

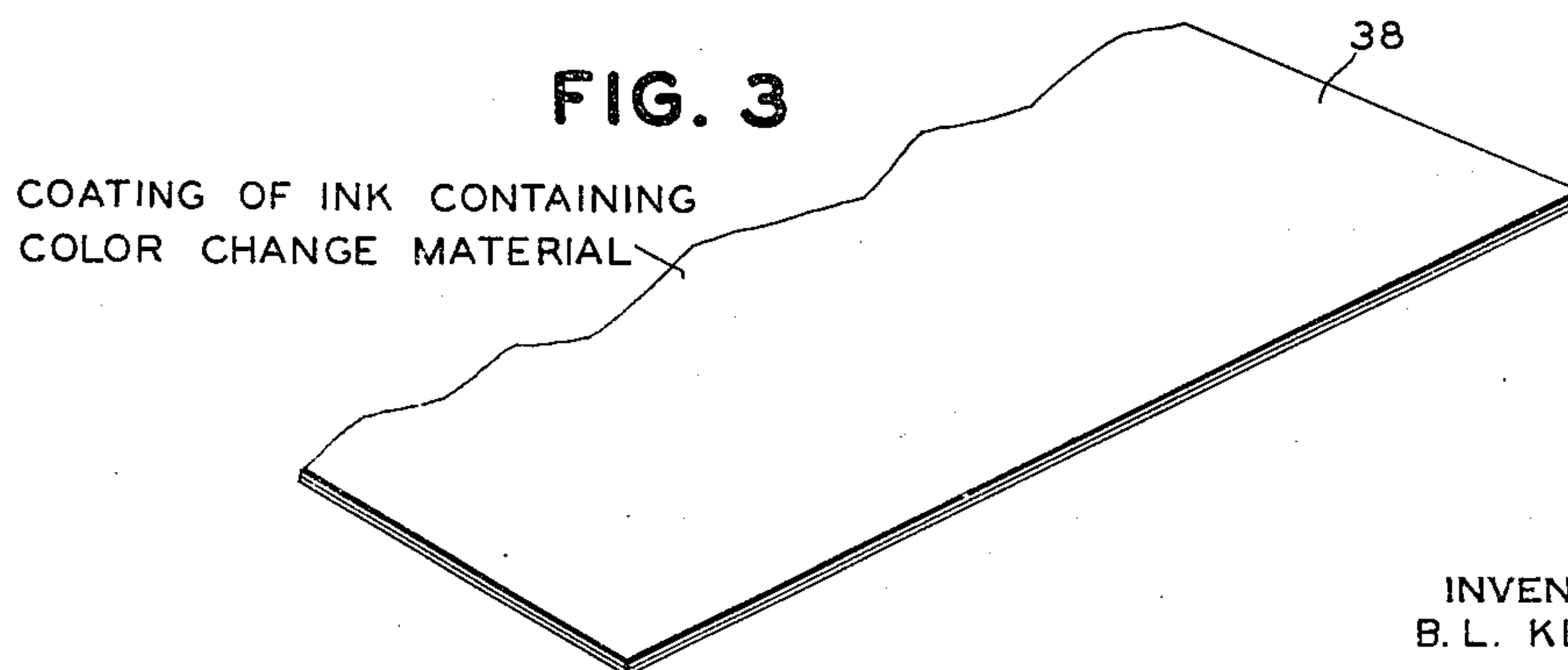
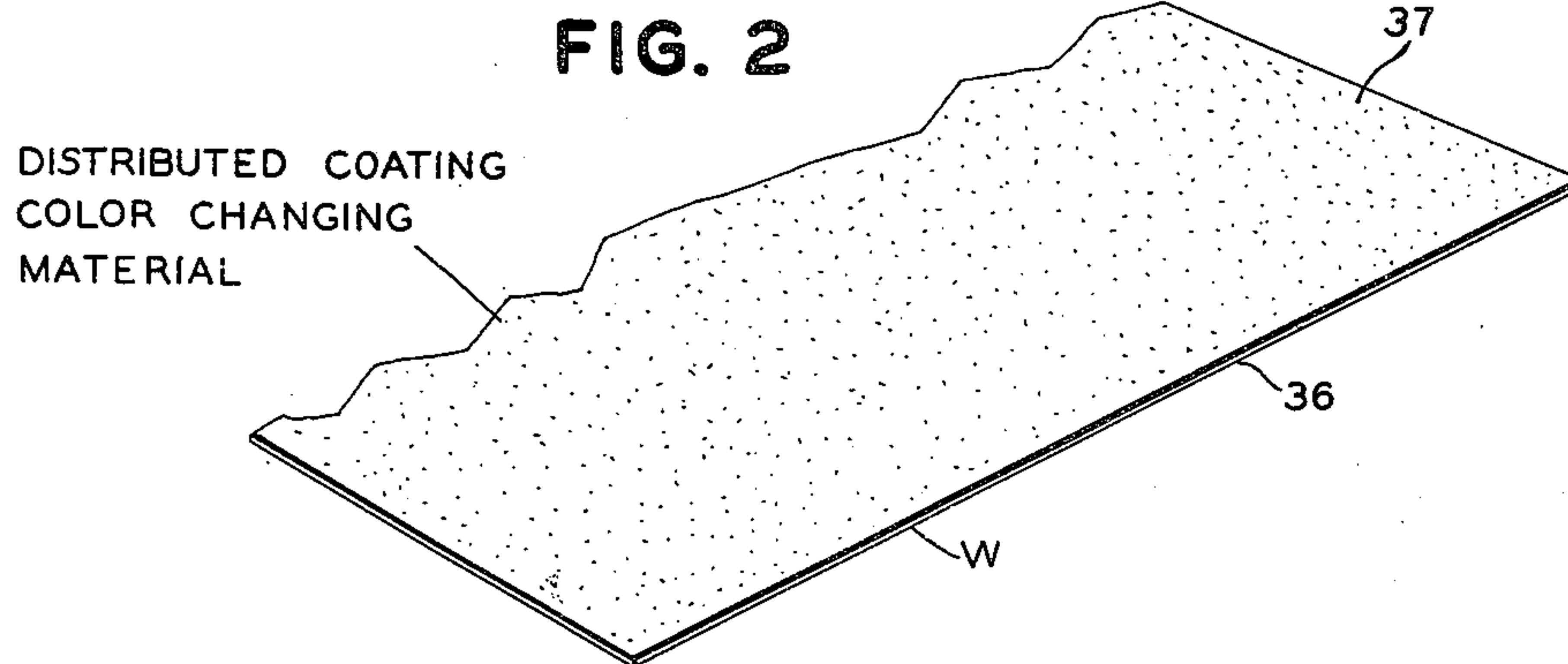
