

Aug. 25, 1942.

R. J. WISE

2,294,146

ELECTROSENSITIVE RECORDING BLANK

Filed Jan. 27, 1939

2 Sheets-Sheet 1

FIG. 1

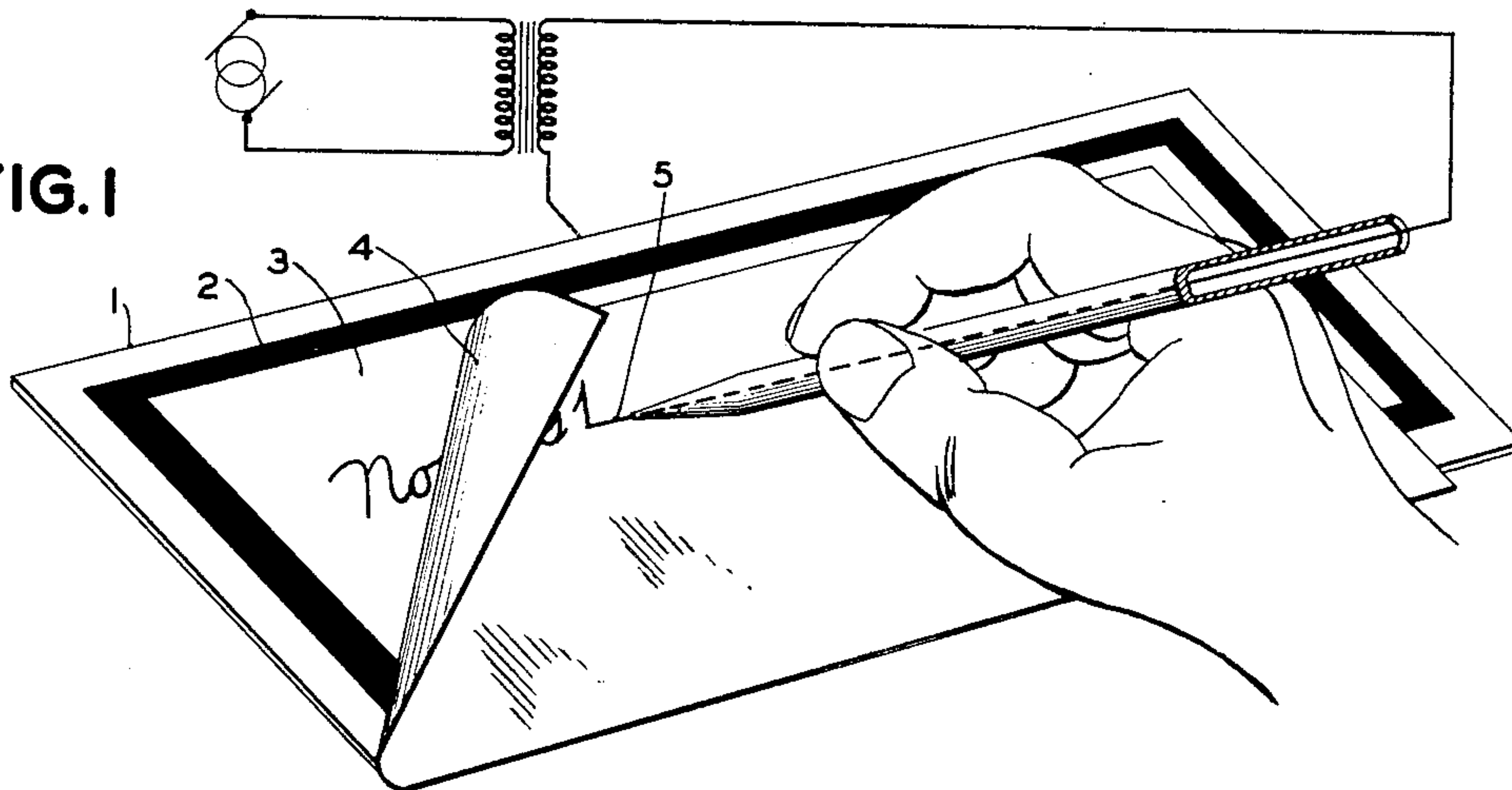


FIG. 3

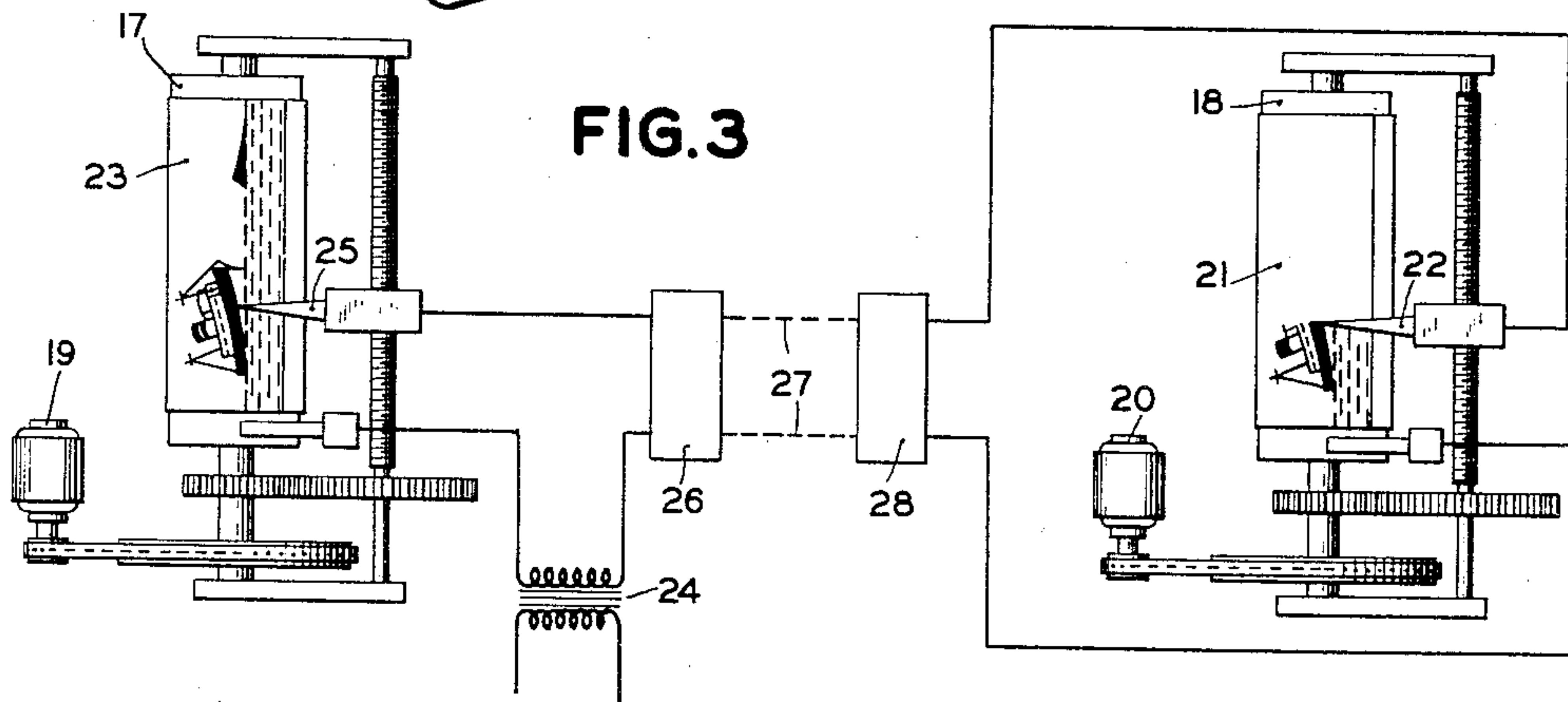
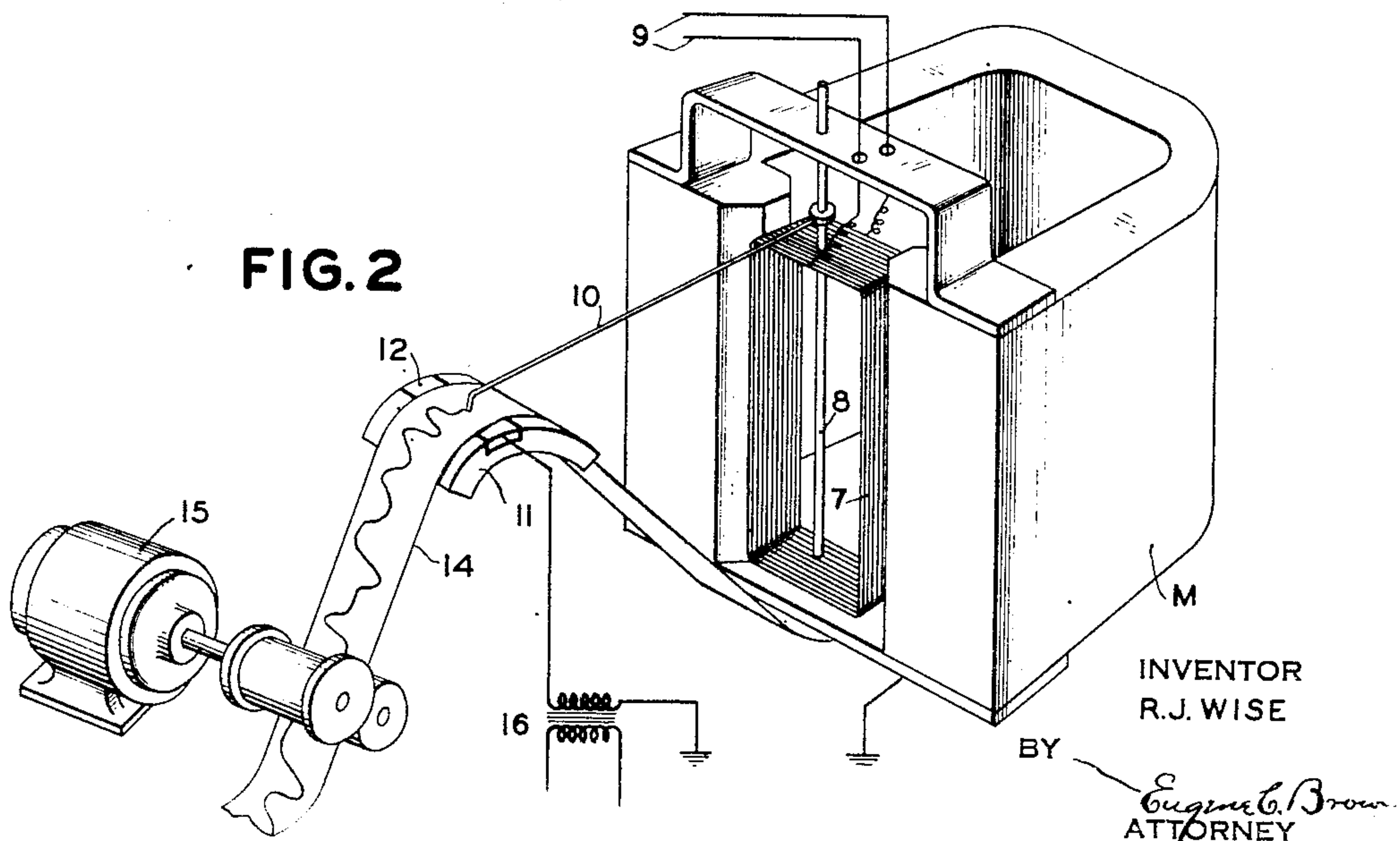


