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FACSIMILE SAFETY DEVICE

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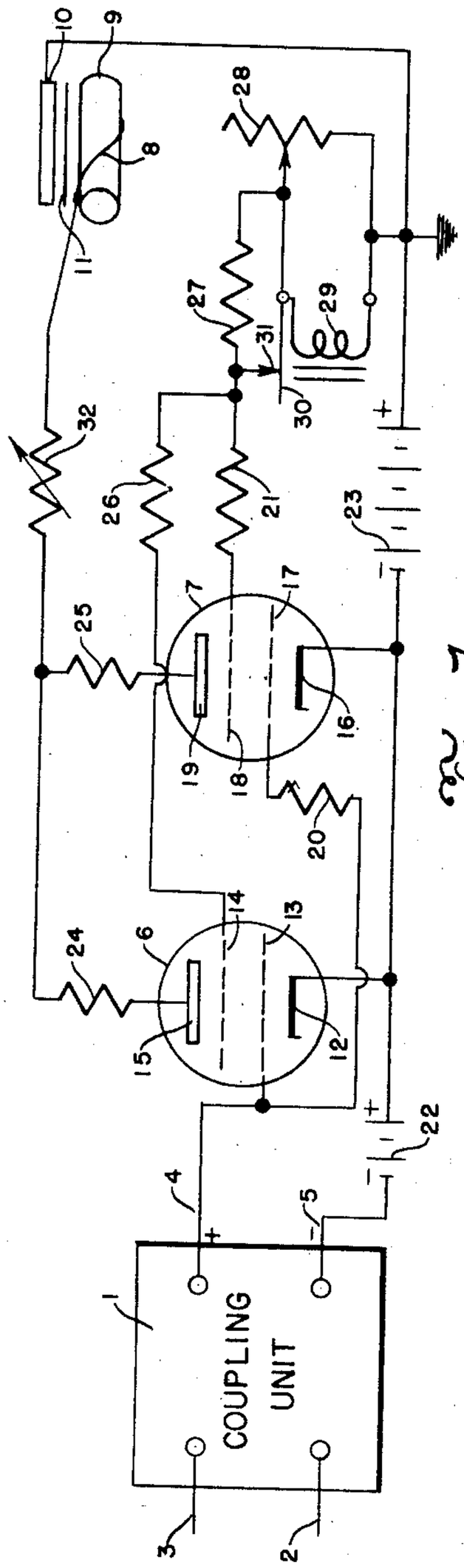


Fig. 1

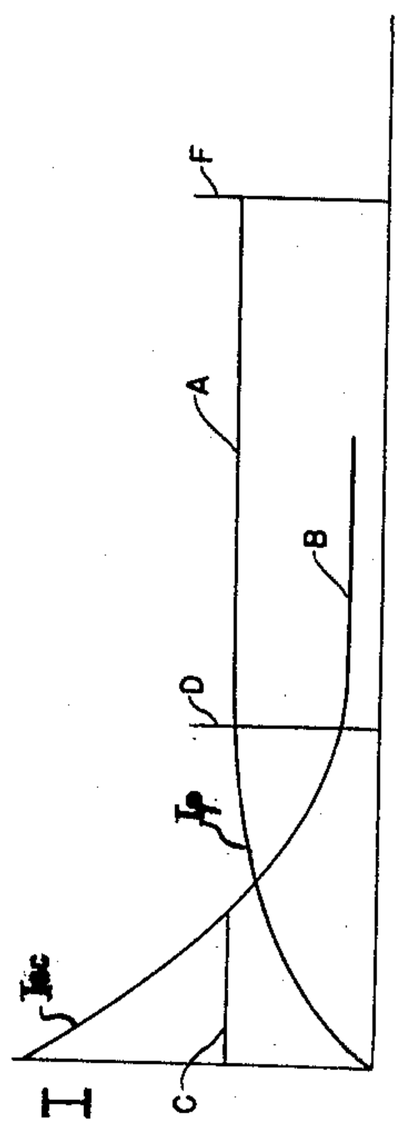


Fig. 2

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## FACSIMILE SAFETY DEVICE

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The present invention relates to facsimile recorders and in particular to safety devices for electrolytic facsimile recorders.

One object of the present invention is to provide a new and improved means for controlling the current to the marking electrode of an electrolytic recording device.

Another object of the present invention is to provide a new and novel means for protecting the output tubes in a facsimile recorder when the load is suddenly removed.

Still another object of the present invention is to provide an improved method and means for controlling the marking current in an electrolytic recorder in order to accommodate a wide range of impedance values due to varying moisture content of the recording paper.

A further object is to prevent burning of an electrolytic recording paper which may be excessively dry.

In practicing the art of facsimile a subject copy comprising pictures, graphic material, or textual matter is scanned and impulses corresponding to density variations are transmitted to a distant point where they are reproduced on a suitable carrier. This carrier may be a photographic film, a paper tape or sheet or other suitable medium. One carrier which has come into considerable use consists of a paper sheet or tape impregnated with an electrolytic solution which may be marked by a varying electric current. Marking may be accomplished by passing a current between a rotating helical electrode and a flexible linear electrode pressing upon opposite sides of the paper. At any given speed and with constant electrode intersecting areas the density of the mark produced is substantially proportional to the current passing through the paper. Hence one of the requirements of such a system is the very close control of the recording current. It has been found, however, that varying paper stocks, varying paper thicknesses, and variations in moisture content in the paper may give rise to considerable impedance variations between the recording electrodes.