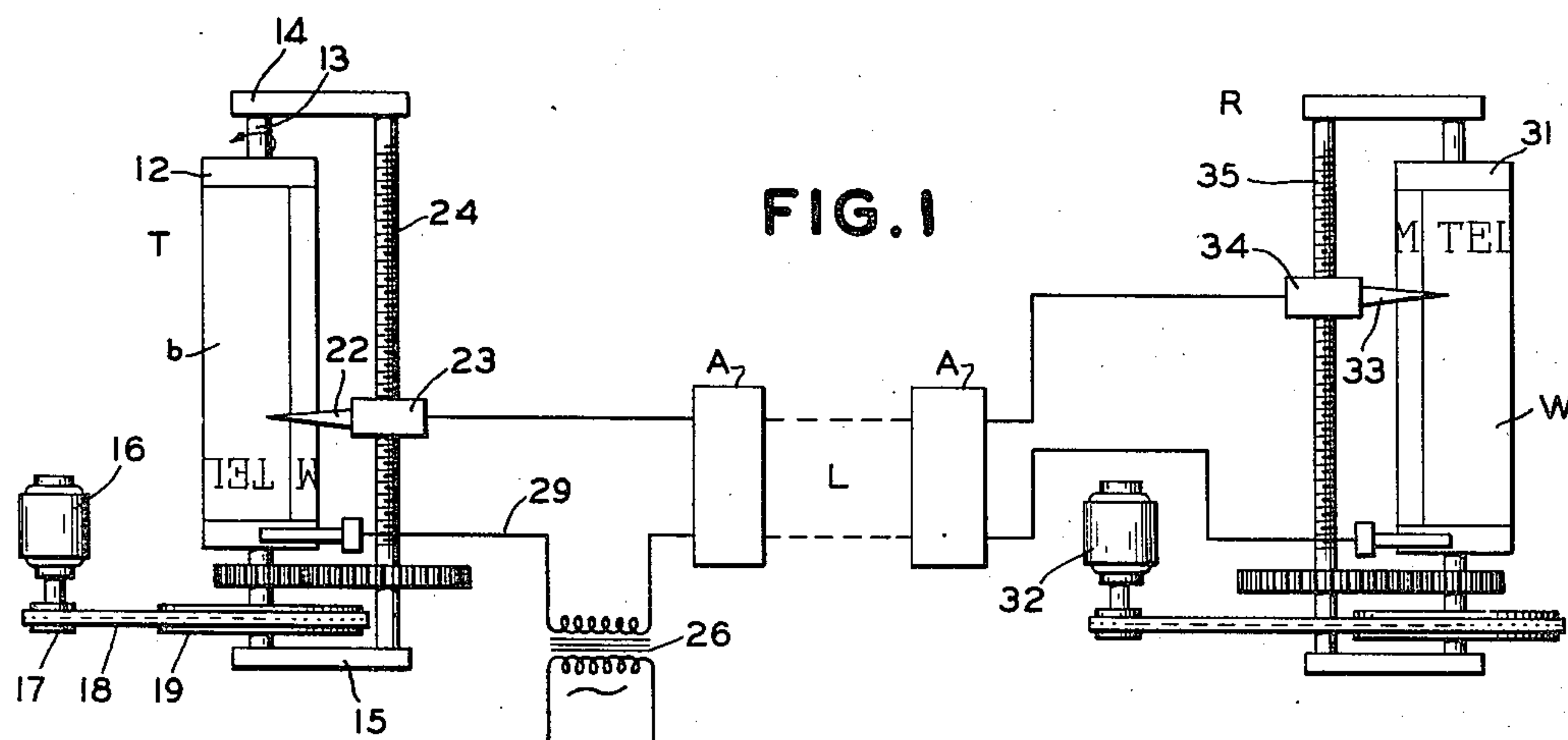
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ELECTRICALLY CONDUCTIVE PAPER AND METHOD OF PRODUCING THE SAME

