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J. G. J. PIRON

3,728,210

DRY TRANSFER

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FIG. 1

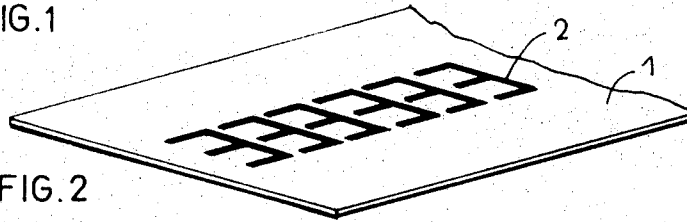


FIG. 2

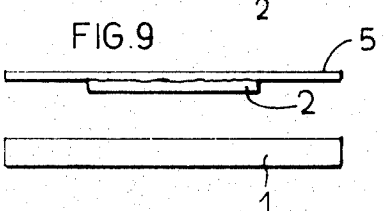
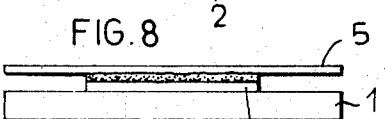
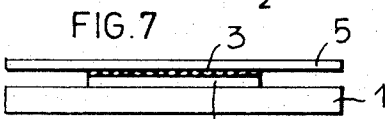
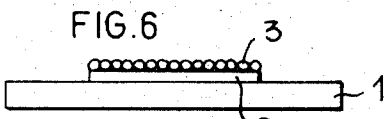
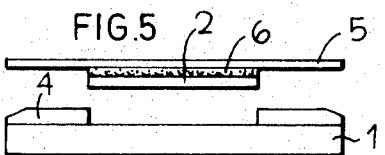
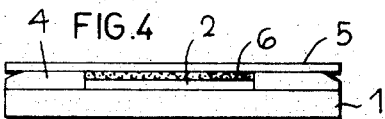
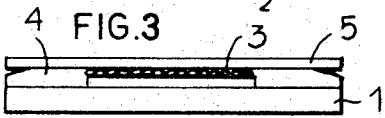
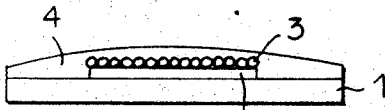


FIG. 10

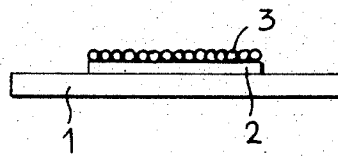


FIG. 11

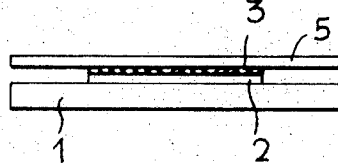


FIG. 12

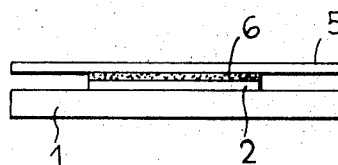
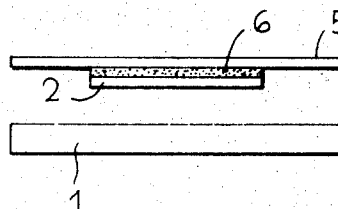


FIG. 13



1

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DRY TRANSFER

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32,716/69

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U.S. Cl. 161—162

20 Claims

ABSTRACT OF THE DISCLOSURE

The invention relates to a dry transfer comprising a temporary support with printed ink signs and means for causing any selected ink sign to adhere to a receptor sheet under a sufficient pressure, so that said ink sign remains adhered to said receptor sheet when the temporary support is peeled away. Said means consist in layer of microcapsules retained on the free surface of each ink sign and containing a core material which will cause adhesion of ink sign to receptor sheet upon bursting of the microcapsules by liberating either a material reactivating a reactivatable adhesive applied on the ink sign, or a material which renders the receptor sheet temporarily tacky, or an adhesive material.

BACKGROUND OF THE INVENTION

The invention relates to dry transfers.

