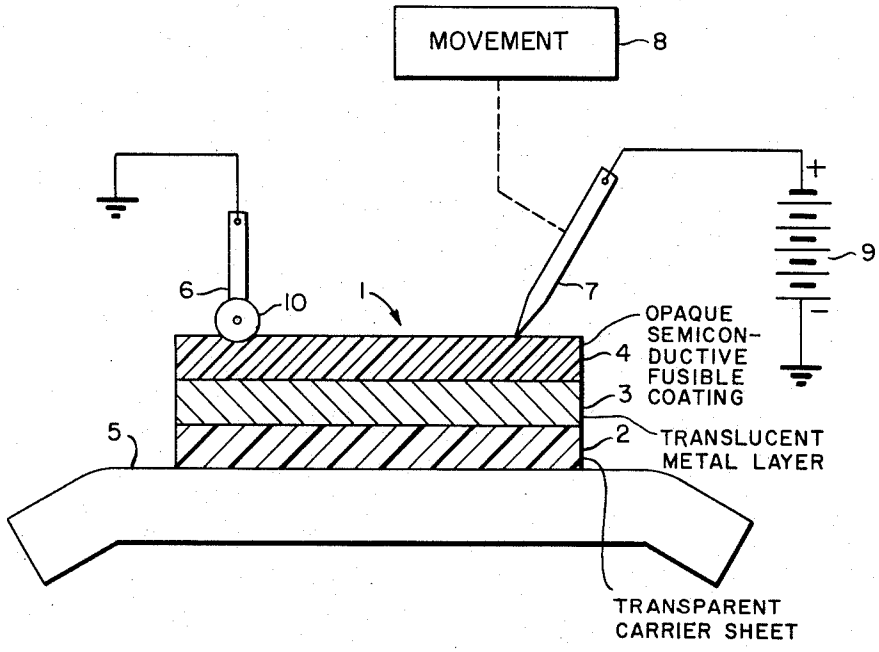
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TRANSLUCENT ELECTROSENSITIVE RECORDING SHEET

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TRANSLUCENT ELECTROSENSITIVE RECORDING SHEET

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Our invention relates to a sheet material for recording or the like capable of being marked directly by the passage of an electric current, and particularly to a novel construction of such sheet material from which electrically inscribed marks or traces may be readily copied by direct positive reproduction processes.

Electrosensitive or thermosensitive recording sheet materials heretofore known have generally comprised a dark base sheet bearing a surface coating which is initially opaque. In use, the surface coating is burned, decomposed, fused or disintegrated in the area immediately adjacent an applied electrode or heated stylus to reveal the dark base sheet.

Where the effect on the coating is produced by an arc or current of electrons, the carrier or base sheet is usually made electrically conductive by coating or impregnation with carbon black or metallic particles, and the sensitive coating may also be of an electrically conductive nature.

In thermosensitive recording media, for example, of the type disclosed by Rosenthal in United States Patent No. 2,739,909, a thermosensitive coating is provided which is initially opaque, but which is fused to transparency or translucency by a heated stylus to expose the dark background of the opaque base sheet.

Regardless of the specific combination of base sheet and electrosensitive or thermosensitive coating involved, the recording materials of the prior art are of opaque nature, and may therefore be classed as exhibiting light reflective contrast between the trace and background when viewed at the marking surface, but as exhibiting no transparent contrast between the trace and background because of the overall opacity of the sheet. Reproduction of such opaque-marked papers is not possible by direct positive processes which require transparent contrast, such as the diazo process, and of necessity expensive photographic processes must be relied upon for copying. Accordingly, an inexpensive recording sheet material capable of providing a record suitable for direct positive reproduction would be highly desirable, and it is the primary object of our invention to provide such a material.

Briefly, our invention is based on the discovery that dry electrically sensitive sheet materials capable of exhibiting the transparent contrast necessary for direct positive reproduction may be prepared by combining a translucent or semi transparent and highly conducting base sheet with a coating of any of the known thermosensitive coating compositions in which particles of electrically conducting material have been dispersed to make the coating behave as a semi-conductor. With this construction, when an electrode of one polarity is brought into contact with the base sheet and an electrode of the opposite polarity is traced across the surface of the coating, an electric current will flow through the coating from the trace electrode, heating the coating in the vicinity of the trace to fuse the coating into transparency along the path followed by the trace electrode. Thus, a transparent trace record is provided which is suitable for direct positive reproduction.

Our invention will best be understood by reference to the accompanying drawing, in which the sole figure is a schematic diagram, partly in cross-section, showing an exaggerated cross-sectional view of a sheet of material constructed in accordance with the preferred embodiment of our invention, and the electrical circuit of a conventional recording device associated therewith.

