

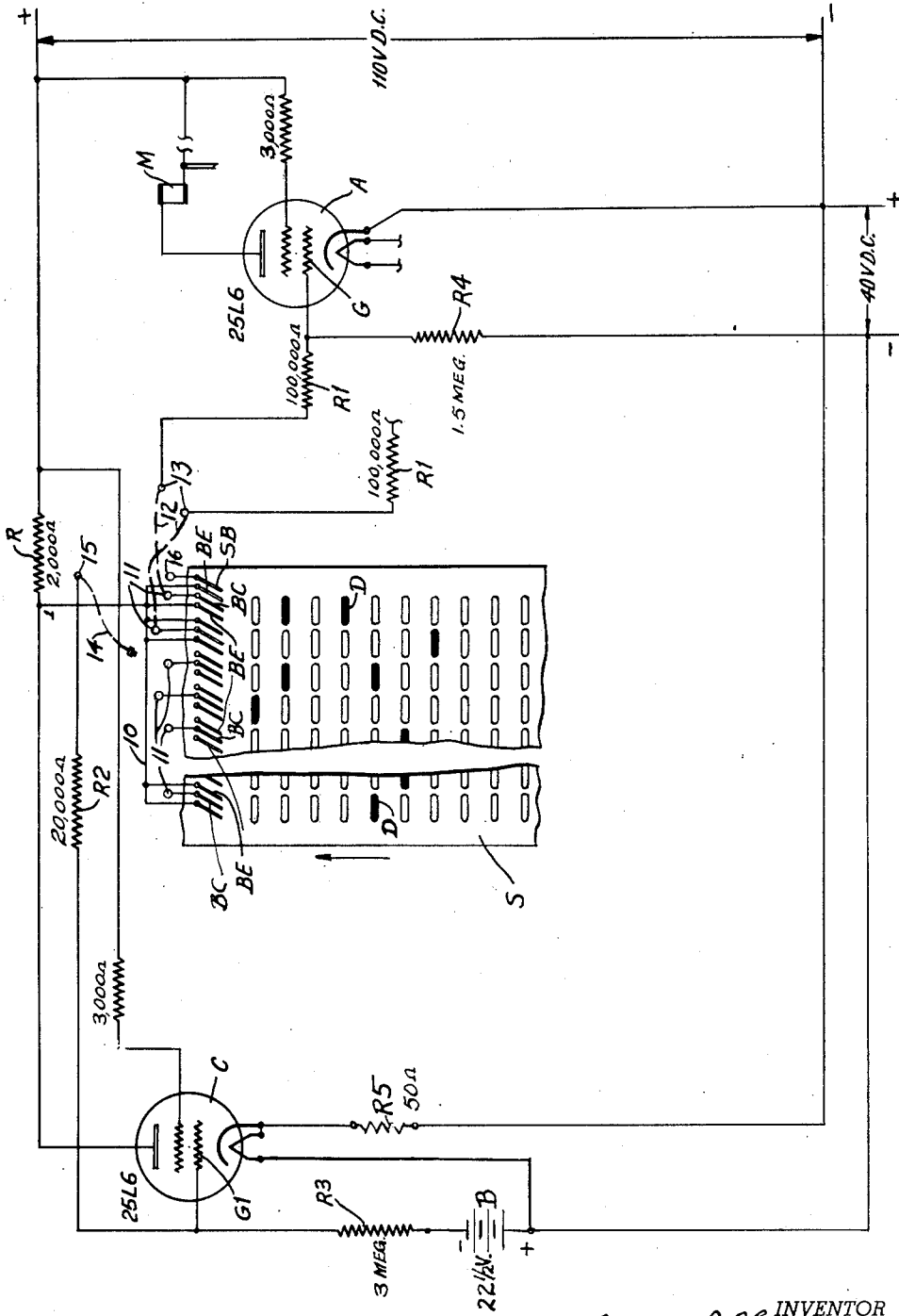
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RECORD SENSING MEANS

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RECORD SENSING MEANS

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This invention relates broadly to code controlled systems, and more particularly to means capable of initiating control impulses upon the sensing of indicia designating code marks upon a control sheet.