Dry transfers are commonly made of a temporary support carrying transferable ink signs or indicia and a layer of either pressure-sensitive or reactivatable adhesive covering at least the areas of the ink signs. In fact, it is necessary that the adhesive overlaps the areas of the ink signs since a perfect registry of adhesive and ink signs, more particularly for ink signs of very little size, is almost impracticable. In view of this difficulty, when adhesive and ink sign are applied using the same stencil, both printings often do not register with one another so that the adhesive may leave uncovered a part of the edge of the ink sign. Accordingly, in order that the adhesive may cover the whole surface of the ink sign, it is generally necessary to apply the adhesive with a stencil of greater size than that used for applying the ink, so that the adhesive overlaps all edges of the ink sign.

The overlapping adhesive often may be transferred together with the ink sign or its shearing may be difficult to effect along the edges of the ink sign, so that these edges may be damaged.

When the adhesive is of the pressure-sensitive type, its lack of cohesion, resulting from its permanently pasty condition, does not produce solid bonds between the ink sign and a receptor surface onto which the ink sign is transferred.

When the adhesive is of the reactivatable type, it should be wetted by means of a solvent before being applied onto a receptor surface. Although this type of adhesive generally gives a very good adhesion of ink to receptor surface, these transfers are however very seldom used in view of the disadvantages inherent to their use. It is dangerous for the user to handle solvents used for reactivating the adhesive either because of their toxicity, or because of their very low boiling point and fire hazards. Moreover, it is almost impracticable to measure exactly the amount of solvent to be applied to reactivate the adhesive. It is further-

2

more unfeasable to limit deposition of solvent exactly to the surface of the ink sign and the solvent flowing out of the ink sign also reactivates the overlapping adhesive so that, at the moment of transfer, the overlapping adhesive is often transferred to the receptor surface.

This invention has for its object to cope with the above described difficulties.

SUMMARY OF THE INVENTION

For this purpose, there is provided according to this invention, a dry transfer comprising a temporary support carrying ink signs or indicia which adhere weakly thereto, each ink sign having on its free surface a plurality of microcapsules which adhere to the ink sign, said microcapsules having a wall inert with respect to the solvents of said ink signs and also inert with respect to the content of said microcapsules, said microcapsules containing a core material which causes the ink signs to adhere to a receptor surface when the microcapsules are caused to burst in contact with said receptor surface, said microcapsules being resistant to a light finger pressure, said core material being unable to dissolve the ink film and the temporary support.

The invention also relates to a process for making a dry transfer which comprises applying onto a temporary support ink signs or indicia, whereby the materials of support and ink signs are selected so that their adhesion to one another is weak, waiting until the ink signs are tacky enough to retain microcapsules and then applying said microcapsules, the thickness of the ink signs and the diameter of the microcapsules being selected in such a way that the microcapsules are embedded in the ink signs up to a depth of from 1/2 to 1/3 of their diameter, allowing the ink signs to harden and, if the microcapsules contain a reactivating material adapted to act on a reactivatable adhesive, applying said reactivatable adhesive onto said ink signs and microcapsules.

DETAILED DESCRIPTION OF THE INVENTION

Preferably, the temporary support is a translucent material having a surface tension below 39 dynes/cm. Non-limiting examples of such materials, which may be used according to this invention, include polystyrene, polyethylene, tetrafluorethylene, polyvinyl chloride, polypropylene, polyethylene, terephthalate, styrene-butadiene copolymers. These support materials may be either used as self-supporting films or applied onto a surface of paper. There may also be used transparent papers coated with a silicone resin, wax, or chromium complexes of fatty acids called "Werner complexes," or the like.

As in known dry transfers, the ink is made of polymer material containing plasticizers and, in order to colour the ink, pigments are mixed therewith. The ink material is applied as a solution in organic solvents which may not be solvents of the temporary support. Accordingly, support and ink are made of different polymers. In addition, the strength of linear adhesivity of the ink signs to the support will preferably be less than 40 g./cm., which means that the ink will adhere weakly to the temporary support. Such weak adhesion will be obtained by eliminating as far as possible physico-chemical bonds of polar nature or hydrogen bonds between ink and support materials.