FIG. 2



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2 Sheets-Sheet 2

FIG. 5

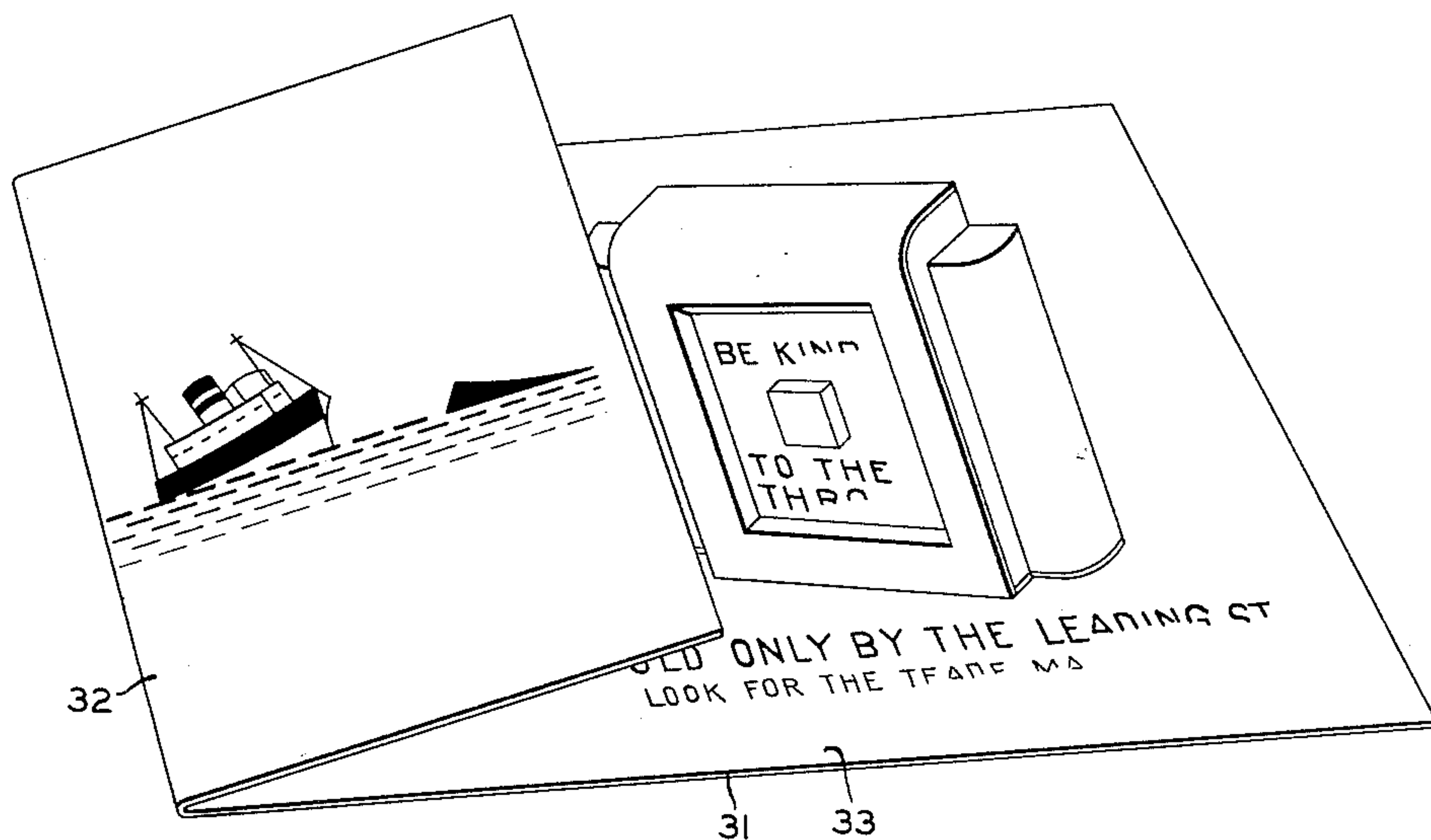


FIG. 6

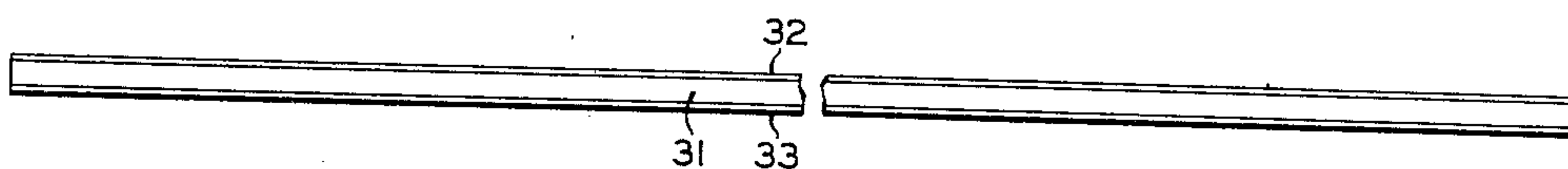
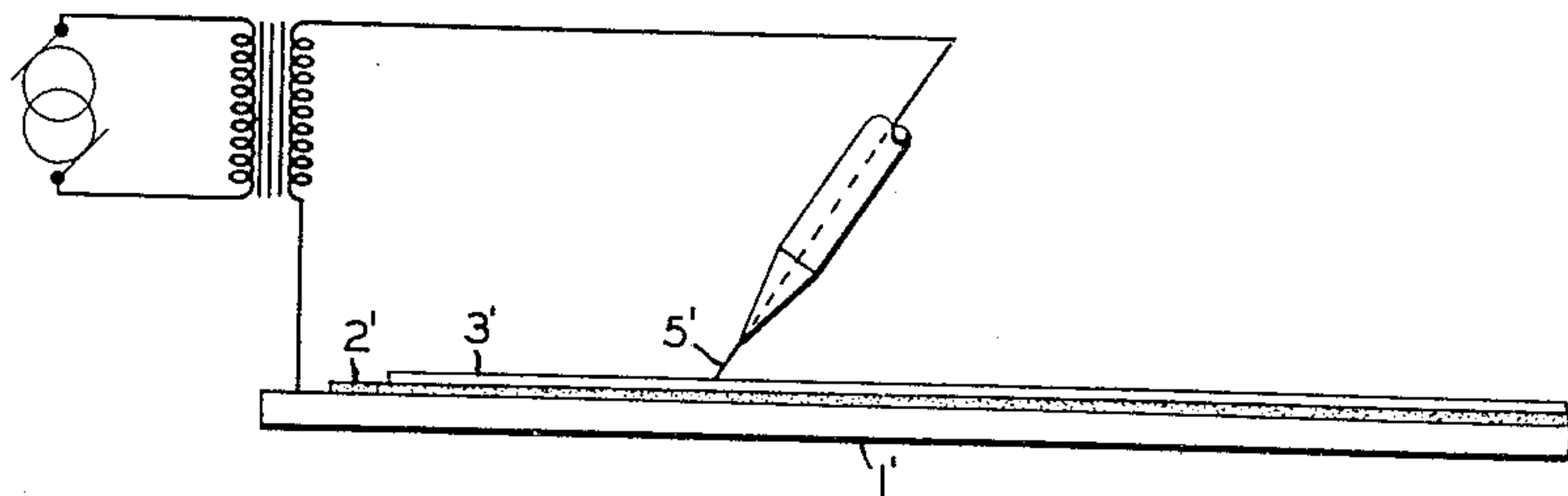


FIG. 4



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2,294,146

ELECTROSENSITIVE RECORDING BLANK

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Application January 27, 1939, Serial No. 253,153

12 Claims. (Cl. 204—2)

The present invention relates to recording means for use principally in high speed telegraph and facsimile systems, in which marks may be made upon a recording medium by subjecting the medium to electrical forces.

Its principal object is to provide an improved electrosensitive recording blank adapted for use with recorders of various kinds, particularly where occurrences of short time duration must be recorded, as for example, in picture transmission systems.

Another object is to provide an electrosensitive recording blank which can be stored and handled as an ordinary paper but which is adapted to be permanently marked by simple electrical means.

Another object is to provide an electrosensitive recording blank comprising a stable supporting sheet for a recording coating for use in the electrical recording of signals which will facilitate the application of marking electrical forces to said coating.

In accordance with the present invention a base such as a fibrous sheet which contains distributed conducting particles, such as carbon, silver, etc., and thinly coated with a contrasting pigment, is employed to produce records, such as facsimile recordation by subjecting it to electrical forces applied through the base and coating. The invention may be practised by including successive minute areas of the base or support and its coating in an electrical circuit. The mark is apparently produced primarily either by a transfer of the conducting particles from the base to and/or through the masking pigment or by removal of the coating medium from its conducting support to disclose the support in contrast thereto or both. In the case of some coating pigments a color change may also occur in the coating itself, either by a change in the allotropic form of the coating or by a change in its chemical composition.

The present application is a continuation in part of my earlier co-pending application Ser. No. 23,927, filed May 28, 1935.

Fig. 1 is a perspective view of a recording medium and a simplified marking means illustrating a principle which probably contributes to the production of a mark in accordance with the invention.

Fig. 2 is a perspective view of the recording medium and a marking means illustrating its application to a tape recorder used to record telegraph signals.

Fig. 3 illustrates the application of the inven-

tion to the recording of pictures electrically transmitted from a distant point.

Fig. 4 is a sectional view of a modified arrangement of the recording means of Fig. 1.