The present invention is particularly applicable to such systems wherein a control or record sheet has code marks utilized to control impulse initiating circuits.

An object of the present invention resides in the provision of improvements applied to sensing means for analyzing a record sheet provided with coded designations formed, for example, by conductive graphite or by conductive ink, and which initiates control impulses whenever the designations are presented to a sensing station.

The sensing means may be of the type for concurrently sensing a plurality of control positions of a record sheet to establish signal or control circuits or may be of the type for sensing control positions of a record sheet successively to control impulse initiating circuits. The control or signal circuits may determine various operations dependent upon the significance of the code marks on the record sheet. For example, in Patent No. 2,275,396, the signal circuits controlled by the sensing means determine operation of punching means to reproduce indicia designated on a record sheet by conductive marks.

The material of which the record sheet is made is usually paper which has negligible conductivity under normal dry atmospheric conditions. When the moisture in the atmosphere increases, the paper absorbs the moisture and its electrical resistance decreases. As a result, sensing circuits may be undesirably established by leakage in the record material providing a circuit path between companion sensing elements.

An object of the invention is to prevent undesired initiation of signal or control impulses resulting from leakage paths in the material of which the record sheet is made.

Stated differently, an object is to provide means for preventing initiation of control impulses by the sensing means except when a designation is sensed.

An object of the invention resides in the provision of means to vary the sensitivity of indicia or designation sensing or reading means according to variations in conductivity of the record material.

More specifically, an object is to reduce the sensitivity of indicia or designation reading means as the conductivity of the record material increases.

An object is, further, to stabilize the action of the sensing means in initiating control impulses regardless of variation in electrical resistivity of the record material.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawing, which discloses, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawing, the figure diagrammatically shows the sensing means and sensitivity control means and related circuits.

The record sheet S may be a tape or individual record member and the designation or designations in a row may represent a character according to a suitable signal code, or the designation in a column may represent a value by its differential position along a column, or a combination of designations in a column may denote desired information.

For purposes of the disclosure, it is assumed the record is fed and its designations utilized in the same way as in the previously mentioned Patent No. 2,275,396. The designations D of the record are conductive marks sensed by conductive brushes BE and BC. The conductivity of the designation is a function of the conductivity of the marking substance and of the record material, and increases as the conductivity of either or both increases. It is to be understood, therefore, that "designation" or "mark" applies here to the marking substance covering a designation position plus the underlying record material. Two brushes BE and a central brush BC comprise a brush group for sensing each column for designations. As many such brush groups are provided as there are columns to be sensed, although not all the brush groups need be utilized, during a run of records through the machine, to control operations according to sensed designations. The end brushes BE of all the groups are connected to a common 10 which is connected to point 1 of a resistor R. The resistor R is connected to the plus side of a 110 v. line. Thus, potential is applied via resistor R and the common to the end brushes BE. The central brushes BC are individually connected to plug sockets 11. When it is desired to utilize a brush group for initiating impulses upon sensing of designations, its socket 11 is connected by a plugwire 12 to a socket 13. There are as many such sockets 13 as the number of signal circuits to be controlled by the columns of the record. Each socket 13 is connected via resistors R1 and R4 to the minus side

of a 40 v. line. A point between resistors R1 and R4 connects to the control grid G of an amplifier tube A. The anode of the tube is connected to a work magnet M. Magnet M leads via contacts (not shown) to the plus side of the 110 v. supply. It will be understood that there is one such tube A and magnet M for each column in which the presence of designations is to be manifested.

As the record feeds in the direction of the arrow, the rows of designation positions successively pass the sensing brushes. When a designation is encountered by a brush group, it bridges the brushes BE and BC of the group and closes a sensing circuit which raises the potential of the grid G of the related tube. The sensing circuit extends from the plus side of the 110 v. line via resistor R, the point I, the brush common 10, both end brushes BE of the group, in parallel across the conductive mark designation to the central brush BC of the group, thence via the plug connection to resistor R1 and via this resistor and resistor R4 to the minus side of the 40 v. line. This circuit raises the potential of the grid G, reducing the grid bias of tube A so current flows through the tube and connected magnet M. Energization of the magnet occurs and manifests the presence of the designation in the sensed column at the time such designation is encountered.

