferred over all other materials of which applicant is aware, other light transmissive materials may be employed for use in supporting sheet 10, such as polyethylene and polyvinyl chloride materials.

As shown in the preferred embodiment of FIGURE 2, discrete images 12 each comprise two films, 14 and 16, which as shown are superposed and in registry with one another. Film 14 is comprised of a plurality of discrete film portions of a release agent which can be applied to one side of supporting sheet 10 by means of a silk screen process. Release film 14 is pigmented in the preferred embodiment of the present invention and as will be pointed out further below, preferably contains mica. Superposed on discrete release film portions 14 and in registry therewith is a film of pressure-sensitive adhesive material 16. Several conditions should exist so that the discrete images 12 may be transferred to a receiving surface by rubbing the side of supporting sheet 10 opposite that on which images 12 are positioned. In the first place, the pressure-sensitive adhesive material should be of such a nature that it is adherable to the receiving surface under ambient temperature conditions upon the rubbing of the side of the sheet opposite that on which the image is positioned. On the other hand, since it is necessary with respect to a sheet containing a
plurality of images 12 to be able to place the sheet against the receiving surface and move it across and in contact with such surface to permit the accurate location of selected ones of the discrete images in the desired position on the receiving surface without adhesion of the adhesive material to said surface, the adhesive material should be adherable to such receiving surface only by such rubbing (and not merely by being placed in contact with said other surface without such rubbing) to avoid the transfer of other images not desired to be transferred. In fact, so as to avoid undesired transfer of such images, the pressure necessary to transfer the images to the receiving surfaces should be an extremely highly localized pressure that such as that obtained by rubbing the supporting sheet with a stylus or other hard object, as distinguished from the type of pressure equivalent to light finger pressure.

Still further the materials of films 14 and 16 should be so selected that the adhesive affinity of the film 14 for the adhesive material 16 is greater than the adhesive affinity of the film 14 for the supporting sheet 10 and, furthermore, that the adhesive affinity of the adhesive material is for the receiving surface when rubbed as indicated above is greater than the adhesive affinity of the film 14 for the supporting sheet 10.

Images or symbols on dry transfer sheets will normally be glossy in their appearance. In accordance with the present invention, the texture of the surface of such images may be significantly modified by incorporating in the pressure-sensitive adhesive material 16 a solvent which is capable of penetrating through the release film 14 without dissolving it and which is also capable of chemically attacking the surface of supporting sheet 10. Thus the solvent will attack and eat away a portion of the surface of the supporting sheet 10 which is in contact with the release film 14 with the result being that such chemically attacked surface portion will be roughened. Because of this roughening when the proper pressure is applied to the back of the supporting sheet 10 as previously described, the surface of the release film 14 which had been in contact with the supporting sheet 10 will be correspondingly roughened and the result will be that the transferred image 12 will have a matte or dull appearance.

In addition to the foregoing, the material used to form the release film 14 should be substantially inert with respect to the material of supporting sheet 10 and should release therefrom in the manner described previously.
A well-known material which has been found to be preferred for use as the release film 14 is a nitrocellulose in a butyl cellosolve solvent.

Nitrocellulose is preferred for use in the release film 14 because of its high solubility in butyl cellosolve, the latter being a preferred solvent since it is inert to the polystyrene which is the preferred supporting sheet 10. This combination of materials also releases readily from polystyrene supports. Other materials can be employed but they are not as effective as the nitrocellulose in butyl cellosolve solvent combination since they tend to adhere to supports (such as those made of polystyrene) more than is desirable. In addition, while other solvents may be employed in release film 14, the butyl cellosolve is highly preferred.

A preferred coloring agent for incorporation in the release film 14 is a pigmented alkyd dispersion which is appropriately mixed with the nitrocellulose in the butyl cellosolve solvent.

To obtain particularly desirable results from the dry transfer sheets of the present invention, mica (preferably 10 microns in diameter) is incorporated in the release film 14. The mica gives body to the material used to form the release film so that it will print sharply and cleanly. A more important function served by the mica is that it definitely has an effect on the texture of the images transferred. More specifically, images transferred from a dry transfer sheet without mica incorporated in the release film 14 have a texture which is less matte or dull than those with mica included in such film.

It is also preferable to include in the release film 14 a plasticizer for the purpose of strengthening the film so that the images will not break during transfer. A preferred and extremely effective plasticizer is castor oil.