Fig. 5 is a perspective view of an improved recording medium constructed in accordance with the invention.

Fig. 6 is a sectional view of the recording sheet of Fig. 5.

In Fig. 1 an electrically conductive platen 1 supports a suitable source of marking material which may comprise a sheet of paper 2 impregnated with, or the surface of which has been coated, as by rolling, with marking particles, such as finely divided carbon, silver, or other suitable material. A recording medium 3, which may be a piece of ordinary writing paper, is placed over the source of marking material 2, and an insulating sheet 4, which may be mica, cellophane or similar material is disposed over the recording medium 3. A stylus 5 is assumed to be movable so that it may be placed upon the recording medium or paper at any point at which it is desired to mark the paper. The platen 1 and stylus 5 are connected to a source of electrical potential 6 so that an electrostatic force is established through the marking medium between the platen and any point on the sheet 4 touched by the stylus. Upon application of this potential through the superimposed sheets 2, 3 and 4, some of the particles of the marking material are detached from the source 2 and are moved toward and in some instances through the recording medium 3. With a suitable potential applied between the platen and the stylus, these particles will become attached to and imbedded into the sheet 3. Thus the path of movement of the stylus 5 over the insulating sheet 4 will be recorded on the surface of the sheet 3 nearest the source of marking material 2, without production of a discharge through the paper and consequent perforation or other damage to the substance of the sheet 3.

When the potential of the power source 6 is increased, the particles of marking material are more deeply imbedded into the sheet 3. The depth to which the particles are imbedded also depends upon the material, texture and penetrability of the recording medium 3, its depth being greater with the more loosely bound, softer and more porous media. If the electrical forces applied are sufficiently great and the sheet 2 sufficiently porous, some of the particles will be moved through the recording medium and become visible upon the surface nearest the stylus.

Thus any legend may be permanently written on the sheet 3 with the stylus 5.

It has been found in practice that the insulating sheet 4 is not essential. It has been included in Fig. 1, however, to prevent passage of current, which would otherwise occur, through the record sheet 3 and conducting supporting sheet 2, thereby to prevent perforation of the sheet 3, which would destroy areas of the sheet on which solid black is to be recorded. The presence of the insulating support 4 permits a suitable electric field strength to be created between the platen 2 and the stylus 5, to effect a marking of the sheet 3 without the occurrence of a disruptive spark. However, where the subject matter to be recorded does not require the production of extended dark areas, the insulating sheet 4 may be omitted and a sufficient electric potential employed to cause a disruptive discharge through the sheet 3. This produces a more intense marking on the recording surface, particularly when a compact material is used for the recording medium, as the rupture increases the penetrability of the medium to the moving marking particles.

Fig. 2 illustrates a direct writer used to record telegraph signals. In the most common form of this recorder a siphon carrying the marking ink is drawn across a moving tape. In Fig. 2 the recording means of the present invention has been substituted for the usual ink and siphon marking means. The moving element 7 consists of a coil of wire mounted in the field of the permanent magnet M in such a manner that it may rotate about an axis 8. This moving element is connected to the electric circuit 9 from which signals are to be recorded. The coil carries an arm or stylus 10, the end of which is disposed above a platen 11. In this platen a conducting member 12, insulated from the remainder of the mechanism, is mounted. A motor 15 pulls a recording medium 14 in the form of a tape over the platen and between the contacting stylus 10 and the conducting member 12.

It has been found that black papers made from pulp in which a quantity of finely divided carbon has been admixed, are well adapted to form the base for blanks prepared in accordance with this invention. An effective contrasting white surface can be obtained by coating this black paper, having conducting carbon particles homogeneously dispersed therein, with a thin layer of any desired white paint or ink. Those paints or inks having high covering power or opacity, such as one containing titanium dioxide, lithopone, antimony oxide, lead oxide, powdered aluminum, etc., or mixtures thereof, are highly effective since thin coatings thereof may be employed. Recordings may be obtained in accordance with the invention by using coatings of different thicknesses, but it has been found in practice that with pigments of good covering power, masking of the carbon bearing sheet may be obtained with coatings of a thickness in the range between .00008 and .00015 of an inch, and that with coatings of this degree of thinness exceptionally fine and sharp recordings are obtainable. Thinner coatings may be used if of sufficient masking or covering power. Thicker coatings may also be used but require the application of proportionally higher potentials and result in somewhat coarser recording. Due to the fact that the recording phenomena is obtainable with a wide variety of dissimilar materials, the recording action is apparently pri-

marily physical in contradistinction to chemical action and the coating may contain any pigment which covers the surface of the underlying conductive particle containing sheet with a contrasting layer. The kind of paper and masking pigment used for a particular application may be varied depending upon the character of the background and the mark desired.

In operation of the arrangement disclosed by Fig. 2, the stylus 10 and the conducting member 12 of the platen are connected to a source of electrical potential indicated by the transformer 16. The effect of electrical energy from the source 16 is to produce a mark on the paper of the color of the support which contrasts with the unaffected portion of the coating. The stylus is moved across the paper whenever a change of current in the circuit 9 alters the position of the coil element 7 in the field of the magnet M, and since the motor continuously pulls a tape under the stylus, a curve will be drawn showing the current changes in the circuit 9.

