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(58) Field of search
G5R
B6A
Selected US specifications from IPC sub-classes
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(54) Optical storage media

(57) An optical storage medium 7 (provided in a credit card for example) e.g. a glass ceramic, the optical characteristics of localised regions of which can be selectively changed by conversion from an amorphous form to a crystalline form. Conversion may be by a scanned modulated laser beam. Reading may be by scanning or flooding with light (including infrared/u.v. as appropriate). The optical material may be in strips or a spiral for example. Fig. 1 also shows printed data 2, signature strip 3, magnetic security strip 4, logos and security holograms 5, 6.

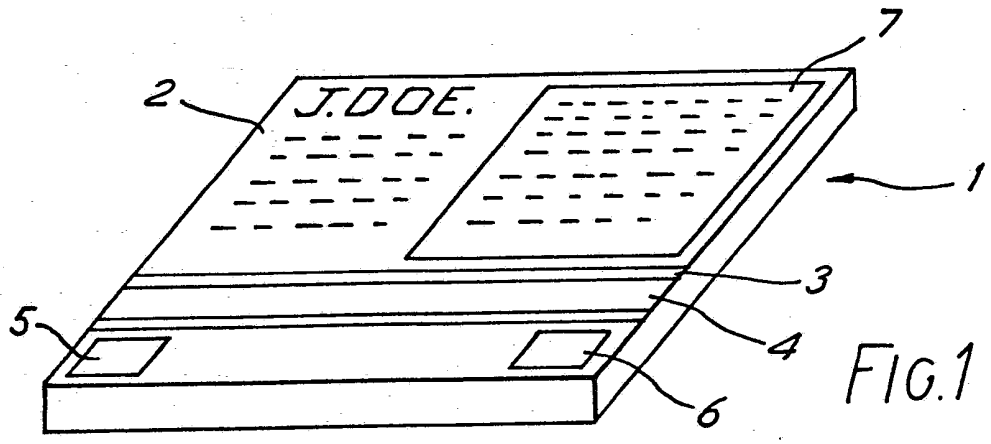

FIG.1

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The drawing(s) originally filed was (were) informal and the print here reproduced is taken from a later filed formal copy.

