PRESSURE-SENSITIVE RECORD SHEET MATERIAL

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2 Claims

ABSTRACT OF THE DISCLOSURE

A pressure-responsive record sheet material including a substrate sheet with a coating of pressure-releasable liquid droplets of marking material isolated by polymeric film material and releasable by marking pressures, wherein said droplets are protected from accidental release, as by scuffing and rolling pressures, by an over-sheet of thin, porous paper bonded adhesively to said coating.

The problem of smudging by the rough handling of transfer-receiving sheet combination forms in the art of pressure-sensitive microcapsule containing carbonless copy-paper is familiar to both the manufacturers and users of said forms. The subject art involves a coating which contains a multitude of liquid ink-containing microcapsules distributed in the coating over a surface of a substrate such as a paper sheet. Such a sheet is called a transfer sheet or a CB sheet, which latter designation indicates the sheet has a "coated back." In use the microcapsules are ruptured by writing or printing pressures, in the areas where a mark is desired, to yield the liquid ink for transfer to an underlying receiving sheet. The so-transferred ink may be already colored before release from the microcapsules or it may be substantially colorless, but chromogenic so that the transferred ink becomes distinctly colored by reaction with color-developing co-reactant material, present in a coating on the receiving sheet. Receiving sheets having a co-reactant coat are commonly called CF sheets, meaning that they have a "coated front."

Various pressure-buffering particulate materials known as still materials are often added to the CB coat formulation as an anti-smudging device to protect the microcapsules from accidental rupture on the paper surface. Such still materials as are known in the art include hard inert microbeads, cellulose fibers, particularly alpha-cellulose fibers, ungelatinized starch granules and other larger microcapsules which contain a non-marking liquid. When the ink-containing microcapsules are not intended to deliver their contents to a second, or receiving sheet, at the time of use, but rather are surrounded in the same sheet by co-reactant color-developing material, that is in a "self-contained" or "autogenous" sheet, said microcapsules are sometimes protected from accidental rupture by being nested down in the sheet among the paper fibers.

In this invention the microcapsules are coated onto a substrate sheet, together with added binder material if the wall material of the microcapsules is not itself adhesive when coated on the substrate, and then a second sheet, particularly a thin, porous paper sheet is adhesively bonded to the microcapsule coat so as to make a laminated transfer sheet having the microcapsule coat as the middle of three layers. The substrate sheet is preferably paper which is generally thicker than the protective over-sheet and is invariably less porous and liquid-transmitting than the protective over-sheet.

It has been found that liquid-cored microcapsules of the type used in the pressure-sensitive paper art, for instance the capsules of U.S. Patents Nos. 2,800,457; 2,800,458; 3,041,289; can efficiently and effectively squirt their contents, when ruptured by pressure, completely through an overlying bonded sheet onto a facing co-reactant receiving sheet. A sheet of tissue paper having a weight of about 11.5 pounds per ream of 500 sheets, measuring 25 x 38 inches, will generally have a thickness of about 45 microns. Even so, when such a sheet is used herein as the protective over-sheet, microcapsules of about 10 to 20 microns average diameter readily deliver their contents through the over-sheet to a receiving sheet. Tissue paper over-sheets which are considerably thinner than 45 microns may be used as the protective over-sheet for the before-mentioned 10 to 20 micron microcapsules. For instance, when a tissue, 23-microns thick, is substituted for the 45-micron over-sheet, discussed above, the 10 to 20-micron microcapsules are still essentially perfectly protected against accidental rupture from frictional forces and deliver their contents through the over-sheets to a receiving sheet surface as efficiently and effectively as do somewhat smaller microcapsules protected by commonly-used still materials. It has generally been found that a protective over-sheet which is up to about 5 times as thick as the average diameter of the protected capsules will still allow useful and effective amounts of released liquid to pass from the microcapsules to the receiving sheet. A protective over-sheet that is only one-half as thick as the protected capsules has been found to give satisfactory capsule protection for most uses. Thus, it can be seen that the protective over-sheet may be from about 1/2 to about 5 times the thickness of the average protected microcapsule diameter. For microcapsule-coated papers which are designed for general use, that is for writing, typing and printing, against receiving sheets of different smoothnesses and absorbencies, a protective over-sheet thickness of about 1 to 3 times the average protected microcapsule diameter is preferred.

The microcapsules in the CB sheet construction of this invention are better-protected against accidental rupture by scuffing and rolling pressures than are the microcapsules protected on a CB sheet by known methods. Therein lies the advantage of this invention: Substantial improvement in anti-smudge protection is achieved without significant loss in ink-transfer efficiency. As can be readily seen the selection of a very thin, porous over-sheet material will give maximum transfer efficiency in the practice of this invention. In all cases tried, it has been found that superior anti-smudge characteristics result from the practice of this invention whether the over-sheet is relatively thin or relatively thick. As before-mentioned, the over-sheet will generally be considerably thinner than the substrate sheet, generally of the order of no greater than about 50 percent the thickness of the substrate sheet. Optionally the substrate sheet may be non-porous, such as a plastic film material, or it can be pre-coated with a masking coat of latex or resinous material as a subcoat between the substrate surface and the microcapsule layer, so as to render said substate essentially impervious to the released liquid ink. An impervious substrate sheet has been found to contribute to the overall transfer efficiency of the CB sheets of this invention. If the base sheet is paper, it may of course be of any maximum weight and thickness, but generally a reasonable range for use for base paper weight is 10 to 100 pounds per defined ream. The protective over-sheet may be of any thickness in the range of 3 to 30 pounds per defined ream.