The following table gives for each indicated temporary support a suitable ink.

3
TABLE

Temporary support:

	Ink
Polystyrene -----	Nitrocellulose plasticized by means of a polymer plasticizer — polyvinylbutyral plasticized by means of dimethylcyclohexyl adipate. 5
Polyethylene -----	Ethylcellulose plasticized by means of dioctylphthalate — polyvinylbutyral plasticized by means of methyl abietate. 10
Silicone paper -----	Chlorinated rubber plasticized by means of tricresylphosphate — nitrocellulose plasticized by means of diamylphthalate; glycerophthalic resin plasticized by means of polyvinylether. 15
Tetrafluorethylene ----	Ethylcellulose plasticized by means of dibutylphthalate — polyvinylbutyral plasticized by means of tributylphosphate. 20

The ink plasticizer has two purposes. As known, it gives to the ink film a sufficient elasticity to avoid rupture of the ink film during a transfer operation. It contributes to increase the adhesion when the ink film is still wet and provides accordingly for a better adhesion of microcapsules to ink signs. 30

The ink is applied onto the temporary support according to a process suitable for obtaining a thickness of at least 8 microns, e.g. the silk screen process. After application, the viscosity of the ink increases. The increase of viscosity, due to the evaporation of the solvents, is shown by the occurrence of a superficial adhesive or tacky effect which tends to disappear when the major part of the solvents is evaporated. It has been noticed that the superficial adhesive or tacky effect appears when 30% of the solvents are evaporated and that such effect remains until 70% of the solvents are evaporated. Between both limits it has been found easy to make microcapsules to adhere to the ink film, the resistance to the penetration of the ink film being sufficient but not too much for enabling the microcapsules to sink in the ink film up to a depth of from $\frac{1}{2}$ to $\frac{1}{3}$ of their diameter. In view of the fact that only the free surfaces of ink signs are tacky, the microcapsules will be retained only on said surfaces, independently of the fact that the microcapsules are thrown onto the entire surface of the temporary support, by projection, sprinkling or by means of a gilding apparatus. 40

The microencapsulation technique of fluids, liquids and adhesives is known and is disclosed in patents and other publications. 45

According to this invention, and as stated above, the walls of microcapsules are made of a material which remains impervious to the organic solvents of the ink. Typical materials are gelatin or complexes of gelatin with other polymer materials such as gum-arabic. 50

As stated above, the walls of the microcapsules are made for cracking under a pressure above 100 g./mm.². The diameter of the microcapsules varies between 3 and 50 microns. 55

The adhesion strength which will be developed between the ink sign and the receptor surface, when the ink sign will be transferred, will depend not only on the adhesive or the material producing adhesion, contained in the microcapsules, but also on the nature of receptor surface. 60

In this respect, the nature of encapsulated material making up the core of each microcapsule will be selected depending on the nature of receptor surface, taking into 65

4

account that said core may dissolve neither the ink film nor the temporary support of the dry transfer.

Materials of receptor surface may be approximately classified in three groups:

(1) Porous receptor materials such as paper, wood, plaster, leather, etc.

(2) Non-porous receptor materials such as glass, metals, bakelite, etc.

(3) Receptor materials which may become tacky when treated by a solvent, such as polystyrene which is rendered tacky by toluene, or polyethylmethacrylate which is rendered tacky by acetone.

For receptor materials of the first group or when the receptor material is not known at the moment of making the dry transfer ink signs and microcapsules are preferably covered with a reactivatable adhesive and the microcapsules contain a core or encapsulated material capable of reactivating said reactivatable adhesive when brought into contact therewith upon bursting of the microcapsules. For instance, said reactivatable adhesive may be selected among adhesives based on neoprene, polyisobutylene, ethylcellulose, and said reactivating material contained in the microcapsules may be selected among xylene, toluene, perchlorethylene, butyl acetate and their mixtures. Said reactivatable adhesive may also be selected among the adhesives based on nitrocellulose and cellulose acetobutyrate, in which instance said reactivating material preferably is butylacetate.