In Fig. 3 is shown a picture transmission system embodying two drums 17 and 18 which are assumed to be synchronously driven by the motors 19 and 20. Drum 17 is the sending instrument of a facsimile system in which the message, picture or other subject matter to be transmitted is scanned and the successive signals over a line depend upon the nature of the picture or message being scanned. Such a system is described in my copending application Ser. No. 23,926, filed May 28, 1935, now Patent No. 2,153,858, issued April 11, 1939.

The recording medium 21 may combine the features disclosed above with the marking means in the copending application of R. J. Wise et al., Ser. No. 23,928, filed May 28, 1935, and entitled "Recording means." Briefly, this copending application discloses a method of and means for recording which involves a change in the allotropic form of a substance, such as mercuric sulphide, applied to or incorporated in a suitable conducting support or sheet by the application of electrical potential variations to the surface thereof in accordance with transmitted signals. The recording medium 21 may consist of the above described black carbon bearing paper coated with vermilion mercuric sulphide or with vermilion mercuric sulphide mixed in any desired proportion with any of the pigments set forth above. The stylus 22 is adapted to move longitudinally as drum 18 rotates so that the stylus traces a helical path on the recording medium 21.

An electric circuit for scanning the picture 23 comprises a source of current 24, drum 17, the picture 23, the sending stylus 25, and amplifier 26. As explained in my aforesaid Patent No. 2,153,858, a current will flow through this electric circuit when the sending stylus 25 contacts a printed portion of the transmitting copy 23. These current impulses are amplified by amplifier 26 and are transmitted over the line 27 to the receiving amplifier 28. The output of the amplifier 28 is connected across the receiving stylus 22 and the drum 18. Thus a potential is applied across and current caused to flow through the recording medium whenever the sending stylus 25 contacts a printed portion of the copy 23. The applied impulse causes a black mark to appear which is believed to be due in part to the movement of black carbon particles to the surface of the mercuric sulphide coating and in part to the change of the vermilion mer-

curic sulphide to the allotropic black form thereof, and also by the removal of a portion of the coating. The marks thus made under the control of the sending equipment form a reproduction of the transmitting copy upon the recording medium.

It will be understood, of course, that the recording medium shown in Fig. 2, which comprises a coating of opaque substance, such as titanium dioxide or other masking pigment, over a sheet containing conductive particles, such as finely divided carbon, silver, or aluminum, may be employed in the facsimile system of Fig. 3. Moreover, the use of mercuric sulphide or other allotropic substance whereby the combined allotropic effect and marking of the coating from the underlying impregnated support, is obtained, may be employed with the apparatus shown in Fig. 2.

In the system of Fig. 1 recording may also be effected on a separate sheet superimposed on the sheet containing the marking particles as shown in Fig. 1 without the insulating sheet 4 interposed between the recording sheet and the stylus and in Fig. 4 I have shown such separate recording sheet 3' superimposed on a sheet 2' impregnated with a conducting solid, such as carbon, silver, etc., in which the stylus 5' contacts directly with the sheet 3'.

Referring now to Figs. 5 and 6 of the drawings which show a modification of the recording medium disclosed in Figs. 2 and 3, reference character 31 indicates a sheet of paper having solid conducting particles of carbon, silver, aluminum, or the like, homogeneously distributed therein. The paper 31 is coated on both sides with thin pigment layers 32 and 33 which may consist of or comprise any of the coating pigments or substances stated above. Coatings 32 and 33 may be identical or they may contain ingredients which differ from each other so that the background of the record on one side of the sheet will differ from the background of a picture or message recorded on the other side. The sheet 31 may be placed upon the drum 18 of Fig. 3 with the coated side 33 in contact with the drum. The stylus 22 will then mark the surface 32, the coating 33 remaining undisturbed since it is in intimate contact over the large peripheral area of the drum 18, thus reducing the current density below that required to cause marking of the surface 33. However, even though the coating 33 is substantially non-conducting, displacement current is passed therethrough at the frequencies ordinarily employed for picture transmission, due to the condenser effect produced by the solid conducting particles of sheet 31 and the drum 18 spaced therefrom only by the thickness of the coating 33. The stylus 22 which has a relatively sharp point causes concentration of electrical forces on the surface 32 thereby producing a mark on the surface 32 but such forces are distributed over a sufficient area on the reverse side 33 to prevent marking thereof. When a picture or other record has been produced on the surface 32, as indicated in Fig. 5 of the drawings, a record may then be made on the opposite side 33 merely by reversing the sheet and placing the previously recorded side 32 in contact with the recording machine platen or cylinder.

The pigment which has been referred to as being applied in the form of a paint or ink, may be suspended in any suitable vehicle or binder, ordinarily employed in the paint or ink industry, such as linseed oil, tung oil, Perilla oil, fish oil,

soya bean oil, etc. The applied electrical forces when certain pigments are used, appears to produce an actual color change in the body of the pigment by chemical or allotropic action, due in large measure to the passage of the current through the pigment. However, such chemical or allotropic change is not necessary for recording since the flow of current and the force of a possible electrostatic field appears to effect the two-fold purpose of blasting off or causing percussive removal of the pigment to disclose the contrasting under sheet and to cause movement of the conducting particles to or near the surface of the base adjacent the stylus. Where the mark is produced primarily by blasting off of the coating and/or movement of the base particles through the coating, any chemical or allotropic color change which may take place within the coating is not essential to the marking.