As previously indicated, the pressure-sensitive adhesive material 16 should contain a solvent which is capable of penetrating through the release film 14 without dissolving it and which is also capable of chemically attacking the surfaces of the supporting sheet 10.

The specific solvent which will be selected will vary within reasonable limits to suit the specific purposes desired.
A preferred solvent useful in the present invention is benzene.

A preferred material to provide the adhesive qualities of pressure-sensitive material 16 is polyvinylisobutylether.

As previously indicated, while various support sheets may be employed to prepare the dry transfer sheets of the present invention, polystyrene is preferred for a variety of reasons. In the first place, it is available in clear, transparent and rigid sheets, facilitating the positioning of the sheet on the receiving surface. Secondly, it is highly glossy, facilitating the removal of the images to be transferred by means of the solvent.

The particular texture of the images transferred from the dry transfer sheets of the present invention may be varied within wide limits through manipulation of the ingredients used to form the films 14 and 16. Merely by way of example, the greater the quantity of mica present in the film 14, the more matte or dull the resulting image in surface will be; reduction in the quantity of mica present in such film, will tend to detract from the matteness of such surface. A practical limitation on the upper quantity of mica which is used in the film 14 is created by the fact that too great a quantity of mica will cause sufficient enhancement of the release properties of such film that the images 12 may tend to fall off the supporting sheet 10 prematurely.

Similarly, the matte texture of the images 12 can be significantly influenced by the nature of the solvent employed in the adhesive film 16.

The proper quantities of the ingredients to be utilized in the formulations employed to prepare tile dry transfer sheets of the present invention can be readily determined in light of the foregoing considerations by those skilled in the art to achieve the desired purpose. Generally speaking, the release film 14 will be prepared by adding to a preliminary formed plasticized nitrocellulose formulation about 10-25% by weight (of such formulation) of a pigment dispersion and from 0-15% by weight of mica.

A typical formulation for use in preparing a black pigmented film 14 involves the preparation of a base formulation as follows:
RELEASE FILM 14

Ingredient: Parts by Weight

Nitrocellulose lacquer ................................................................. 100
Nitrocellulose ..................................................................................... 20
Butyl Cellosolve ............................................................................ 80
Castor oil (plasticizer) ................................................................. 10

To 10 to 20 parts by weight of the formulation prepared as described above, the following should be added:

Ingredient: Parts by Weight

10 Alkyd dispersion (containing black pigment) .......................... 4
2 Mica (approximately 10-20 microns in diameter) .................... 2

This material is applied to supporting sheet, such as one made of polystyrene, as previously indicated, by means of a silk screen technique to form discrete image portions of the black pigmented release film. After such film has dried, pressure-sensitive adhesive material is printed in registry with such discrete film portions also by means of a silk screen technique.

An appropriate pressure-sensitive adhesive formulation may be prepared in the following manner. The first step involves the preparation of a basic formulation as follows:

PRESSURE SENSITIVE ADHESIVE FILM 16

Ingredient: Parts by Weight

20 Benzene (aromatic hydrocarbon solvent) ................................. 25
5 Polyvinylisobutylether ............................................................... 5

In the embodiment described above (that of FIGURE 2) the pressure-sensitive adhesive film 16 was printed in registry with release film 14 so that the spaces between the resulting images 12 were left free of pressure-sensitive adhesive material. This embodiment is preferred since it makes possible the transfer of images to a receiving surface without the
presence of the bothersome shadow (penumbra) which accompanied prior art transfer techniques and sheets which are generally undesirable.
What is claimed is:

1. A dry transfer sheet comprising:
   (a) a supporting sheet;
   (b) a release film on one side of said supportingsheet, said film being in the form of a plurality of discrete portions spaced apart from one another; and
   (c) a film of pressure-sensitive adhesive material superposed on said release film.

2. A dry transfer sheet defined in claim 1 wherein said release film contains a pigmented alkyd dispersion.

3. A dry transfer sheet as defined in claim 2 wherein said release film contains mica.

4. A dry transfer sheet as defined in claim 3 wherein said supporting sheet is polystyrene.
ABSTRACT OF THE DISCLOSURE

A dry transfer sheet has a plurality of pigmented release film portions on one side of a light transmissive supporting sheet. A film of pressure-sensitive adhesive material is superposed on the release film. The adhesive film contains a solvent, such as benzene, which is capable of penetrating through the release film without dissolving it and attacking the surface of the supporting sheet.