The pressure-sensitive transfer sheet of this invention may best be understood by reference to the drawings herein. FIG. 1, 21 is the capsule-protecting over-sheet of paper which is attached to the capsule layer, 22, with binder material such as common glue. The microcapsules of layer 22 contain oily liquid ink which in use is to be transferred through the over-sheet to the surface of an opposing receiving sheet for
viewing as indicia. The base sheet 23, also called the substrate sheet, carries the capsule layer adhesively bound to a surface thereof, with binder material such as cooked starch binder or gelatin glue.

When in use the pressure-sensitive laminated sheet of this invention is greatly used with 23 uppermost, as shown in FIG. 2, with the uncoated surface thereof presented for writing, typing or printing on. A receiving sheet 24, underlies the laminated sheet with a surface thereof opposing 21 in order to receive the pressure-expressed ink from layer 22. When the contained and later-released ink is colorless chromogenic ink, such as a liquid solution of crystal violet lactone (CVL), the receiving sheet is placed so that its color-developing (CF) surface is the surface that opposes 21. The liquid-ink inclusions, enclosed and isolated in layer 22 may be the core material of a multiplicity of microcapsules, or, as a fully equivalent structure for use in this invention, said inclusions may be distributed by a dispersed phase of a continuous emulsion film.

As a preferred practice, the microcapsules of this invention are gelatin or gelatin-gum arabic microcapsules, such as those described in the above references. When the aqueous manufacturing vehicles described in those references are also used as the coating vehicle, that is when the microcapsules are coated onto the substrate sheet without isolation from the manufacturing vehicle, there is commonly enough undeposited wall-material colloidal left in the vehicle to serve as binder material for the microcapsules. The deposited colloidal actually present as wall-material is also somewhat adhesive when it is in a wet state so that the microcapsules adhere to the substrate sheet. Furthermore, when a preferred protective over-sheet is applied to the microcapsule layer while said microcapsules are still wet, the microcapsule wall material together with the before-mentioned undeposited colloidal will serve as the binder material to hold the over-sheet adhesively bound to the microcapsules. In the preferred practice no additional binder material, such as cooked starch binder, is added to either the microcapsule coating slurry or to the over-sheet at the time of its application to the microcapsule layer.

The liquid ink of this invention is an oil-base ink such as the above-disclosed solution of CVL. Any of the many known colored and colorless oil-base inks may be used so long as they are not too viscous for transfer through the over-sheet to the receiving sheet. Inks having a viscosity no greater than about 250 Saybolt Universal seconds at 100°F. have been found satisfactory. A useful ink may be made by dissolving CVL (1.5 percent by weight) and benzyl leuco methylene blue (1.25 percent by weight) in a mixed solvent which is made up of 2 parts by weight of chlorinated biphenyl (42 percent chlorine content) and 1 part by weight of refined paraffin oil, distilled over a collection point temperature range of about 370 to 500 degrees Fahrenheit. The above-described ink wherein isopropylbiphenyl is substituted for the chlorinated biphenyl is preferred. The manufacture and use of chromogenic inks having isopropylbiphenyl-paraffin oil vehicles is disclosed and claimed in U.S. Pat. No. 3,627,581 which issued Dec. 14, 1971 on application of Paul S. Phillips, Jr.

Typical results obtained by the practice of this invention are shown below for a laminated sheet of this invention, having a paper substrate sheet of 32.4 pounds per defined ream, a microcapsule layer of 3.3 pounds per defined ream wherein the capsules have a diameter range of 5 to 25 microns and were of the kind disclosed in Example I of U.S. Pat. No. 3,533,958 which issued Oct. 13, 1970 on application of Isidore L. Yurkowitz and a lightweight paper over-sheet of 5.8 pounds per defined ream.

In the above table FS is "frictional smudge," CI is "calender intensity" and TI is "typewriter intensity." These values are indices, defined as follows:

100× (Optical reflectance of imaged or smudged area)

(4) Optical reflectance of neighboring background)

A value of 100 for any of the above parameters indicates the imaged (or smudged) area to be indistinguishable from the background. A perfect FS value is therefore 100. Calender and typewriter intensities are arbitrary imaging and a low value is therefore desirable: the lower the value, the more intense the print.

What is claimed is:

1. Pressure-responsive record sheet material comprising a base sheet having bound to its surface a layer of pressure-rupturable microcapsules enclosing liquid inclusions of an oily marking substance having a viscosity no greater than 250 Saybolt Universal seconds at 100°F. and having adhesively bound to, overlying and protecting the layer of microcapsules a thin porous paper web of a thickness less than that of the base sheet and about 1/2 to 5 times the average diameter of said microcapsules and weighing in the range of about 3 pounds to about 30 pounds per ream, said base sheet being impervious to the oily marking substance.

2. The record sheet material of claim 1 wherein said base sheet is paper weighing in the range of about 10 pounds to about 100 pounds per ream.

References Cited

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