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ELECTRICALLY CONDUCTIVE PAPER AND METHOD OF PRODUCING THE SAME

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The present invention relates to a novel means for electrically recording visible marks on a recording surface; and more particularly to the production of a novel recording sheet and to a novel method for rendering a sheet of fibrous material electrically conductive.

Known electric recording papers of the kind which are adapted for electrical recording must be saturated with a liquid since the color change is produced by a wet chemical reaction. An improved electric recording paper is disclosed and claimed in a copending application of B. L. Kline, Ser. No. 38,825, filed May 31, 1935, now Patent No. 2,251,742, issued August 5, 1941, employing a color changing medium, such as lead thiosulphate, capable of changing color in the dry state upon application of an electric current. However, the paper which carries the dry color changing material should retain some solvent or be moistened with a liquid or exposed to a source of moisture in order that it will become sufficiently conductive to permit recording. Improved dry recording papers which are inherently conductive because the color changing medium is applied in or on a special conducting paper are disclosed and claimed in a copending application of R. J. Wise et al., Ser. No. 23,928, filed May 28, 1935. The present invention provides a means for making any ordinary paper electrically conductive and is based upon the discovery that a solid conductive solution may be formed in or on the body of a sheet of fibrous material.

A major object of the present invention, therefore, is to provide a novel method of producing a dry telegraphic recording blank.

Another object of the present invention resides in a novel method for rendering a sheet of paper or other fibrous material electrically conductive.

In practicing the invention in one of its preferred forms, a recording medium which will change color upon application of an electric current is applied to the surface or to the fibrous body of a sheet or web of paper and the paper is rendered conducting by the addition of an electrolyte in the form of a solid solution.

It is also within the scope of the present invention to apply an adherent film of a color changing recording medium upon the surface of a web or sheet of paper which has been rendered conductive in accordance with the present invention.

Accordingly, a further object of the invention is to provide a record blank comprising a sheet

or web which is rendered electrically conducting by the addition of a solid solution of an electrolyte and which is provided with a coating of a dry recording medium.

Other objects of the invention relate to the provision of solid electrolytic solutions which act as conductors of electricity and which are useful in fields other than that of electrical recording.

Further and more specific objects will appear in the following complete disclosure of the invention in its several aspects. Referring to the drawing:

Fig. 1 illustrates diagrammatically a facsimile system embodying transmitting and recording means, the said system being of a simple type in which a blank embodying the present invention may be used;

Fig. 2 is a perspective view of a receiving blank embodying the present invention; and

Fig. 3 is a perspective view of a slightly different form of blank embodying the present invention.

Referring for the present to Fig. 1 of the drawing, there is shown a transmitter T comprising a rotatable metallic cylinder 12 supported by a driving shaft 13 which is journaled in a suitable manner in the frame members 14 and 15. During transmission of signals, the cylinder is rotated in the direction indicated by the arrow by suitable means such as the motor 16. The latter may conveniently be of the alternating current synchronous type and is connected by a driving pulley 17 and the belt 18 to the driven pulley secured for rotation with the shaft 13. Means are provided as shown to prevent slippage of the belt on the pulleys.

Transmission is effected by the apparatus illustrated in Fig. 1 in the manner described in my copending application above referred to. Briefly, a scanning electrode or stylus 22, whose point bears on the surface of a blank b bearing conductive characters, is supported by a traveling carriage 23 adapted for longitudinal movement. The stylus 22 is caused to traverse the cylinder in a longitudinal manner by means of the rotatable threaded shaft 24 and therefore the stylus point will describe a spiral path as it moves over the surface of the transmitting blank and thus produce a scanning action.

The method of obtaining the scanning movement described above is well known as are various other methods of scanning a given field, and likewise the action of the receiver R which is to be briefly described and which forms no part

of the present invention, is well known. The transmitting apparatus T and the receiving apparatus R may include transmitting and receiving amplifiers A₁ and A₂, respectively, which are interconnected by an available communication circuit L. If desired, the transmitted signals may have a carrier frequency component introduced by the transformer 26 which is connected in series with the lead 29 from the transmitting drum 12.

At the receiving end the recording is to be accomplished by any apparatus suitable for the purpose. It is to be especially noted that a telegraphic blank produced in accordance with the present invention enables the receiving device to be of an extremely simple nature. The receiver R illustrated by Fig. 1 shows one arrangement for recording upon a recording web or blank *w* and comprises a rotatable cylinder 31 of substantially the same diameter as the cylinder of the transmitter T. The cylinder 31 is rotated in synchronism with the transmitting cylinder 12 in any suitable manner, as by means of an alternating current synchronous motor 32 or other kind of motor which is kept in step with the transmitting motor 16 by any known method of obtaining synchronism. The receiving blank *w* is secured to the cylinder 31 in any suitable manner so that it may be traversed by the point of the scanning stylus 33. The stylus 33 is mounted on a carriage 34 resting upon a threaded shaft 35 rotated with the cylinder 31. The threaded shaft in combination with the rotation of the cylinder produces the scanning action of the stylus 33. The incoming signals are repeated and amplified in the amplifier A₂ in a manner well known in the art to translate the signals into suitable current impulses of the received image. It is to be noted that the only essential of a suitable receiver is that it possess an electrode or stylus similar to the stylus 33 which is capable of exposing the message blank to an electric charge or to cause passage of a current through the blank in accordance with the impulses to be recorded.