It will be clear now that the current flow in the sensing circuit depends upon the voltage applied by common 10 to the end brushes BE and upon the resistivity of the conductive mark. The normal resistivity of the conductive mark between one end brush BE and the associated central brush BC is, in the present case, approximately 13 or 14 megohms when the record material is in a normal dry state. Since both end brushes BE of a group lead in parallel, through the conductive mark, to the central brush of the group, the normal resistivity of the conductive mark, as a whole, is approximately 7 megohms. The resistance values of the sensing circuit are so chosen that with a given, normal voltage on common 10, the circuit will be effective to operate tube A when the resistance across the brushes in the circuit is no greater than said normal resistance of a designation. It will be appreciated that the resistivity of the record material itself, between brushes BE and BC of a group, should be greater than the resistivity of a conductive mark in order to prevent a sensing circuit from being established through the record material itself. Normally, the resistance of the record material is greater than the resistance of a conductive mark, so that none of the brush groups will be bridged conductively by a portion of the record material, and sensing circuits will be established only in response to conductive marks. However, owing to absorption of moisture, or for some other reason, the conductivity of the record material may increase and, correspondingly, the resistance of the record material, considering a portion occupying a designation position, may decrease to a value equal to or less than the normal resistance (approximately 7 megohms) of a conductive mark. Under such conditions, there is danger that a sensing circuit will be established across the record material itself, even though a conductive mark is absent. The present invention obviates this danger. Generally, the means provided by this invention for accomplishing the desired result operates by reducing the potential applied via common 10 to the end brushes BE of the brush groups. The potential applied to brushes BE, as brought out before, is one of the two factors which determine whether

a sensing circuit will be established, the other factor being the resistivity of the path between brushes BE and BC of a group. The resistivity of the record material may vary, for reasons given before. This factor is difficult to control. Hence, the other factor; namely, the potential applied to brushes BE, is varied according to this invention. In a manner and by means which will be described presently, the potential applied to brushes BE will be varied in accordance with the resistivity of the record material. Specifically, the potential will be reduced in proportion to the decrease in resistance of the record material. The resistance factor of the record material will be sensed continuously and whenever a bare designation position is found by such sensing means to have a resistance equal to or less than the normal resistance (approximately 7 megohms) of a conductive mark, the potential applied to the brushes BE will be reduced. The reduction in potential will prevent a sensing circuit from being established except when a conductive mark is sensed. In other words, the sensitivity of the mark searching or sensing means will be reduced so that it will not respond to bridging portions of the record material itself but will respond only to conductive marks. In further explanation, if the potential on common 10 remained constant, the sensing circuit would be effective when the brush group in the circuit encountered a resistance of no more than approximately 7 megohms, whether such resistance were imposed by a conductive mark or by bare record material. Means are provided, however, to reduce the potential on common 10 when the bare record material under a group of brushes has a resistance no greater than approximately 7 megohms. The reduction in potential will be proportional to the decrease in resistance of the bare material so that at no time will the sensing circuit operate under control of a bare designation spot. The reduction in potential on common 10 will not prevent the sensing of a conductive mark because the resistance of the conductive mark is always lower than that of the bare material, in view of the fact that the lowering of the resistance of the record material produces a corresponding reduction in the resistivity of the conductive mark or designation.

Let E_1 denote the potential on common 10, E_2 the potential at say socket 11, and R_x the resistance across the brush group. Then

$$E_2 = E_1 - IR_x$$

When the resistance of the bare material under the brush group is no more than approximately 7 megohms, E_1 is reduced, causing a corresponding reduction in E_2 to less than effective value. It is thus seen that under the stated condition, the brush group becomes less sensitive to a particular resistance. However, since the designation itself, upon reduction in resistance of the record material, experiences a proportional drop in resistance, the reduction of R_x is proportional to the reduction in E_1 and E_2 remains substantially constant at effective voltage for a designation. Thus, while the sensitivity of the sensing circuit to bare material is reduced under the stated conditions, it is stabilized as far as the designations are concerned. In further explanation, since socket 11 is connected, via resistance R1, to the control grid G of tube A, the potential at socket 11 governs the control grid potential of the tube. Inasmuch as the potential E_2 at socket 11 is at effective value, regardless of variations in conductivity of the record material, when a designation is sensed, it

