

# United States Patent

Tollef

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[54] **RECORD MEDIUM AND A METHOD FOR STORAGE OF INFORMATION**

[72] Inventor: Gunnar Tollef, Akerbyvagen 264, Taby, Sweden

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**Primary Examiner**—Maynard R. Wilbur

**Assistant Examiner**—William W. Cochran

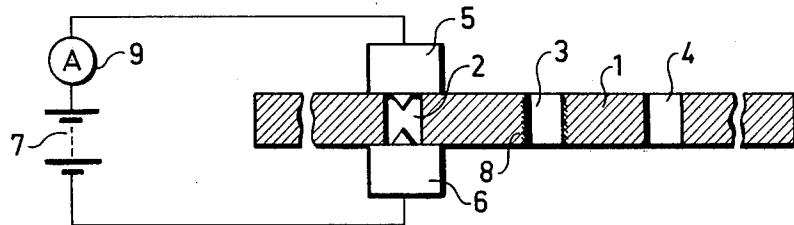
**Attorney**—Oldham & Oldham

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**ABSTRACT**

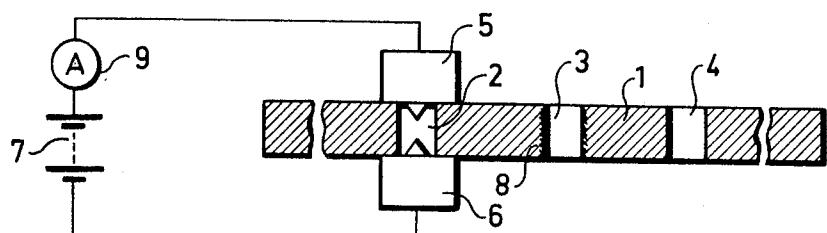
A storage medium consisting of a dielectric with preformed holes. Electrode pairs are inserted into selected ones of the holes and an electric discharge renders the walls of these holes conductive, either by deposition of carbon from the dielectric or by metal deposition from the electrodes. Sensing of information is by similar electrodes having a voltage not large enough to cause discharge.

3 Claims, 1 Drawing Figure



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Inventor:  
Gunnar Tollett  
by Oldham & Oldham  
attorneys

**RECORD MEDIUM AND A METHOD FOR STORAGE OF INFORMATION**

The present invention relates to a record carrying medium and a method for storing information by means of such a record carrier. The record carrier according to the invention comprises a plate of dielectric material which has a number of holes disposed in predetermined positions and the walls of which have been made electrically conductive while the remainder of the plate is electrically nonconductive. In addition to the holes aforementioned, the plate may also have holes whose walls are nonconductive but which can be made conductive. The conductive walls are produced by means of an electric discharge through a predisposed hole with nonconducting walls in such a manner that the material of the walls of the hole, under the influence of the heat generated during the discharge, is changed by being carbonized (in the instance when it comprises organic material) so that it becomes conducting, or by causing, during the electric discharge, a portion of the material of the electrodes used in creating the discharge to vaporize and settle on the walls of the hole as an electrically conducting coating, or by a combination of these two phenomena. The holes having conducting walls may also be produced in a plate in which no holes are disposed, by creating a discharge straight through the material, whereupon a hole is formed simultaneously as its walls become conductive.

The method of the invention for storing information comprises the steps of providing a plate of dielectric material with at least one hole at a predetermined position and simultaneously therewith, or at a later stage, making the walls of at least one hole conductive by creating an electric discharge between electrodes mounted at the ends of the hole, said discharge being sufficient to carbonize the material in the walls of the hole and/or to deposit conductive material from the electrodes on said walls.

For the purpose of reading information thus stored, there are used electrodes which are mounted at the hole to be read or at some other location on the plate where a hole can be disposed. A voltage which is insufficient to cause a discharge but which is sufficient to enable a current to pass through a hole whose walls are conductive is placed cross the electrodes. This current can be read on an ampere meter or other current measuring device, or can be used to give a signal to a device whose activity is to be controlled by the record carrier. If the electrodes are mounted at a hole having nonconducting walls or at a location where no hole is present no current will pass.

The method and record carrier of the invention are particularly intended for storing digital information. A "marked" hole, i.e., a hole having conducting walls, can signify one of the digits 1 and 0, whereas an "unmarked" hole (or a location without a hole) signifies its complement. The method and record carrier, however, can also be used for storing analogue information. In this instance the amount of current in the discharge when marking can be varied so that different degrees of conductivity are obtained in different holes. When reading, different current strengths are then obtained for different holes.