A message blank *w* embodying the invention in its simplest form is shown in Fig. 2 of the drawing wherein reference numeral 36 represents a sheet of fibrous material such as paper. Any kind of paper may be used and it is especially to be noted that the paper selected may be pure white since white paper will not be discolored by treatment to be disclosed. The paper layer 36 is rendered conductive in accordance with the invention by the use of solid aliphatic and aromatic alcohols both monohydric and polyhydric or aldehyde or ketone type materials in which there is dissolved an electrolyte. One solid which gives excellent results as a solvent is mannitol, also known as mannite, which is a white solid. This is a hexahydric alcohol and is obtainable in powder form. Another material which will serve as a solvent is erythritol which is a tetrahydric alcohol. Another is resorcinol, a dihydroxybenzene, which may be considered as a phenolic alcohol. Other solids suitable for use as solvents are the higher monohydric alcohols where there are ten or more atoms of carbon in the molecule, certain sugars such as dextrose, and certain hydroxy acids such as succinic acid. Higher aldehydes and ketones are solids and will dissolve certain solids to form electrically conductive solutions. Polyhydroxy compounds which have been partly esterified, structurally similar to glycerylmonophthalate, may also serve as solid solvents.

Preferred solvents are solid polyhydric alcohols; however, related materials such as aldehydes, ketones, sugars and certain hydroxy acids exhibit the same solvent tendency. These materials and those named above may be called solid solvents and are so referred to in the appended claims.

The preferred electrolyte is ammonium nitrate. Salts which exhibit solubility in ethyl alcohol are in general adapted to form the solid solution of the invention. Some of these, for example, are salts of sodium, potassium and ammonium, preferably their iodides, sulpho-cyanides, bromides, chlorides, nitrates and sulphates. Certain organic compounds also may be employed such as nitrobenzene sulphonic acid.

To prepare the sheet or blank *w* to make it conductive in accordance with the present invention, it is preferable to make an aqueous or alcoholic solution of the selected solvent such as mannitol and the electrolyte such as ammonium nitrate, and impregnate the paper with this liquid solution. Upon evaporation of the volatile content of this solution, the paper then contains the solvent in solid form and the ammonium nitrate separately. To form the solid solution the paper which has been treated with the liquid solution and dried, is calendered under heat and pressure. Both the solvent and the electrolyte melt and form a solid solution within the paper which is conductive even when it and the paper which contains it are perfectly dry. It is to be noted that heat alone in some instances can be used to form the solid solution of the materials in the paper and that in some instances pressure alone will serve to form the solid solution.

The color changing materials which may be applied as a layer 37 to the surface of the paper *w*, are lead thiosulphate; a material having a plurality of allotropic forms such as mercuric sulphide, mercuric iodide or mercuric oxide; and lead thiocyanate. Any one of these color changing materials may be incorporated into an ink as disclosed in Patent 2,251,742 above referred to and applied as a film to the exposed surface of the sheet *w* in the manner suggested by Fig. 3 of the drawing in which 38 indicates a color changing film, or they may be dusted on or mixed with an adherent binder and painted or sprayed upon the web *w*. It is within the scope of the present invention to incorporate the color changing medium in the pulp prior to the manufacture of paper therefrom, and when this is done, the resulting paper product may be made electrically conducting at any time by forming the solid solution in the paper in the manner described above, using heat or pressure or perhaps both. It is also within the scope of the invention to add the solvent and electrolyte to the pulp. If this is done, the color changing medium may be added to the pulp or it may be applied to the electrically conductive paper product which results. While the color changing material may be added in any of the above stated ways before forming the solid conducting solution within the body of the paper, it is preferably applied after the paper has been made conductive in accordance with the invention.