In the embodiment of the invention which uses a reactivatable adhesive, the latter is applied after the microcapsules are fixed to the ink signs and after drying of the latter. The adhesive is applied as a solution which, after evaporation of its solvent, forms a layer covering at least the areas of ink signs, and preferably overlaps the ink signs. For applying the adhesive, one may apply a silk-screen process or use a coating apparatus, as known. 60

In order that the adhesive, after drying, may be well reactivated by the reactivating material encapsulated in the microcapsules, the ratio of solvent volume to volume of adhesive deposited on each ink sign is to be adjusted taking into account that a too little volume of solvent will be ineffective to reactivate the upper surface of adhesive which is to come into contact with a receptor surface, whereas a too great volume of solvent will dissolve too much of the adhesive and give a too weak adhesion so that it will not be practicable to separate immediately the ink signs from the temporary support. 65

A good reactivation of adhesive will be obtained giving an almost immediate transfer result when the ratio of the diameter of the microcapsules to the thickness of layer of said reactivatable adhesive is from 20/100 to 60/100, the content of said microcapsules making up about 90% of the volume of said microcapsules.

Dry transfers according to said first embodiment of the invention are used as follows. The dry transfer is deposited with its dry adhesive surface in contact with a receptor surface. In the area of each to be transferred ink sign, there is applied a pressure of at least 100 g./mm.² using a hard tool. Under said pressure in said area, the walls of the microcapsules are ruptured so that the microcapsules burst and liberate their content which propagates into the adjacent adhesive layer activating only the adhesive in contact with the ink sign so that the ink sign is adhered to said receptor surface and can be separated, accordingly transferred, from the temporary support. After transfer of the sign, the materials which reactivated the adhesive, evaporate and the adhesive gets its maximum hardness and adhesion, so that ink and receptor surface are bonded to one another. 70

With dry transfers of this kind, the overlapping adhesive is not likely to be transferred because the microcapsules cover only the ink signs and will not reactivate the overlapping adhesive. In addition, the adhesive is easily sheared along the edges of the ink sign because of the difference of physical conditions between adhesive 75

5

covering the ink sign and overlapping adhesive, the one being temporarily pasty and the other being hard.

In a second embodiment of this invention, the ink signs are to be applied onto a receptor surface which can be rendered temporarily tacky and the microcapsules contain a liquid core material which, when brought into contact with said receptor surface upon bursting of the microcapsules, renders said receptor surface temporarily tacky so that the ink signs are caused to adhere to said receptor surface and that their adhesion to said receptor surface is strong enough after hardening of said receptor surface to make that the ink signs remain adhering to said receptor surface upon peeling of the temporary support. For example the ink signs are made of a nitrocellulose or glycerophthalic resin ink to be applied onto a receptor surface of polystyrene, and the microcapsules contain an aromatic solvent such as toluene, xylene.

In a third embodiment of this invention, the microcapsules contain an adhesive material, which makes that, upon bursting of the microcapsules in contact with a receptor surface, the ink signs are adhered to said receptor surface and remain adhered thereto upon peeling of the temporary support. In this instance, the adhesive may be provided either as a solution, for example neoprene in toluene, a mixture of ethylcellulose and chlorinated polyphenyl in toluene and butylacetate, or as a hardenable liquid which will harden in contact with a hardener upon bursting of the microcapsules, for example a polysulfide adhesive which may be hardened by a lead dioxide. When the microcapsules contain a hardenable or curable adhesive, the hardener may be located either in the outer side of the walls of the microcapsules, or in other microcapsules carried by the ink sign's free surface.