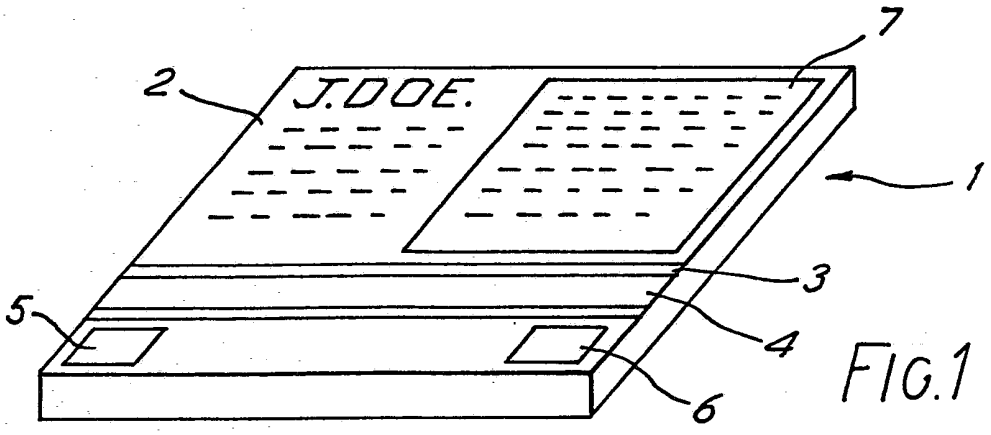
7
2
J.DOE.
1
3
5
4
6

FIG.1

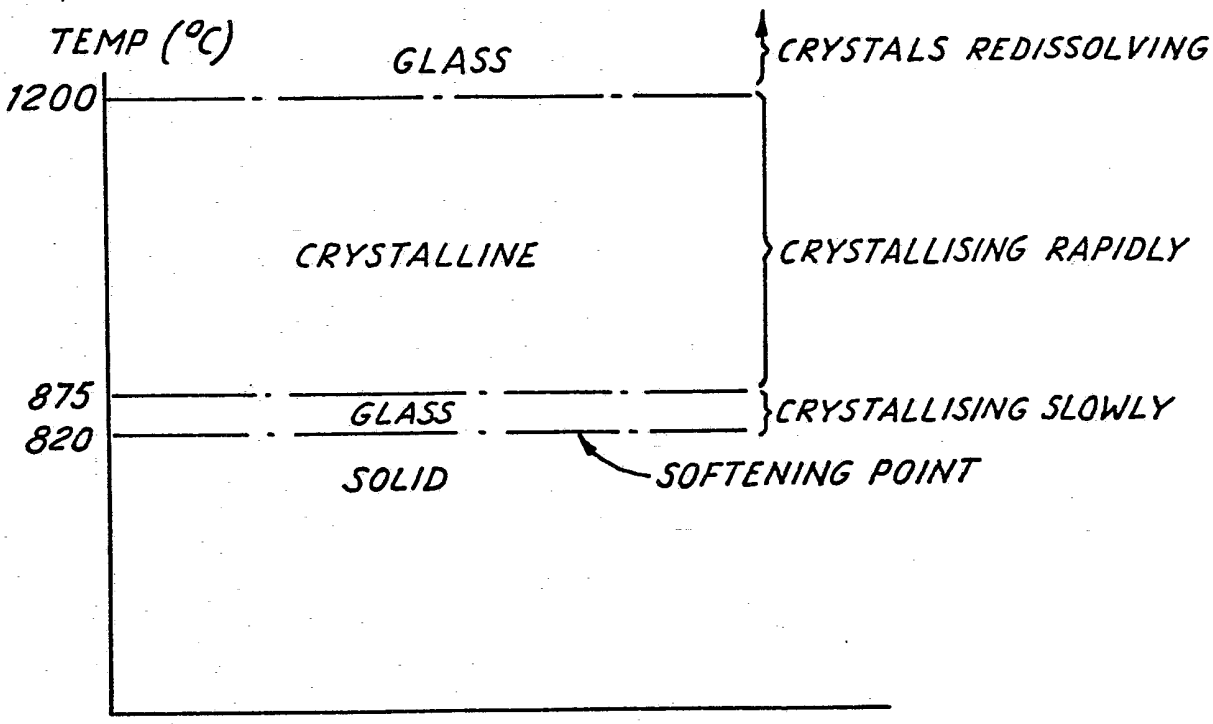
TEMP (°C)
GLASS
CRYSTALS REDISSOLVING
1200
CRYSTALLINE
CRYSTALLISING RAPIDLY
875
GLASS
CRYSTALLISING SLOWLY
820
SOLID
SOFTENING POINT

FIG.2

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STORAGE MEDIA

The present invention relates to storage media, and it relates more especially to such media as can store digitised information which is detectable by optical means. Such media will hereinafter be termed optical storage media.

Optical storage media are capable of storing considerable amounts of data in small volume because of their intrinsically high resolution and so such media are of interest in circumstances where it is desired to provide a compact data store. The compact audio disc is an excellent example of these attributes of optical storage media.

Unfortunately, many previously proposed optical storage media suffer from disadvantages when it is proposed to use them in volume production of low unit cost items, such as credit cards. Some media require excessively expensive production techniques, others rely on use of materials which of themselves are difficult to make, difficult to apply to an appropriate substrate, or do not have the necessary degree of long term stability.

It is an object of this invention to provide an improved optical storage medium.

According to the invention there is provided an optical storage medium comprising a material, localised regions of which can be converted from an amorphous form to a crystalline form and in which the two forms are optically distinguishable.

According to the invention from another aspect there is provided a credit card bearing an optical storage medium of the

kind described in the last preceding paragraph.

According to another aspect of the invention there is provided a method of recording information in a storage medium of the kind described in the last preceding paragraph but one wherein the material in localised regions thereof is crystallised by the application of energy directed at said regions.

In order that the invention may be clearly understood and readily carried into effect, one embodiment thereof will now be described, by way of example only, with reference to the accompanying drawings, of which:

Figure 1 shows a credit card bearing a medium in accordance with the one example of the invention, and

Figure 2 shows a schematic phase diagram for a particular glass ceramic material.

