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**Process for the manufacture of paper sheets for paper money, paper securities and other items, and sheets made by this process.**

The paper pulp is made to contain heat-sensitive dyes which are visible by external inspection and whose colour varies with a variation in their temperature. Preferably, the paper pulp will be made to contain incorporated components such as fibrils, laminar fragments (chad), threads or chips, these components being dyed with heat-sensitive dyes.

The invention relates to a process for manufacturing paper sheets for paper securities, paper money and other items, and to paper sheets made by this process.

One object of the invention is the production of a paper sheet which permits easy inspection by direct observation, without requiring complex and expensive instruments, and without the need for such difficult and sometimes uncertain operations as are frequently encountered in the solutions known at the present time.

These and other objects and advantages will be made clear in the following text.

A first subject of the invention is a process for the manufacture of paper sheets for paper money, paper securities and other papers which are to provide guarantees of security, according to which process the pulp is made to incorporate heat-sensitive dyes which are visible by external inspection and whose colour varies with a variation in their temperature.

In practice, and advantageously, the paper pulp may be made to incorporate components dyed with heat-sensitive dyes, which are included in the paper pulp in such a way that they are visible by external inspection, and whose colour varies with a variation in their temperature.

Evidently, a rise in temperature at the surface of the paper sheet is easily caused, even merely through contact with the skin of the hand, or by using simple, compact and economical equipment, giving reliable and easily interpreted visible results.

The said heat-sensitive dyes or the said components dyed with heat-sensitive dyes may be distributed in restricted areas of the paper, for example along longitudinal bands in the continuous production of the paper.

Components dyed as stated above may be fibrils of various kinds and/or laminar fragments of various shapes and various kinds, known as "planchette" or "glitters" or "chad", and/or threads, chips or other materials, possibly provided with microprinted text, which becomes visible with the variation of the temperature and consequently of the colour of the component.

The process mentioned above does not exclude the simultaneous use of other security treatments of different kinds.

The paper pulp may also be made to incorporate components with a plurality of heat-sensitive dyes, or dyes which are heat-sensitive at different temperatures.

Another subject of the invention is a paper sheet for paper securities, paper money and other papers, characterized by the presence of at least one heat-sensitive dye, which varies with temperature and whose variations are observable externally. The sheet may comprise incorporated components dyed with heat-sensitive dyes, whose colour varies with a variation in the temperature of the sheet, and whose

colour is observable externally.

Paper sheets according to the invention may have other characteristics as specified above and as claimed.

The production of paper sheets as specified cannot be carried out on a small scale, but requires large-scale equipment and investment, and is therefore justified only for quantities such that the possibility of fraudulent disposal is excluded. The risks of fraudulent production are therefore very great, and such that this possibility is excluded.

The components - which may also be incorporated superficially and in restricted areas - containing the heat-sensitive dyes may also react by contact, and the colour variation can be checked by visual inspection.

Heat-sensitive fibrils may have dimensions varying from 2 to 20 mm in length and 3-100 Dtex in diameter.

Heat-sensitive planchette or glitters or chad may have dimensions from 1 to 10 mm or above, and have various shapes including round, square and hexagonal, and may be made of plastic or paper material.

The threads or chips or other components may have dimensions varying from 0.4 to 10 mm and thicknesses varying from 5 to 100 microns. They may be made of metallic, paper, textile or plastic material, or with multiple layers of identical or different materials.

The heat-variable dye used varies with temperature, virtually immediately and in a highly visible way. Heat-variable dyes cover the whole chromatic range of the dye and are also sensitive to different temperatures or in different ways to a single temperature.

When the colour of an incorporated component, such as a thread or chip, varies with a variation in temperature, it may also make visible a microprinted text such as the name of the desired bank or credit institution, or other information.

A plurality of heat-sensitive dyes may be chosen, having different variations of colour on reaching the same temperature, or on reaching different and successive temperatures.

It is to be understood that the above description is only an example provided purely as a practical demonstration of the invention, this invention being variable in its forms and dispositions without thereby depositing from the scope of the guiding concept of the invention.

## Claims

1. Process for the manufacture of paper sheets for paper money, paper securities and other papers which are to provide guarantees of security, characterized in that the paper pulp is made to incorporate heat-sensitive dyes which are visible by

external inspection and whose colour varies with a variation in their temperature.

2. Process for the manufacture of paper sheets for paper money, paper securities and other papers which are to provide guarantees of security, characterized in that components to be incorporated in the paper pulp are dyed with heat-sensitive dyes, are included in the paper pulp so that they are visible by external inspection, and have their colour varying with a variation in their temperature. 5
3. Process according to Claim 1 or 2, characterized in that the said heat-sensitive dyes and/or the said components dyed with heat-sensitive dyes are distributed in restricted areas of the paper. 10
4. Process according to Claim 3, characterized in that the said restricted areas are longitudinal bands in the continuous production of the paper. 15
5. Process according to at least Claim 2, characterized in that the said components are fibrils of various kinds. 20
6. Process according to at least Claim 2, characterized in that the said components are laminar fragments of various shapes and various kinds, known as "planchette", "glitters" or "chad". 25
7. Process according to at least Claim 2, characterized in that the said components are threads, chips or other materials, possibly provided with microprinted text which becomes visible with the variation of the temperature and consequently of the colour of the component. 30
8. Process according to at least one of the preceding claims, characterized in that it also comprises other security treatments of different kinds. 35
9. Process according to at least one of the preceding claims, characterized in that the paper pulp is made to incorporate components with a plurality of heat-sensitive dyes or dyes which are heat-sensitive at different temperatures. 40
10. A paper sheet for paper securities, paper money and other papers, characterized by the presence in it of at least one heat-sensitive dye, which varies with temperature and whose variations are observable externally. 45
11. A paper sheet for paper securities, paper money and other papers, characterized in that it comprises incorporated components dyed with heat-sensitive dyes whose colour therefore varies with 50

a variation in the temperature of the sheet and whose colour is observable externally.

12. Paper sheet according to Claim 10 or 11, characterized in that the said heat-sensitive dyes and/or the said components dyed with heat-sensitive dyes are distributed in restricted areas of the paper. 55
13. Paper sheet according to Claim 12, characterized in that the said restricted areas are longitudinal bands in the continuous production of the paper.
14. Paper sheet according to at least Claim 11, characterized in that the said components are fibrils of various kinds.
15. Paper sheet according to at least Claim 11, characterized in that the said components are laminar fragments of various shapes and various kinds, known as "planchette", "glitters" or "chad".
16. Paper sheet according to at least Claim 11, characterized in that the said components are threads, chips or other materials, possibly provided with micro-printed text which becomes visible with the variation of the temperature and consequently of the colour of the component.
17. Paper sheet according to at least one of Claims 10 to 16, characterized in that it also comprises other security arrangements of different kinds.
18. Paper sheet according to at least one of Claims 10 to 17, characterized in that it comprises, incorporated in the paper pulp, components with a plurality of different dyes, which are heat-sensitive at the same temperature or heat-sensitive at different temperatures.