The invention will now be described with reference to the accompanying drawings wherein:

FIG. 1 is a perspective view of a dry transfer according to this invention;

FIGS. 2-5 are enlarged cross-sectional views showing schematically the various steps of a transfer operation using a first embodiment of this invention;

FIGS. 6-9 are enlarged cross-sectional views showing schematically the various steps of a transfer operation using a second embodiment of this invention; and

FIGS. 10-13 are enlarged cross-sectional views showing schematically the various steps of a transfer operation using a third embodiment of this invention.

In these drawings, similar reference numerals designate similar parts.

A dry transfer according to this invention comprises a temporary support 1 having printed thereon weakly adhering ink signs or indicia 2. Each sign 2 carries a layer of microcapsules 3 which are retained and partly embedded on the free surface of the ink sign.

In the first embodiment, shown in FIGS. 2-5, the microcapsules 3 contain a core of reactivating material (not shown), whereas at least the areas of ink signs and microcapsules are covered with a layer of reactivatable adhesive 4.

When the transfer is brought with the ink sign 2 into contact with a receptor sheet 5, a pressure being applied in the area of the ink sign, the microcapsules are compressed together with the superimposed adhesive located in the area between the ink sign and the receptor surface, as shown in FIG. 3. When the pressure in the area of the ink sign exceeds 100 g./mm.², the microcapsules burst as shown in FIG. 4 so that the reactivating material is liberated and reactivates the adhesive in said area, without reactivating the adhesive outside said area. As a result thereof the ink sign 2 is adhered to the receptor sheet 5 through an intermediate reactivated adhesive layer 6. Upon peeling of the temporary support 1, the adhesive 4 is easily sheared along the edges of the ink sign 2 and the latter remains adhering to the receptor

6

sheet 5, whereas the temporary support is separated therefrom.

In the second embodiment shown in FIGS. 6-9, the microcapsules 3 contain a core of solvent (not shown). Such dry transfer is adapted for cooperating with a receptor sheet 5 the surface of which can be rendered tacky by said solvent. When the transfer is brought, with the ink sign 2, into contact with the receptor sheet 5, a pressure being applied in the area of the ink sign, the microcapsules are compressed between the ink sign and the receptor surface, as shown in FIG. 7. When the pressure in the area of the ink sign exceeds 100 g./mm.², the microcapsules burst as shown in FIG. 8, so that the solvent is liberated and causes the surface of the receptor sheet 5 to become tacky only in the area of the ink sign. In said area, the ink sign is caused to adhere without intermediate adhesive layer, and as soon as the solvent is evaporated, the bond between receptor sheet and ink sign becomes strong enough to allow the temporary support 1 to be peeled-away without detaching the ink sign 2 from the receptor sheet 5.

In the third embodiment shown in FIGS. 10-13, the microcapsules 3 contain or encapsulate a core of adhesive material (not shown). When the transfer is brought, with the ink sign 2, into contact with the receptor sheet 5, a pressure being applied in the area of the ink sign, the microcapsules are compressed between the ink sign and the receptor surface, as shown in FIG. 11. When the pressure in the area of the ink sign exceeds 100 g./mm.², the microcapsules burst as shown in FIG. 12, so that the adhesive is liberated only in the area of the ink sign. In said area, the ink sign is caused to adhere, through an intermediate adhesive layer 6 and as soon as the adhesive 6 has hardened or cured, the bond between receptor sheet and ink sign becomes strong enough to allow the temporary support 1 to be peeled-away without detaching the ink sign from the receptor sheet 5.

This invention is now further described with reference to the following examples.

EXAMPLE 1

A dry transfer according to the first embodiment illustrated in FIGS. 2 to 5, is made using as a temporary support a sheet of polyethylene.

Onto one face of said support, ink signs or indicia are printed.

The ink for the ink signs has the following composition:

	Parts
Nitrocellulose ½ second	100
Carbon black	18
Ethylglycol	130
Isopropylglycol	40
Methyl abietate	80

When the ink of the ink signs is still tacky, microcapsules are projected onto the surface of the transfer carrying said ink signs and the microcapsules are retained only on the tacky surfaces of the ink signs.

