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(54) Security paper

(57) Security paper 3 for documents etc. protected against forgery is provided with crushable micro-capsules 6 containing a high boiling, colorless solvent which is not readily volatilized. The solvent solubilizes erasable or non-erasable ball-point pen ink 2 and commercial erasers. The micro-capsules 6 burst when the security paper is written on with a ball-point pen. When erasure is attempted the eraser is solubilized and a smear 7 containing ink and/or eraser material forms over the entire erasure area. Chance folding does not cause smears to form due to the colorlessness of the solvent and the lack of a second reactant. The solvent may be an alcohol, ketone, or ester, e.g. toluene or dimethyl phthalate.

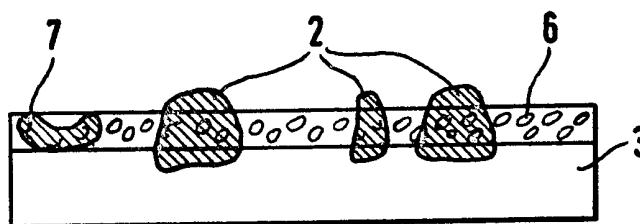


FIG. 3

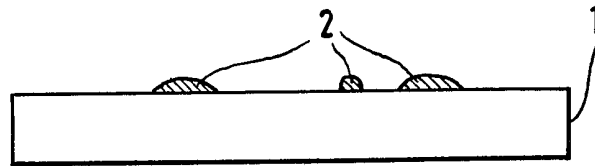


FIG. 1

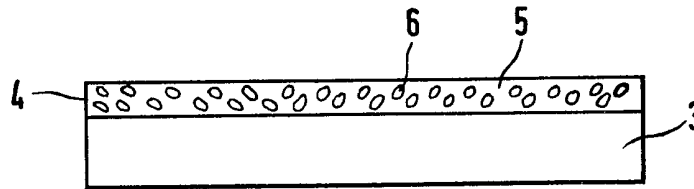


FIG. 2

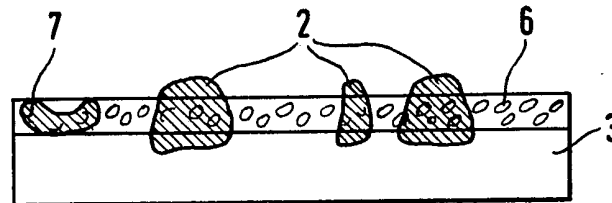


FIG. 3

## SPECIFICATION

**Security paper**

5 The invention relates to security paper having protection against forgery of items entered thereon for use for documentation and the like.

10 In the international payments system security paper, on which items must be entered, is used in great quantities. Such items can include the value to be given to the paper, the name of the issuer or the payer and/or the name of the authorized recipient and so on.

15 In order to rule out damage by abuse of this security paper it is of greatest importance that the entry of such items be not subject to subsequent change.

20 It has thus been known for some time that security paper can be protected against attempted forgery by chemical means. These means of protection are aimed at preventing changes of the items entered or at least making such changes evident.

25 Thus reagents are known which yield color reactions or form blotches when attacked by acids, leaches, bleaches, solvents and other chemicals. The blotches of color that arise show that an attempt at forgery has taken place.

30 Protection against forgery by mechanical means like erasers, penknives, razor blades, can of course not be achieved by chemical means alone. In particular erasure cannot be prevented or made obvious by reagents which are added to or printed upon the paper.

35 Generally, the printer of this type of security paper takes pains to obstruct attempted forgery by means of a complicated design on the background of the paper. The forger then does not only destroy the items entered, but also the printed background. It is also known to produce paper for such purposes with a loose fiber structure (DE-PS 497178). In this way even the most careful erasure attempt shows clearly that paper fibers have been rubbed off, so that the background printing is destroyed relatively quickly. In addition, the change can also be recognized in the paper structure itself with the help of a magnifying glass or a microscope.

40 The known means of protection against mechanical erasure, however, are not yet satisfactory. It must, for example, be expected that the destroyed background printing of security paper can be repaired to some extent by careful drawing by hand. The disturbance in the structure of the sheet cannot be readily recognized and often escapes notice in daily intercourse.