is clear that the control grid potential of tube A also remains effective under the stated condition. Hence, since the control grid potential is effective under the stated condition, tube A will be rendered conductive and the plate current will be capable of energizing work magnet M. In short, the work magnet can be energized whenever a designation is sensed, regardless of variations in conductivity of the record material itself. On the other hand, in the absence of a designation at the designation sensing brushes, the potential E_2 at socket 11 and, hence, the control grid potential of tube A will be reduced sufficiently, upon a chosen increase in conductivity of the record material, to prevent the tube A from becoming conductive and operating magnet M. This reduction in control grid potential of tube A will be brought about under control of the conductivity sensing brush group. A chosen increase in conductivity of the record material will act through this brush group to increase the control grid potential of tube C, causing increased current flow in its anode-cathode circuit, in turn reducing the potential at point 1 and on the brush common 10. This reduction in potential on the brush common will render the designation sensing circuit ineffective to transmit sufficient potential to the control grid of tube A to drive this tube to a conductive state.

The means for varying the potential applied to common 10 will be referred to broadly as control means, which controls sensitivity of the designation searching means. The control means includes means to sense the conductivity factor of the record material and means responsive thereto for varying the potential applied to brush common 10. For such material sensing means, any idle group of brushes BE and BC may be utilized. The central brush BC of the chosen group will have its plug socket 11 connected by a plugwire 14 to a socket 15. The socket 15 is wired via a resistor R2 to the grid G1 of a vacuum tube C which may be of the same type as the tube A. The grid G1 is normally biased to about 45 volts negative with respect to the cathode by means of a 22½ volt battery B and by connection of the plus side of the battery through the heater of tube C to cathode resistor R5. Resistor R5 may have a value of about 50 ohms. The shut-off grid bias is only about 24 volts, so that with the grid bias normally maintained at approximately 45 volts, the tube C will be at shut-off. The tube will remain at shut-off until the chosen idle group of brushes BE and BC senses a resistance of the record material which is no greater than the normal resistance of a conductive mark. When, owing to increased conductivity of the record material, the resistance of the material decreases to about 13 or 14 megohms between one brush BE and the associated brush BC, then the point has been reached where the material presents no greater resistance to a current flow than the normal resistance of the conductive mark. At this point, a circuit path is completed from the plus side of the 110 v. line via resistor R, terminal 1 thereof, the brush common 10, the brushes BE of the chosen, idle group, across the record material itself, the central brush BC of the chosen group, the plugwire from its socket 11 to the socket 15, thence via resistor R2, and a resistor R3 to the minus side of bias battery B. The circuit is completed via battery B and the 40 v. source to the minus side of the 110 v. line. This circuit path, with current flowing therethrough, raises the potential of grid G1 to above the cut-off point,

so that tube C becomes conductive. The anode of tube C is connected to point 1 of resistor R. Hence, when the tube becomes conductive it draws current from point 1 of resistor R. As a result, current flow through resistor R increases, so that the voltage drop across the resistor increases and the potential at point 1 decreases. Therefore, the potential on brush common 10, connected to point 1 of resistor R, decreases. Such reduction in potential applied to common 10 reduces the sensitivity of the designation searching means, so that brushes BE and BC of such searching means will not be effectively conductively bridged by the record material and will not establish sensing circuits. It may be noted that a reduction in potential on common 10 reacts on the control brush group, tending to cause the potential on the common to rise. However, a substantially instantaneous balance is reached between the opposing tendencies with the effect of producing a substantially steady potential, for a given card leakage, on the brush common, such potential being of such reduced value as to prevent the mark sensing brush groups from operating, through bare material, to cause energization of magnet M.