The microcapsules have a diameter of about 20 microns and 85% of their volume consist in a liquid core of toluene.

At least onto the ink signs, there is applied, after drying of the ink signs, a layer of a reactivatable adhesive having the following composition:

	Parts
Neoprene AD 20	100
Magnesium oxide	8
Zinc oxide	5
Antioxidizing agent	2
Phenolic resin	45
Toluene	300
Cyclohexane	160

so as to form a layer of about 40 microns.

7 EXAMPLE 2

The method of Example 1 is followed, using as a temporary support a piece of paper treated with silicone resin.

The ink used for the ink signs has the following composition:

	Parts
Glycerophthalic resin with 55% of linseed oil	100
White spirit	190
6% cobalt naphthenate in white spirit	0.9
24% lead naphthenate in white spirit	1.4
6% manganese naphthenate in white spirit	0.6
Carbon black	18
Polyvinylethylether	20

The microcapsules have a diameter of about 25 microns and 80% of their volume consist in a liquid core of toluene.

The reactivable adhesive has the following composition:

	Parts
Ethylcellulose having 49% ethoxy groups	100
Polychlorinated polyphenyl resin	80
Toluene	300
Butylacetate	100
Diamyl phthalate	20

The adhesive forms a layer of 55 microns.

EXAMPLE 3

A dry transfer according to the second embodiment, illustrated in FIGS. 6-9, is made according to the method of Example 1 for applying the ink signs onto the support and the microcapsules onto the ink signs.

The temporary support and the ink signs have the same compositions as in Example 2.

The same microcapsules as in Example 1 are used.

No adhesive is applied onto the ink signs. One obtains a dry transfer for use with receptor sheets of polystyrene, the adhesion of the ink signs to the latter being provided simply by the action of toluene on polystyrene when the microcapsules burst under compression in contact therewith.

EXAMPLE 4

A dry transfer according to the third embodiment, is made by applying the ink sign onto a support and applying microcapsules onto the ink signs in the way described in Example 1.

The support is a polystyrene sheet.

The ink has the following composition:

	Parts
Polyvinylbutyral	100
Ethylglycol	40
Diacetone alcohol	20
Isopropylglycol	13
Carbon black	15
Diocetyl sebacate	15

The microcapsules contain a liquid adhesive core of the following composition:

	Parts
Polysulfide, average molecular weight 4000	100
Phenolic resin	5
Titanium dioxide	10
Calcium carbonate	25

the walls of the microcapsules have on their outer side a lead dioxide hardener adapted for reacting with the liquid adhesive core of the microcapsules to harden or cure said adhesive, such as in French Pat. No. 1,522,310.

EXAMPLE 5

A dry transfer according to the third embodiment is also made by applying the ink signs onto a support and applying microcapsules onto the ink signs in the way described in Example 1.

8

The support and ink signs are as in Example 2.

The microcapsules contain a liquid adhesive core of the following composition:

	Parts
Ethylcellulose having 49% ethoxy groups	100
Polychlorinated polyphenyl resin	80
Diamylphthalate	20
Toluene	700
Butylacetate	200

In this instance, no hardener is necessary and the adhesive hardens upon evaporation of its solvents after bursting of the microcapsules.

With regard to the dry transfers of Examples 3 to 5, it takes a somewhat longer time for obtaining a sufficient adhesion between transferred ink sign and receptor surface before the temporary support can be peeled away without tearing the ink sign away from the receptor sheet. The bond between ink sign and receptor surface is otherwise strong.

What I claim is:

1. A dry transfer comprising a temporary support carrying ink indicia which adhere weakly thereto, each ink indicia having on its free exposed surface a plurality of microcapsules which adhere to the ink indicia, said microcapsules having a wall inert with respect to the solvents used in making said ink indicia and also inert with respect to the core material contained in said microcapsules, said core material causing the ink indicia to adhere to a receptor surface when the microcapsules are ruptured in contact with said receptor surface, said microcapsules being resistant to a light finger pressure, said core material being unable to dissolve the ink indicia and the temporary support.