45 For some time there have thus been attempts to provide security paper with genuine active protection against mechanical erasure attempts. Austrian Patent Specification No. 147,178; for example, describes security pa-

per containing at least two chemical components which are separated from each other by a layer which can be easily injured mechanically. This intermediate layer is destroyed by mechanical erasure attempts, and the resulting color reaction reveals the attack of the forger. But security paper protected in this way was not a success in practice because the intermediate layer is also destroyed by the stress which this sort of security paper is subject to in normal circulation.

70 The basic idea of this protection technique was developed in a substantially better form in the published specification of German Patent Application P 29 51 486.1. In order to separate the reaction partners at least one of the reaction partners was micro-encapsuled and then the color reaction partners prepared in this way were added during the preparation of the paper in patterns covering only part of the surface. When written on the micro-capsules underneath the writing burst; the subsequent color reaction causes the writing to appear a second time inside the paper. The "inner" writing can, of course, not be inconspicuously erased. The disadvantage with this and other similar methods of protecting security paper by means of micro-encapsuled color reaction partners is the fact that undesirable coloring can occur as a result of bending and comparable influences.

85 US-PS 36 77 887 discloses another method of protecting the entry of items on security paper from being mechanically erased. During the production of the paper the high level of  $\alpha$ -cellulose and skilful control of the method ensure that a very porous and open paper is produced. This paper has the property of having liquid mineral inks penetrate deeply into its volume without the letters being too blurred.

90 The method is designed for betting tickets and cannot be adapted to high-quality security paper such as cheques, stocks, banknotes etc.; these make high demands on the quality of the paper which cannot be met by paper produced as in US-PS 36 77 887.

95 From DE-AS 22 23 076 it is known to provide papers with coatings which contain micro-capsules or also to embed the micro-capsules directly in the paper composition. In this way the micro-capsules are not burst in the daily use of the thus treated papers, for example banknotes. The micro-capsules contain a certain crystalline liquid, which displays on temperature changes a color alteration. The presence of this color alteration should show the authenticity of the security paper.

100 Recently, a development of this type of protection method has begun to appear especially desirable since ball-point pen inks have been developed and can be obtained commercially, which can be removed almost without a trace from any sort of paper with a normal eraser. These ball-point pen inks in practice

do not penetrate into the paper pulp and can therefore be removed by light and careful erasure. The methods listed in prior art thus offer no protection against the erasure and subsequent forgery of items entered on security paper when the items are entered with the above-mentioned erasable ball-point pens whether due to thoughtlessness or to the intention to deceive.

10 According to the present invention, there is provided security paper protected against forgery of items entered thereon for documentation and the like which paper is provided with micro-capsules containing solvent, the micro-capsules bursting when an item is entered onto the paper and the solvent being capable of solubilizing colorant with which the item is entered and/or means of erasure of the item from the paper.

20 The security paper according to the invention can be used for documents in such a way that items entered with erasable ball-point pens cannot be removed either.

25 The solvent used in the micro-capsules is suitable high boiling and not readily volatilized e.g. a high boiling alcohol, ketone or ester. The solvent may be toluene or dimethyl phthalate. Preferably the solvent solubilizes normal and erasable ball-point pen ink and preferably also commercial erasers.

30 The micro-capsules may be provided within the paper pulp or, together with a binding agent and a filler, in a surface coating on the paper. Suitably the binding agent has a minimal film forming temperature less than 20°C. The binding agent can be water-soluble or soluble in organic solvents, preferably it is soluble in the solvent in the micro-capsules.

40 According to a preferred embodiment the security paper has a coating which consists essentially of a high-boiling and not readily volatilized solvent which solubilizes ball-point pen ink enclosed in micro-capsules, as well as a binding agent and a filler. When this mixture is applied to the surface of a paper in an appropriate way and dried, effective protection against erasure attempts results.

45 The effect of the protection is further increased when the solvent is selected so that it also solubilizes usual erasers and/or the binding agent; then the use of an eraser gives rise to a sticky, dirty mass made of the material of the eraser, the solvent released from the micro-capsules, the binding agent and the filler, which yields a conspicuous blotch in the area of the attempted forgery.