From the foregoing disclosure of my invention in the several aspects thereof, it will be seen that I have provided a recording blank which possesses advantages not to be found in recording blanks of the prior art. The recording blank constructed in accordance with the teachings of the present invention can be made of ordinary paper so that it may be pure white in appearance, or tinted to

match any desired shade, and it can be used perfectly dry, which facilitates the handling thereof and makes unnecessary the use of special arrangements in the receiving apparatus to provide for moistening prior to and during reception of impulses or signals which it is desired to record.

The nature of the invention will be determined from the foregoing and the scope thereof is defined in the appended claims.

I claim:

1. The method of producing an electrically conductive paper product which comprises forming a solid solution in the body of a fibrous sheet of an electrolyte in a solid oxygen containing solvent.

2. The method of producing an electrically conductive paper product which comprises the steps of treating a fibrous sheet with a liquid containing a solid oxygen containing solvent and an electrolyte capable of forming a solid solution with said solid solvent, drying said sheet, and thereafter treating said sheet to cause said solid solvent and said substance to combine in the form of a solid solution.

3. The method of claim 2, wherein said solid solvent is an alcohol.

4. The method of claim 2, wherein said solid solvent is a polyhydric alcohol.

5. The method of claim 2, wherein said solid solvent is a ketone.

6. The method of claim 2, wherein said solid solvent is a hydroxy acid.

7. The method of producing an electrically conductive paper product which comprises the steps of treating a fibrous sheet with a liquid containing a solid oxygen containing solvent and an electrolyte capable of forming a solid solution with said solvent, drying said sheet, and thereafter subjecting said sheet to heat to cause said solvent and said substance to combine in the form of a solid solution.

8. The method of producing an electrically conductive paper product which comprises the steps of treating a fibrous sheet with a liquid containing a solid alcohol and an ammonium salt soluble therein, drying said sheet, and thereafter

subjecting said sheet to heat to cause said higher alcohol and said ammonium salt to combine in the form of a solid solution.

9. The method of producing an electrically conductive paper product which comprises the steps of treating a fibrous sheet with a liquid containing a hexahydric alcohol and ammonium nitrate, drying said sheet, and thereafter treating said sheet to cause said alcohol and said ammonium nitrate to combine in the form of a solid solution.

10. The method of producing an electrically conductive paper product which comprises the steps of treating a fibrous sheet with a liquid containing a solid oxygen containing solvent and an electrolyte capable of forming a solid solution with said solvent, drying said sheet, and thereafter calendering said sheet to form a solid solution comprising said solvent and said substance.

11. An electrically conductive paper product comprising a sheet of paper having a solid solution of an electrolyte dissolved in a solid oxygen containing solvent formed in the body of said sheet.

12. An electrically conductive paper product comprising a sheet of paper containing a solid solution of a solid oxygen containing solvent and an electrolyte capable of forming a solid solution with said solvent distributed through said fibrous body.

13. The paper product defined in claim 12 wherein said solid solvent is an alcohol.

14. The paper product defined in claim 12 wherein said solid solvent is a polyhydric alcohol.

15. The paper product defined in claim 12 wherein said solid solvent is a ketone.

16. The paper product defined in claim 12 wherein said solid solvent is a hydroxy acid.

17. An electrically conductive paper product comprising a sheet of paper containing a solid solution of an organic solid oxygen containing solvent and an electrolyte capable of forming a solid solution with said solvent distributed through said fibrous body.

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