As stated, the composition of the masking pigment is not material, providing it suitably masks the impregnated sheet since, due to the presence of the distributed conducting particles in the base sheet, the only material resistance to the flow of current from the stylus through the sheet is that of the coating itself. By using a thin layer of pigment in intimate contact with the carbon impregnated paper, this resistance path is extremely short and hence permits the concentration of powerful electrical forces in the portion of the coating directly beneath the stylus by nature of which a rapid and intense marking of the coating is obtained over a confined area, and at relatively low potentials. Due to the thin coating and the presence of the conducting carbon particles in direct contact therewith, mushrooming or spreading of the discharge is prevented and extremely sharp and distinct markings may be obtained, the width of the recorded line varying in direct proportion to the potential applied. The potential required to mark the coating is a function not only of the thickness of the coating but also of the rate of scanning and with a coating such as titanium dioxide of a thickness of one ten thousandths of an inch applied in a binder such as linseed oil, scanned at a speed of thirty inches per second, may be of the order of magnitude of 300 volts.

From the foregoing disclosure of the invention it will be seen that there is provided a stable recording medium comprising a base containing conducting particles and covered by an opaque or masking film which provides ready means for recording electrical signals. The nature of the invention will be determined from the foregoing and the scope thereof is defined in the appended claims.

I claim:

1. An electrosensitive recording blank having a recording surface layer adapted to be scanned by an electrode for applying to selected elemental areas of said surface layer electrical marking forces representative of subject matter to be recorded thereon, said surface layer comprising a substance responsive to said electrical marking forces when applied to the surface layer to provide a contrasting appearance in said selected areas with respect to the background of the recording surface of said blank, said blank having means for causing concentration of the applied electrical marking forces in said selected areas of the recording surface layer to provide sharp definition of the recorded subject matter, said last named means comprising a layer of material of good electrical conductivity embodied in said

blank in contact with said recording surface layer, said conducting layer being adapted to be operatively connected in circuit with said scanning electrode for causing said electrical marking forces to be exerted through said recording surface layer.

2. An electrosensitive recording blank having a recording surface layer adapted to be scanned by an electrode for applying to selected elemental areas of said surface layer electrical marking forces representative of subject matter to be recorded thereon, said surface layer comprising an adherent superficial coating of a substance responsive to said electrical marking forces when applied to the surface layer to provide a contrasting appearance in said selected areas with respect to the background of the recording surface of said blank, said blank having means for causing concentration of the applied electrical marking forces in said selected areas of the recording surface layer to provide sharp definition of the recorded subject matter, said last named means comprising a layer of material of good electrical conductivity embodied in said blank in contact with said recording surface layer, said conducting layer being adapted to be operatively connected in circuit with said scanning electrode for causing said electrical marking forces to be exerted through said recording surface layer.

3. An electrosensitive recording blank having a recording surface layer adapted to be scanned by an electrode for applying to selected elemental areas of said surface layer electrical marking forces representative of subject matter to be recorded thereon, said surface layer comprising an adherent superficial coating of a pigment responsive to said electrical marking forces when applied to the surface layer to provide a contrasting appearance in said selected areas with respect to the background of the recording surface of said blank, said blank having means for causing concentration of the applied electrical marking forces in said selected areas of the recording surface layer to provide sharp definition of the recorded subject matter, said last named means comprising a layer of material of good electrical conductivity embodied in said blank in contact with said recording surface layer, said conducting layer being adapted to be operatively connected in circuit with said scanning electrode for causing said electrical marking forces to be exerted through said recording surface layer.

4. An electrosensitive recording blank having a recording surface layer adapted to be scanned by an electrode for applying to selected elemental areas of said surface layer marking currents representative of subject matter to be recorded thereon, said surface layer comprising a substance responsive to said marking currents when applied to the surface layer to provide a contrasting appearance in said selected areas with respect to the background of the recording surface of said blank, said blank having means for causing concentration of the marking currents in said selected areas of the recording surface layer to provide sharp definition of the recorded subject matter, said last named means comprising a layer of electrical conducting material embodied in said blank in contact with said recording surface layer, said conducting layer being adapted to be operatively connected in circuit with said scanning electrode for causing said marking currents to pass through said recording surface layer, the volumetric electrical resistance of said conducting layer being low relative to the volumetric elec-

trical resistance of said recording surface layer.

5. An electrosensitive recording blank having a thin recording surface layer of high volumetric electrical resistance adapted to be scanned by an electrode for applying to selected elemental areas of said surface layer electrical marking forces representative of subject matter to be recorded thereon, the thickness of said surface layer being of the order of magnitude of .00008 to .00015 of an inch, said surface layer comprising a substance responsive to said electrical marking forces when applied to the surface layer to provide a contrasting appearance in said selected areas with respect to the background of the recording surface of said blank, said blank having means for causing concentration of the applied electrical marking forces in said selected areas of the recording surface layer to provide sharp definition of the recorded subject matter, said last named means comprising a conducting layer of electrical conducting material embodied in said blank in contact with said recording surface layer, said conducting layer being adapted to be operatively connected in circuit with said scanning electrode for causing said electrical marking forces to be exerted through said recording surface layer, the volumetric electrical resistance of said conducting layer being low relative to the volumetric electrical resistance of said recording surface layer.