50 In addition when this type of paper is written on with a ball-point pen, especially with one that is easily erased, the micro-capsules are destroyed by the pressure of the writing in the area where the writing takes place. The released solvent joins the ink of the ball-point pen and thins it. In this way a less viscous solution or mixture arises which penetrates more easily into the structure of the

sheet. This has the effect that paper according to the invention is more difficult to erase than a normal sheet; the ink of the pen can practically only be removed from the deeper layers of the paper, into which it has penetrated, by destroying a substantial part of the paper.

70 Normal erasure attempts always leave a conspicuous trace of the forged item so that the attempted forgery can easily be detected.

75 It is obvious that the latter property can also be used advantageously in the case of documents which are not written on with an erasable ball-point pen. For example, forgery and changes can be recognized by the formation of blotches after erasure attempts on a typed contract on paper according to the invention as well.

80 The method according to the invention also has the advantage relative to the methods of protection against attempted erasure known up to now, that active protection by means of micro-encapsulated reagents is obtained without having to accept the well-known disadvantages of same. This is due to the fact that no reaction partner for a color reaction is enclosed in the micro-capsules, but rather a preferably completely colorless solvent which does not lead to disturbing blotches as a result of bending and comparable influences.

95 The micro-capsules that can be used are well known in the technology of self-copying paper. Solvents have also been developed in connection with this paper that can be encapsulated well and are high-boiling and not readily volatilized. The encapsulating techniques and the solvents which can be used are thus known.

100 Dispersions on the basis of polyvinyl acetate, polyacrylate, polyvinyl chloride, etc. also corresponding to the prior art are suitable as binding agents. However, water-soluble or organically soluble binding agents are also suitable, for example, starch, casein, polyvinyl alcohol, etc.

110 The filler that is to be used should be selected from the series of inorganic white or colored pigments. The following have proved suitable: titania, kaolin, aluminium silicate of synthetic origin, dispersed silicic acid, etc.

115 The technique of applying this type of mixture to the surface of paper is also sufficiently known. For example, coating machines using air brush coating means are used. However, it is also possible to apply such mixtures as these to the paper surface with rollers when the contact pressure is kept accordingly low. In extreme cases it is possible to apply the mixture to the surface of the paper by means of the glue press rollers of a conventional paper machine during the production of the paper. Finally, it has been shown that it is even possible to apply this sort of means of protection to the paper pulp before the production of the paper. Care must be taken only that the micro-capsules are not destroyed by

the pressing apparatus of the paper machine. Drying should take place in such a way that solvents do not evaporate out of the micro-capsules unnecessarily.

- 5 Paper protected against mechanical erasure attempts can be produced by the methods depicted here in all cases.

The invention is described in more detail in the following on the basis of Examples of preferred forms of execution and with reference to the accompanying drawings wherein:

*Figure 1* shows, in cross-section, a commercial paper written on at several places with erasable ball-point pen ink.

- 15 *Figure 2* shows a security paper according to the invention in cross-section, not written on, and, not erased, and,

*Figure 3* shows a security paper according to the invention, written on in several places with erasable ball-point pen and erased at another place.

- 20 As shown in Fig. 1, erasable ball-point pen ink does not penetrate into the fiber structure in the case of customary paper types 1, but rather remains on the surface of the paper as a colored mass.

The security paper 3 according to the invention shown as in Fig. 2 comprises micro-capsules 6 which are filled exclusively with solvent. In a preferred embodiment these micro-capsules are applied as a layer 4 to the surface of the paper 3, together with a mixture 5 of binding agent and filler.

- 25 During writing, the micro-capsules burst in the area of the writing as shown in Fig. 3, the solvent is released and thins the ball-point pen ink 2, which can therefore deeply penetrate the fiber structure. In the erased places the solvent solubilizes the eraser and the binding agent, if any; and a wide, sticky blotch 7 is obtained.

#### *Example 1*

- 30 As in DE-AS 1267961 a precondensate is produced from urea and formalin, in which toluene is dispersed as a solvent. Then 6 mol of 37% formaldehyde and 4 mol of urea in water are added, the mixture is made alkaline by the addition of triethanolamine and then heated to 70° to 80°C for about an hour.