Referring to the drawing, a credit card 1 contains printed data 2 and a signature strip 3, which covers or includes a magnetic security strip 4. Alternatively, the magnetic strip may spaced apart from strip 3 or it may be omitted. Various other material, such as logos of the card-issuing company, security holograms etc., may be provided as shown schematically at 5 and 6.

The aspect to which the invention relates, however, lies in the provision of an optical data store 7. This store is provided by the application to the card 1, either directly, for example by screen printing, or on a separate substrate which is later affixed to the card 1, of a glass ceramic material applied in the form of amorphous glass particles. The material

can be rendered crystalline by the application of heat energy, and this heat when applied to selected local regions of the material, for example by means of a modulated and scanned laser beam, renders those selected regions crystalline.

The crystalline regions are optically distinguishable from the remainder of the material, which remains in its amorphous state, and thus the information stored in the material can be reproduced optically, for example by scanning or flooding with a suitable light beam (including infra-red or ultra-violet frequencies if applicable) - and detecting the light transmitted through or reflected from the medium. For transmission read-out, the card substrate, at least in the region under the optical medium, is rendered transparent or translucent. For reflective read-out, the area beneath the optical medium may be rendered reflective, if necessary, to enhance the output.

The optical medium can be applied in any convenient thickness, bearing in mind the need for the material to be rugged and to resist fracture when the card is flexed. It may also be applied in any convenient pattern and may, for example, be laid down in a series of rectilinear strips, a spiral or any other convenient form.

Decrementing of any stored value indicated amongst the optically recorded data can be effected by selectively exposing further areas of the material which remains in its amorphous form to a beam of energy sufficient to crystallise the material.

The resolution of the medium is determined by the crystal

dimensions and is of the order of a few microns, depending on the material chosen. Application and processing can be readily and cheaply effected without the need for special environmental care and the medium is of a rugged and stable character.

One glass ceramic material that is particularly suitable for the purposes described hereinbefore is $CaMgSiO_4$, the phase diagram for which is shown in Figure 2. Most glass ceramic materials exhibit similar characteristics, but at different temperatures. As can be observed from Figure 2 the phase diagram includes a "low temperature" region, just above the softening point of the glass, where crystallisation occurs very slowly and a transparent glass layer can be formed. This region, or "glazing window" is that into which the material is locally heated, by means for example of a laser beam, in order to convert it locally into crystalline, rather than amorphous, form as described hereinbefore.

If desired, the information can be removed, and the amorphous glassy layer re-formed, in some or all of the material by further heating of the glass ceramic material to a temperature at which the crystals re-dissolve in the glass. This temperature is above the crystallisation temperature and for $CaMgSiO_4$ is in excess of $1200^{o}C$ so, if this facility is required, the substrate which carries the glass ceramic material needs to be capable of withstanding such heat treatment. Lower temperature glass ceramics could be used to reduce the required temperature for this decrystallising treatment.

In any event, once the material has been rendered glassy again, it can be re-written exactly as described in relation to the initial writing operation.

The decrystallising treatment can be conducted in an oven or by means of a flood tyre or scanned but unmodulated beam of energy, such as a laser beam. The use of a beam of energy is especially advantageous if the data recorded on part only of the material is to be erased and re-written.

CLAIMS

1. An optical storage medium comprising a material, localised regions of which can be converted from an amorphous form to a crystalline form and in which the two forms are optically distinguishable.

2. A medium according to Claim 1 wherein said material is a glass ceramic material.

3. A medium according to Claim 2 wherein said glass ceramic material is $CaMgSiO_4$.

4. A medium substantially as herein described with reference to the drawings.

5. A credit card bearing an optical storage medium according to any of Claims 1 to 4.

6. A method of recording information in a storage medium according to any of Claims 1 to 4 wherein the material in localised regions thereof is crystallised by the application of energy directed at said regions.

7. A method according to Claim 6 wherein the application of said energy is effected by means of a modulated and scanned laser beam.

8. A method according to either of Claims 6 or 7 including the further step of erasing at least selected parts of material by heat treatment sufficient to render said material in at least selected parts amorphous again.

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