6. An electrosensitive recording blank having a recording surface layer adapted to be scanned by an electrode for applying to selected elemental areas of said surface layer electrical marking forces representative of subject matter to be recorded thereon, said blank comprising a sheet impregnated with conducting particles so as to form a conducting layer, said sheet having thereon an adherent coating comprising a masking pigment of contrasting color to said conducting particles, said adherent coating forming said recording surface layer and having the characteristic of being responsive to said electrical marking forces when applied to the surface layer to provide a contrasting appearance in said selected areas with respect to the background of the recording surface of the blank, said layer of conducting particles causing concentration of the applied electrical marking forces in said selected areas of the recording surface to provide sharp definition of the recorded subject matter, said conducting layer being adapted to be operatively connected in circuit with said scanning electrode for causing said electrical marking forces to be exerted through said recording surface layer.

7. An electrosensitive recording blank having a recording surface layer adapted to be scanned by an electrode for applying to selected elemental areas of said surface layer electrical marking forces representative of subject matter to be recorded thereon, said blank comprising a sheet impregnated with carbon particles so as to form a conducting layer, said sheet having thereon an adherent coating comprising a masking pigment of contrasting color to said carbon particles, said adherent coating forming said recording surface layer and having the characteristic of being responsive to said electrical marking forces when applied to the surface layer to provide a contrasting appearance in said selected areas with respect to the background of the recording surface of the blank, said layer of carbon particles causing concentration of the applied electrical marking forces in said selected areas of the recording surface to provide sharp definition of the recorded subject matter, said conducting layer

being adapted to be operatively connected in circuit with said scanning electrode for causing said electrical marking forces to be exerted through said recording surface layer.

8. An electrosensitive recording blank having a recording surface layer adapted to be scanned by an electrode for applying to selected elemental areas of said surface layer electrical marking forces representative of subject matter to be recorded thereon, said blank comprising a sheet impregnated with a conducting substance so as to form a conducting layer, said sheet having thereon an adherent coating of a masking pigment comprising titanium dioxide, said masking pigment forming said recording surface layer and having the characteristic of being responsive to said electrical marking forces when applied to the surface layer to provide a contrasting appearance in said selected areas with respect to the background of the recording surface of the blank, said conducting layer causing concentration of the applied electrical marking forces in said selected areas of the recording surface to provide sharp definition of the recorded subject matter, said conducting layer being adapted to be operatively connected in circuit with said scanning electrode for causing said electrical marking forces to be exerted through said recording surface layer.

9. An electrosensitive recording blank having a recording surface layer adapted to be scanned by an electrode for applying to selected elemental areas of said surface layer electrical marking forces representative of subject matter to be recorded thereon, said blank comprising a sheet impregnated with a conducting substance so as to form a conducting layer, said sheet having thereon an adherent coating of a masking pigment comprising one or more materials of the class consisting of titanium dioxide, lithopone, antimony oxide, lead oxide and powdered aluminum, said masking pigment forming said recording surface layer and having the characteristic of being responsive to said electrical marking forces when applied to the surface layer to provide a contrasting appearance in said selected areas with respect to the background of the recording surface of the blank, said conducting layer causing concentration of the applied electrical marking forces in said selected areas of the recording surface to provide sharp definition of the recorded subject matter, said conducting layer being adapted to be operatively connected in circuit with said scanning electrode for causing said electrical marking forces to be exerted through said recording surface layer.

10. An electrosensitive recording blank comprising a recording surface which includes a marking substance responsive to electrical mark-

ing potentials when applied to selected areas of the recording surface for producing visual marking effects in said selected areas, a layer of dielectric material embodied in said blank, and a layer of a substance of relatively good electrical conductivity embodied in said blank and disposed adjacent to said dielectric layer, said dielectric layer and said conducting layer providing electrical condenser elements of sufficiently high capacity to cause displacement currents to flow through said recording blank in accordance with the electrical marking potentials applied to said selected areas of the recording surface.

11. An electrosensitive recording blank adapted to be scanned by an electrode for applying to selected elemental areas thereof electrical forces representative of subject matter to be recorded thereon, said blank comprising a layer of a substance of relatively good conductivity, and a layer of a dielectric material disposed on each side of said layer of good conductivity, each of said dielectric layers including a substance responsive to the passage of electrical marking current through selected areas thereof for producing visual marking effects in said selected areas, said dielectric layers being sufficiently thin to cause such a concentration of said electrical current in said selected areas of the said dielectric layer to which said electrode is applied to produce a marking effect thereon, and such a capacitative effect across said opposite dielectric layer as to pass said electrical current by displacement without producing a marking effect thereon.

12. An electrosensitive recording blank having on one side thereof a recording surface which includes a marking substance responsive to electrical marking potentials when applied to selected areas of the recording surface for producing visual marking effects in said selected areas, a layer of dielectric material embodied in said blank, and a layer of a substance of relatively good electrical conductivity embodied in said blank and disposed adjacent to said dielectric layer, said dielectric layer and said conducting layer providing electrical condenser elements of sufficiently high capacity to cause displacement currents to flow through said recording blank in accordance with the electrical marking potentials applied to said selected areas of the said recording surface, said layer of dielectric material being disposed on the opposite side of said blank from said recording surface and comprising a marking substance responsive to electrical marking potentials when applied to selected areas thereof, whereby both sides of the blank may be used at different times, respectively, for recording purposes.

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