35 The precondensate produced in this way is thinned by water and its pH is reduced to 2 to 4 by the addition of acid. During production it is stirred constantly and the toluene that is to be encapsulated is added before or after the acidification. In another four hours the urea-formaldehyde precondensate polycondenses at temperatures between 40° and 45°C to microscopically small capsule walls which enclose the toluene. During this time it is stirred constantly, whereby the size of the capsules can be regulated by the intensity of the stirring. It is thus possible to obtain any desired size from 1 to approximately 2000µm. Capsules with diameters of about 10µm on aver-

age are preferred for use according to the invention.

- In order to product a spreadable composition the following are then mixed: 20g titania, 70 10g of the microcapsules described above (measured dry), 10g Mowilith DM 60 (Hochst AG, acrylic ester dispersion), 50g water.

The mixture is applied to commercial paper at a concentration of about 10g/m<sup>2</sup> measured dry) by means of a hand wiper. After drying a very thin white coating results, which can be normally written on.

- 75 When ball-point pen marks are erased on this sort of coating, blurred effects over a large area result which show the attempted erasure.

Furthermore, the writing can be clearly recognized even after erasure, because the ball-point pen ink has penetrated the fibre structure and colored it. Bending and comparable strains do not cause the formation of blotches or color changes of any kind; the entire appearance of the check paper remains unaffected.

- 80 *Example 2*

Micro-capsules are produced in the same way as in Example 1, but dimethyl phthalate is added to the precondensate as the solvent to be encapsulated.

- 85 The corresponding spreadable composition is applied to paper with a wiper.

The security paper produced in this way also shows smudges over a large area after erasure attempts, leaving the original writing clearly recognizable.

- 90 Bending and comparable mechanical stresses do not cause the formation of smudges or color changes of any kind.

- 95 *Example 3*

100 10% of the capsules containing solvent described in Example 1 are added to a furnish of 100% rag pulp (freeness value about 45 SR). Shortly before sheet formation, a strongly cationic polymer is added as a retention means (Polymin SK BASF Ludwigshafen). A sheet of about 80 g/m<sup>2</sup> basis weight is then formed from this mixture in the usual way on a wire.

- 105 After drying this sheet can be written on normally with ball-point pen. Attempts to erase the ball-point pen writing are not completely successful even when special erasable ball-point pens are used. Fine writing always remains in the depths of the paper, revealing the earlier mark. The solvent released by the bursting of the micro-capsules has solubilized a trace of the ball-point pen material and thus caused it to sink more deeply into the paper.

#### CLAIMS

1. Security paper protected against forgery of items entered thereon for documentation and the like which paper is provided with

micro-capsules containing solvent, the micro-capsules bursting when an item is entered onto the paper and the solvent being capable of solubilizing colorant with which the item is entered and/or means of erasure of the item from the paper.

2. Security paper according to claim 1, wherein the solvent is high boiling and not readily volatilized.
- 10 3. Security paper according to claim 2, wherein the solvent is a high boiling alcohol, a high boiling ketone or a high boiling ester.
4. Security paper according to claim 3, wherein the solvent is toluene.
- 15 5. Security paper according to claim 3, wherein the solvent is dimethyl phthalate.
6. Security paper according to any of claims 1 to 5, wherein the solvent solubilizes normal and erasable ball-point pen ink.
- 20 7. Security paper according to any of the preceding claims, wherein the solvent solubilizes commercial erasers.
8. Security paper according to any of the preceding claims, wherein the micro-capsules are within the paper pulp.
- 25 9. Security paper according to any of claims 1 to 7, wherein the micro-capsules together with a binding agent and a filler are applied to the surface of the paper as a coating.
- 30 10. Security paper according to claim 9, wherein the binding agent has a minimal film forming temperature less than 20°C.
11. Security paper according to claim 9 or 35 10, wherein the binding agent is water-soluble or soluble in organic solvents.
12. Security paper according to claim 11, wherein the binding agent is soluble in the solvent in the micro-capsules.
- 40 13. Security paper according to claim 9 or 10, wherein the binding agent is a dispersion on the basis of polyvinyl acetate, polyacrylate or polyvinyl chloride.
14. Security paper protected against forgery of items entered thereon for documentation and the like, which paper is provided with micro-capsules containing solvent, the micro-capsules bursting when subjected to writing and/or erasure pressure and the solvent being capable of solubilizing ink and/or means of erasure.
- 50 15. Security paper substantially as described in any one of the Examples.