The record carrier may be made of any type of organic material which can be carbonized to a sufficient extent by an electric discharge. Examples of such material are paper, cardboard, different types of plastic materials, such as thermoplastics, e.g. polyvinyl chloride, and thermosetting resins, e.g. phenolformaldehyde plastics, carbamide plastics. Laminated material can also be used. When the conducting walls are created by depositing thereon electrode material, inorganic materials may also be used, such as ceramic material or glass. An appropriate electrode material in this case is gold. Tungsten is suitable in other cases.

The thickness of the plate may be from 0.1 to 5 mm. or more. When the plate is constructed with previously disposed holes therein the size of the holes may be from 0.1 to 5 mm. suitably 0.5-1 mm. in diameter. The holes may be round or square or of an other cross section. For instance, they may be grooved to make marking clearer. The word "plate" does not necessarily mean a planar object. The plate, if desired, may be

curved and may have any desired shape, such as square, rectangular or round.

A record carrier according to the invention and a device for storing (or reading) information are shown diagrammatically on the accompanying drawing.

The drawing shows a plate 1 of dielectric material, selected from one of the examples above. The thickness of the plate has been exaggerated in the drawing and in the exemplary embodiment is provided with three holes, of which three 2, 3, 4 are shown. Two electrodes 5, 6 are shown positioned one on either side of the hole 2, although not in electric contact with each other. The electrodes are connected to a source of current, indicated at 7, which gives sufficient voltage to create a discharge between the electrodes, resulting in carbonization of the material in the hole walls or deposition of electrode material thereon, so that an electrically conducting layer is formed, as is shown at 8 in hole 3. The hole 4 is an unchanged hole.

Reading is effected in a device of principally the same type, although in this instance the voltage is kept at such a low level that no discharge is created, but that current passes through the layer 8 when the electrodes are positioned at a hole, such as the hole 3. The strength of the current can be read on the ampere meter 9. When concerning digital information, all that is required is to differentiate between the instances when a current is obtained (the hole 3) and those instances when no current is obtained (when the electrodes are positioned at a hole such as 4). When concerning analogue information the current strength illustrates the conducting ability imparted to the hole.

Naturally, whether concerning analogue or digital information, the current obtained can be used as a signal which initiates a certain function of an apparatus or machine which is 35 to be controlled by the record carrier.

It will be understood that the requisite voltage during marking and reading is dependent on such factors as the thickness of the plate, the material of the plate, the size of the holes and electrode material, which factors can easily be established by 40 one having normal skill in the art.

It should also be understood that it is possible to use a system of electrodes for contemporaneous marking of a given number of holes in a specific pattern according to a certain code and for corresponding reading of the information. The 45 record carrier can also be used in such a way that when an unmarked hole (or an unmarked hole location) is sensed and thereby a certain function initiated, the same hole may then be immediately marked by increasing the voltage between the electrodes so that a discharge is created with the aforementioned result. One example of this use is to use a record carrier of the invention as an identity or authorization card which shows that the owner has a prerogative which, however, can only be availed upon for a limited extent within a given period of time. For instance, such a record carrier can be used for controlling automatic banknote machines in banks. Clients of the bank shall enjoy the privilege of withdrawing a certain sum from such an automatic banknote machine when necessary. Consequently, it is desirable from the point of view of the 50 bank that no client can avail himself of this privilege more than, for instance, once in every 24 hours. This can be arranged simply by providing the clients of the bank with an authorization card in the form of a record carrier of the invention and the automatic banknote machine with a corresponding marking and reading device, which initiates the activity of the machine only if the location on the card which corresponds to the actual date is unmarked, and which in immediate conjunction therewith marks the location so that the card cannot be used for removal of a new sum until the following day.

I claim:

1. A method of storing and reading information on a plate of dielectric material which comprises the steps of providing an arrangement of holes in predetermined location on the dielectric material;

positioning a pair of electrodes on opposite sides of a hole at which it is desired to store information; establishing a first potential across the pair of electrodes, the potential being sufficient to produce a discharge across the electrodes whereby the walls of the hole are rendered conductive; removing a first potential and the pair of electrodes; subsequently positioning a pair of electrodes on opposite sides of a hole at which it is desired to read information; establishing a second potential across the reading electrodes, the second potential being sufficient to cause conduction between the reading electrodes across the hole

walls which has been rendered conductive but insufficient to cause discharge between the electrodes if the hole walls are not conductive and detecting current flow between the reading electrodes.

5 2. The method according to claim 1, wherein the electric discharge carbonizes the walls of the hole to provide a conductive layer.

10 3. The method according to claim 1, wherein a portion of the material of the electrodes is deposited on the walls of the holes during the electric discharge to provide a conductive layer.

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