It will be clear that the positive potential applied via the chosen, idle brush group to the grid G1 of control tube C will increase in proportion as the resistance of the record material decreases. Therefore, the conductivity of tube C will increase in corresponding degree and the current flow through resistor R will increase likewise. Hence, the potential at point 1 will decrease in proportion to the decrease in resistivity of the record material. Thus, the lower the resistance of the record material, the greater is the reduction in sensitivity of the designation searching groups of brushes. In this manner, when the resistance of the record material falls to or below a critical value, the sensitivity of the designation searching means to bare record material is reduced, such reduction being in proportion to the drop in resistivity of the record material with respect to the critical resistance value of the record material. By such means, the capacity of a designation searching brush group to establish a sensing circuit which will reduce the grid bias of a connected tube A is restricted in such manner that only when a conductive mark is encountered by the brush group will the sensing circuit be established. Stated differently, even though the resistance of an unmarked designation position falls to a value no higher than the normal resistance of a conductively marked designation position, the sensitivity control means prevents the transmission of a control impulse to a grid G of a tube A.

It may be pointed out, however, that the sensitivity of the mark sensing means to conductive marks is not lessened, but is, in fact, stabilized by the sensitivity control means. This is because as the resistance of the record material decreases, the combined resistance of a marked designation position, which takes into account both the resistance of the conductive mark and of the record material, is reduced. Hence, substantially the same current value will prevail in the mark sensing circuit, although the potential applied to brush common 10 may have been reduced. In other words, the two factors, reduced brush potential and reduced overall resistance of a marked designation position, balance each other, so that the capacity of the designation sensing means to respond to conductive marks is stabilized. At the same time, the capacity of the designation sens-

ing means to respond to unmarked designation position is reduced, so that sensing circuits will be established only when conductively marked designation positions are encountered.

In place of utilizing an idle brush group as means to sense the conductivity of the record material itself, alternative means may be used. As an example, such alternative means may comprise a supplemental brush SB to sense the right hand margin of the record S. This brush SB will coact with the right hand end brush BE. The plugwire 14 will be plugged into the socket 16 of the supplemental brush SB. Hence, when the conductivity of the material between brush SB and the adjacent brush BE increases to a critical value, a circuit path will be completed from the plus side of the 110 v. line via resistor R, common 10, the right hand end brush BE, the bridging portion of the record material, the brush SB, its socket 16, the plugwire 14, the socket 15, resistance R2, and as before via resistor R3 to battery B. This circuit path will apply positive potential to grid G1 of tube C. The tube C will become conductive, and increased current flow will occur through resistor R. Accordingly, the potential applied to brush common 10 will be reduced, decreasing the sensitivity of the designation searching means to the record material itself. It may be mentioned that when brush SB is used as part of the sensitivity control means, there is only a single leakage path between this brush and the adjacent brush BE, whereas there are two parallel leakage paths between the end brushes BE and central brush BC of each of the brush groups. Accordingly, when brush SB is used, the sensitivity impulse circuit to grid G1 must respond to a higher critical resistance value of the record material than when an idle brush group is used to establish the impulse circuit. This result may be obtained by decreasing the resistance value of resistor R2 or of resistor R3 or of both resistors, or may be obtained in any other suitable way which will compensate for the existence of only a single leakage path between brush SB and the adjacent brush BE. It is also evident that the control grid circuit for tube C may, by use of suitable resistance values in the circuit, be made effective to drive the tube to a conductive state upon a reduction in resistivity of the record material which is greater to a desired extent than the normal resistivity of a designation at an index position of the record. The reduction in potential on common 10 will then prevent the sensing circuit from rendering the tube A conductive except when a designation is presented to the sensing brushes.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In apparatus having electrical sensing means to sense a record sheet for marked indicia points to initiate control impulses, the combination of a circuit for applying sensing potential to the sensing means, a circuit responsive to conductivity of the material of the record sheet and including means engaging the sheet, and electrical means controlled thereby for varying the potential ap-

plied by the first mentioned circuit to the sensing means in accordance with variations in conductivity of the record material.

2. In apparatus having electrical sensing means to sense a record sheet for designations to produce control impulses, the combination of a circuit applying sensing potential to the sensing means, and electrical means, including means engaging the sheet, responsive to an increase in conductivity of the material of the record sheet for reducing said potential to prevent initiation of control impulses resulting from conductivity of the material itself.