2. A dry transfer according to claim 1, wherein the temporary support is made of a translucent material having a surface tension below 39 dynes/cm.

3. A dry transfer according to claim 2, in which the temporary support is polystyrene, polyethylene, tetrafluorethylene, polyvinyl chloride, polypropylene, polyethylene terephthalate, styrene-butadiene copolymers, papers coated with a silicone resin, papers coated with a wax or papers coated with chromium complexes of fatty acids called "Werner complexes."

4. A dry transfer according to claim 1, in which the strength of linear adhesivity of the ink indicia to the temporary support is less than 40 g./cm.

5. A dry transfer according to claim 1, in which the microcapsules have a wall made of a material selected from the group consisting of gelatin or a complex of gelatin with gum arabic and the content of the core material of the microcapsules makes up from 80-90% of the volume of the microcapsules.

6. A dry transfer according to claim 1, in which the microcapsules rupture under a pressure above 100 g./mm.².

7. A dry transfer according to claim 1, in which the microcapsules have a diameter between 3 and 50 microns.

8. A dry transfer according to claim 1, in which the ink indicia and microcapsules are covered with a reactivable adhesive and the microcapsules contain a core material capable of reactivating said reactivable adhesive when brought into contact therewith upon rupturing of the microcapsules.

9. A dry transfer according to claim 8, in which said reactivable adhesive is selected from the group consisting of adhesives based on neoprene, polyisobutylene, and ethylcellulose and said reactivating material contained in the microcapsules is selected from the group consisting of xylene, toluene, perchlorethylene, butyl acetate and mixtures thereof.

10. A dry transfer according to claim 8, in which said reactivable adhesive is selected from the group consisting of adhesives based on nitrocellulose and cellulose acetobutyrate, and said reactivating material contained in the microcapsules is butylacetate.

9

11. A dry transfer according to claim 8, in which the ratio of the diameter of the microcapsules to the thickness of layer of said reactivatable adhesive is from 20/100 to 60/100, the content of said microcapsules making up about 90% of the volume of said microcapsules.

12. A dry transfer according to claim 1, in which the ink indicia are to be applied onto a receptor surface which can be rendered temporarily tacky and the microcapsules contain a liquid core material which, when brought into contact with said receptor surface upon rupturing of the microcapsules, renders said receptor surface temporarily tacky so that the ink indicia are caused to adhere to said receptor surface and that their adhesion to said receptor surface is strong enough after hardening of said receptor surface to ensure that the ink indicia remain adhered to said receptor surface upon peeling of the temporary support.

13. A dry transfer according to claim 12, in which the ink indicia are made of a nitrocellulose or glycerophthalic resin ink to be applied onto a receptor surface of polystyrene, and the microcapsules contain an aromatic solvent such as toluene or xylene.

14. A dry transfer according to claim 1, in which the microcapsules contain an adhesive material, which ensures that, upon rupture of the microcapsules in contact with a receptor surface, the ink indicia are adhered to said receptor surface and remain adhered thereto upon peeling of the temporary support.

15. A dry transfer according to claim 14, in which the adhesive is dissolved in a solvent.

16. A dry transfer according to claim 15, in which the adhesive comprises neoprene dissolved in toluene.

17. A dry transfer according to claim 15, in which the

10

adhesive comprises a mixture of ethylcellulose and chlorinated polyphenyl resin dissolved in a mixture of toluene and butylacetate.

18. A dry transfer according to claim 14, in which the adhesive is a hardenable liquid which may harden or cure in contact with a hardener or curing agent released upon rupture of the microcapsules.

19. A dry transfer according to claim 18, in which the hardener or curing agent is located on the outer side of the walls of the microcapsules.

20. A dry transfer according to claim 18, in which the hardener or curing agent is located in other microcapsules carried on the free exposed surface of the ink indicia.

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161—164, 188, 406, 413, Dig. 1