Referring now to the drawing, we have shown, greatly exaggerated in thickness, a sheet of recording material generally designated **1** consisting of a base sheet comprising an optically transmissive carrier sheet **2** bearing an electrically conducting and optically transmissive layer **3**, and a semi-conducting coating **4** on the base sheet, each of which will be described in further detail below. As indicated schematically, sheet **1** is adapted to be disposed on the platen **5** of a conventional recording instrument. A stationary electrode **6**, which is grounded as shown, is provided with a conducting wheel **10** which is disposed to press sheet **1** against the platen with sufficient force to somewhat compress the semi-conducting **4**, as indicated in the drawing, over an area that is relatively large with respect to the area of contact of the trace electrode **7**, to be described. In this manner, the dielectric strength of the semi-conducting coating **4** is sufficiently reduced to effect a relatively low resistance connection between the conducting layer **3** and electrode **6**, the current density being reduced by its distribution over the relatively large area presented to coating **4** by contact wheel **10**. Alternatively, other methods of completing a circuit between stationary electrode **6** and the conducting layer **3** could be employed, if so desired, without departing from the scope of our invention. For example, wheel **10** could be omitted and a broad contacting head could be formed on electrode **6**, or a narrow head could be employed if pressed hard enough into sheet **1** to sufficiently reduce the resistance between electrode **6** and conducting layer **3**. Or, if desired, the semi-conducting coating **4** could be omitted at an edge of sheet **1**, to expose conducting layer **3** to direct contact with electrode **6** or an equivalent electrode with an elongated contacting edge. In a manner that will be well understood by those skilled in the art, a trace electrode **7**, which is adapted to be actuated by the movement **8** of the recording instrument, is disposed to move over the surface of coating **4** to describe a trace to be recorded.

As indicated, trace electrode **5** is returned to ground through a suitable source of voltage, schematically indicated as a battery **9**. The use of a direct current source, with the polarity indicated in the drawing, is preferred, since we have found that a smooth trace with less erosion of the trace electrode will result from this arrangement. However, it is within the scope of our invention, in its broader aspects, to employ an alternating source of voltage, and in this event the platen may be grounded to serve as the stationary electrode, replacing electrode **6**, and the capacitance between the platen and conducting layer **3** will complete the electrical circuit.

It will be appreciated that the details of the recording instrument with which our novel recording sheet is employed do not form a part of our invention, and accordingly, we have only shown those portions of a conventional instrument which directly cooperate with the recording sheet and serve to illustrate its use.

Turning now to the detailed construction of the electrosensitive recording sheet of our invention, carrier sheet **2** can be made of any suitable thin, relatively strong material, which is sufficiently transmissive to light to serve as a base for direct copying processes. For example, transparent plastics such as Mylar polyester film, or translucent materials such as glassine or the like, can be employed. Preferably, the conducting layer **3** comprises a metallic deposit of aluminum on sheet **2**, sufficiently thin to be optically transmissive to an extent permitting the exposure of underlying diazo type copy papers, layer **3** forming a half-mirror surface on the carrier sheet **2**. In addition to aluminum, it is obvious that any other suitable conductive metal could be employed, such as zinc, copper, gold, silver, or the like.

Since the sole purpose of sheet **2** is to form a strong support for the very thin, relatively weak layer **3**, it can be omitted, if desired, by employing a conductive base sheet combining the qualities of relatively high conductivity, strength, and optical transmissiveness. In particular, we have found that in addition to metallic coatings, various types of electrically conductive glass surfaces, such as Libby-Owens-Ford 81–E glass coatings, may be employed without departing from the scope of our invention in its broader aspects.

As generally described above, the electrosensitive coating **4**, which in combination with the transmissive electrically conductive layer **3** results in a direct positive reproduction master when electrically marked, must be of a type which is opaque to ultra violet light before being acted upon by an electric current but which subsequently becomes transparent in the area of the mark or trace. The coatings above referred to as being disintegratable or removable by the reaction to electric current would serve in our novel combination, but we prefer to use a coating which is less destructible in its reaction and which is less likely to produce undesirable rubble that would collect on the stylus or trace electrode of a marking instrument. Specifically, we prefer to employ an opaque electrosensitive coating which will fuse to transparency by the passage of an electric current. The exact degree of opacity of the coating is not critical, so long as it is sufficient to give adequate contrast with the backing material by transmitted light. As an example of a coating suitable for this purpose, in accordance with one embodiment of our invention, we may employ an electrosensitized blushed lacquer. Thus, for example, cellulose acetate may be dissolved in a solvent mixture of acetone and water, to which has been added a strong electrolyte such as nickel nitrate, sodium thiocyanate, sodium chloride, or the like, and the solution coated on the conducting layer **3**. On drying, the acetone evaporates the more quickly, and causes cellulose acetate particles and included electrolyte particles to precipitate out, the resultant film being "blushed" as it is termed, and in this state appearing as a white opaque coating. Due to the included electrolytes, the coating behaves as a semi-conductor, and in a thin coating of less than 3 mils, and preferably of the order of 1 mil or less, will conduct sufficient current upon the application of a moderate voltage of 300 volts or less to heat the point directly adjacent the trace electrode to fusion, in which state the material of the coating is essentially transparent.