3. In apparatus having electrical sensing elements to be bridged by conductive marks on a record sheet to initiate control impulses, the combination of means to apply sensing potential to the sensing elements, means sensitive to the conductivity of the record material, and electrical means controlled thereby for reducing the sensing potential upon an increase in conductivity of the record material so as to prevent initiation of control impulses by the bridging of the sensing elements by the record material itself.

4. Apparatus comprising electrical sensing means including elements to sense a record sheet for a conductive indicia mark on the sheet to initiate a control impulse, said sensing means also including a sensing device engaging the record sheet to sense the resistance of the record material, a circuit for applying potential to the elements to cause initiation of the control impulse through the elements when bridged by the conductive mark, said circuit also applying potential to said sensing device, a grid control circuit including said sensing device and effective upon a decrease in electrical resistance of the record material, and electronic means connected to the potential applying circuit and rendered conductive by the grid control circuit, when effective, for reducing the potential applied by the first mentioned circuit to the sensing elements and sensing device.

5. Apparatus comprising electrical sensing means including elements to sense a record sheet, of highly resistive material, for conductive indicia marks to initiate control operations, said sensing means also including spaced brushes engaging the bare record material and bridged by electrical leakage paths in the material, a source of potential, means including an impedance for transmitting potential from said source to the electrical sensing means, an electron tube including an anode, a cathode, and a control electrode responsive to varying potential applied thereto for varying current flow through the tube, said anode being connected, in parallel with the sensing means, to said impedance so as to vary the current flow through the impedance upon a variation in current flow through the tube, whereby the voltage transmitted to the sensing means is correspondingly varied, and means electrically coupling the spaced brushes to said control electrode to impress varying values of potential on the control electrode depending upon the degree of electrical leakage in the record material across said brushes.

6. Apparatus to vary the potential applied to a circuit line according to degrees of resistivity of variably resistive moving material, comprising a source of potential, means including an impedance electrically connecting the circuit line to the source to apply varying potential thereto dependent upon a varying drop of potential across the impedance, spaced, conductive brushes electrically connected to said line and wiping the mov-

ing material, an electron tube including an anode, cathode, and control means for governing the current flow through the tube in accordance with the potential applied to said control means, means electrically coupling said tube in parallel with the circuit line to said impedance so as to vary the potential drop across the impedance upon variation in current flow through the tube, whereby correspondingly varying potential is transmitted by the impedance to the circuit line, and means electrically coupling said brushes to said control means of the tube to apply varying potential thereto in accordance with the degree of resistivity of the material moving across the brushes.

7. In apparatus having a sensing circuit including a device for sensing record material for designations to initiate control impulses and work means responsive to said impulses, the combination of means sensitive to conductivity of the record material itself and electrical means controlled thereby for rendering the sensing circuit ineffective to produce control impulses capable of operating the work means upon an increase in conductivity of the record material itself and in the absence of a designation at the sensing device.

8. In apparatus having a sensing circuit including a device to sense record material for designations to initiate control impulses and work means for performing work in response to said impulses, the combination of means sensitive to

conductivity of the record material, an electronic discharge tube including an anode, cathode, and control grid, a grid control circuit including said grid and said conductivity-sensitive means for increasing the anode current upon an increase in conductivity of the record material, and an anode-cathode circuit electrically coupled to the sensing circuit and effective upon an increase in anode current for rendering the sensing circuit ineffective to produce control impulses capable of operating said work means, in the absence of a designation at the sensing device.

9. In apparatus having a work magnet and electrical means, including a conductive device engaging record material for sensing conductive designations thereon and an electronic discharge tube electrically coupled to said conductive device and to said work magnet, for operating said work magnet in response to the sensing of conductive designations; the combination of means sensitive to conductivity of the bare record material, electronic discharge means rendered effective thereby upon an increase in conductivity of the bare record material beyond an allowable value, and a circuit thereupon effective under control of said electronic discharge means for rendering said electrical means incapable of operating said work magnet in response to the sensing by said conductive device of the bare record material despite the increase in conductivity thereof.

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