A second, and preferred, coating which may be employed comprises a plastic composition including a multiplicity of enclosed microscopic or submicroscopic voids throughout its volume beneath the outer surface thereof, and including dispersed particles of a strong electrolyte or of a finely divided metal. Such a plastic coating, apart from the voids, is essentially continuous and homogeneous, and the film as a whole is opaque because of its heterogeneous physical structure, due to the voids. This coating may be prepared in the manner fully described in United States Letters Patent No. 2,739,909 to Rosenthal, with the exception that electrically conductive particles are incorporated in the coating during its manufacture. While this may be done in numerous ways known to the art, one simple method is to dissolve in the water phase of the coating emulsion a suitable electrolyte, for example, 25% of sodium thiocyanate by weight. Of course, the electrolyte could be dissolved in either the water phase or the organic phase, and in place of the electrolyte, metallic particles could be dispersed in both phases. The result in any event will be an opaque semiconducting coating which can be fused to transparency by an electric voltage applied across it. While various theories may be advanced to explain the semiconductive nature of the coating, and we do not wish to be bound by any particular theory, we believe that the mechanism involves arcing over short paths from one conductive particle to the next, with a net lowering of the breakdown potential or an effective decrease in the resistance of the coating. It will be obvious that the required voltage can readily be adjusted by adjusting the thickness of the film and the concentration of electrolyte or other conductive material added to it. Since these matters are well within the scope of the designer, and can be determined by calculation or by routine experimentation without the exercise of the inventive faculties, it is believed unnecessary to describe them in further detail.

In the preferred embodiment of our invention, a semiconducting opaque coating is employed which is fused to transparency by the passage of an electric current. However, it is within the scope of our invention in its broader aspects to employ other coatings known to the art, which respond to the passage of an electric current by vaporizing or disintegrating in the path of the trace electrode to expose the underlying base sheet to the passage of light.

While we have described various embodiments of our invention in detail, many changes and variations will become apparent to those skilled in the art upon reading our description, and such can obviously be made without departing from the scope of our invention. Accordingly, we do not wish to be limited to the details shown, but only by the spirit and scope of the following claims.

Having thus described our invention, what we claim is:

1. A normally opaque recording sheet capable of being marked by the passage of an electric current, comprising an optically transmissive electrically conducting base, a coating on said base of an opaque material fusible to transparency upon heating, and electrically conducting particles dispersed in said coating in an amount sufficient to render said coating conductive.

2. An electrosensitive normally opaque recording sheet, comprising, in combination, an optically transmissive carrier sheet; a thin translucent layer of metal deposited on said carrier sheet; and an electrosensitive coating on said sheet comprising fusible plastic, containing sufficient voids to be opaque to light, and having particles of an electrolytic salt dispersed therein in an amount sufficient to render said coating conductive.

3. A normally opaque recording sheet, comprising a sheet of translucent electrically conductive material and a coating on said sheet of an opaque semiconducting material fusible to transparency by the passage of an electric current through said coating whereby an optically transmissive mark is formed on said sheet.

4. An electrosensitive normally opaque recording sheet, comprising an optically transmissive and electrically conductive base sheet and an opaque conductive coating on said sheet capable of being rendered optically transmissive by the passage of an electric current through said coating whereby an optically transmissive mark is formed on said sheet.

5. A normally opaque recording sheet comprising, a base sheet of optically transmissive sheet material and a layer on said sheet of metal sufficiently thin to be optically transmissive, and an opaque coating on said sheet of a material reactive to the passage of an electric current through said coating to render said coating optically

transmissive and thereby to permit the passage of light through the sheet.

6. An electrosensitive normally opaque sheet, comprising an optically transmissive electrically conductive base sheet and an opaque coating on said sheet of a material reactive to the passage of an electric current through said coating to render said coating optically transmissive and thereby to permit the passage of light through the sheet.

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