According to the present invention, greatly improved fidelity in the recording in the presence of paper impedance variations is accomplished by providing marking current which is substantially independent of these variations. This is accomplished by feeding the marking electrodes by means of a device which determines the marking current independent of the paper impedance. A preferred feeding device is a so-called constant current vacuum tube. Tetrodes,

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pentodes or beam tetrodes may be used. Triodes with a large amount of current feed-back may also be used. A pair of tetrodes connected in parallel is shown in the drawing to illustrate the operation of the invention.

In the drawing Figure 1 shows a circuit of a preferred embodiment of the present invention.

Figure 2 shows curves illustrating the operation of Figure 1.

Figure 1 shows a coupling unit 1 receiving facsimile signals to be recorded, over leads 2 and 3. The output of coupling unit 1 consisting of rectified facsimile signals is fed through the circuit to be described over leads 4 and 5. Two tetrode tubes 6 and 7 are utilized in the embodiment shown. Tetrode tube 6 includes a cathode 12 heated by a conventional heater not shown, a control grid 13, a screen grid 14 and a plate 15. The tetrode tube 7 includes cathode 16 heated by a conventional heater means not shown, control grid 17, screen grid 18, and plate 19. The rectified facsimile signals from coupling unit 1 carried by lead 4 are applied to grid 13 and grid 17. A suppressor resistor 20 for suppressing undesired spurious oscillations may be included as shown in the lead to grid 17. Plate and screen voltages for tubes 6 and 7 are supplied from a conventional direct current source such as battery 23. Cathodes 12 and 16 are connected to the negative side of battery 23 and the return circuit from coupling unit 1 through lead 5 is returned to the negative end of battery 23 through the bias battery 22. Bias battery 22 is sufficient to operate tubes 6 and 7 at substantially cut-off in the absence of facsimile signals from coupling unit 1. The positive end of battery 23 is connected to screen grid 18 through the circuit consisting of relay coil 29 shunted by variable resistor 28 in series with resistor 27 shunted by relay contacts 30 and 31 and may pass through a spurious oscillation suppressor resistor 21. The screen voltage for screen 14 is similarly supplied except that a second suppressor resistor 26 may be used as shown. The voltage from battery 23 reaches plates 15 and 19 through a circuit including the linear printer electrode 10, the electrolytic recording paper 11 and the helix wire 8. Suppressor resistor 24 may be included in series with plate 15 and resistor 25 in series with plate 19 to suppress undesired spurious oscillation. Variable resistor 32 may also be included in series with the plate circuits to enable adjustment of the overall series resistance from the battery to the plates.

The facsimile signals to be recorded appear at

the output of coupling unit 1 as positive pulses of electric current and these serve to unblock tubes 6 and 7 causing plate current to flow through the plate circuits and thus between linear electrode 10 and helical electrode 8 through the electrolytic recording paper 11. Helical electrode 8 is rotated as it is attached to the surface of rotating drum 9. The intersection between linear electrode 10 and rotating helical electrode 8 forms the scanning spot which moves across the paper. The electrolytic recording sheet 11 is advanced at a constant rate of speed by conventional means not shown which completes the scanning operation to cover the entire sheet from top to bottom. The varying currents passed through sheet 11 cause its optical density to change as a function of the current and thus produce marks on the paper producing the facsimile copy. In order that the facsimile record shall be a true reproduction of the original, it is necessary that the current passing through the electrolytic paper 11 be a predetermined function of the signals received by tubes 6 and 7 from coupling unit 1. If the rectified signals from coupling unit 1 are passed directly through electrolytic recording paper 11 the current will vary considerably due to variations in the impedance of the paper. This variation of the paper impedance may be produced by a number of causes. The paper stock, the thickness of the sheet, the strength of the electrolyte in the paper, and the amount of moisture in the paper all affect the impedance of the recording sheet.

Figure 2 shows several curves illustrating the operation of Figure 1. Curve A shows the plate current of tubes 6 and 7 plotted against plate voltage. It has been found that the plate voltage may be increased from point D to point F with a very slight change in plate current. Since the variations in the impedance of the recording paper is equivalent to a variation in plate voltage the characteristics of tetrodes 6 and 7 operate to maintain constant marking current for a constant grid voltage over a wide range of paper conditions.

It has been found that not only is the fidelity of the recording improved but that a new and unexpected result has been achieved. While the electrolytic recording paper is used in a moist condition under certain circumstances it may become quite dry as for instance upon standing idle for some time. If a heavy current is passed through substantially dry paper it may char or even catch on fire. The present control system has eliminated this trouble entirely since the current cannot rise to a dangerous point.

Thus the system of the present invention provides means for improved fidelity in facsmile recording by determining the recording substantially independently of the paper condition or characteristics. It provides, in addition, the unexpected result of preventing burning of the paper. It also provides for lifting the linear electrode from the paper by automatically modifying the control device to prevent damage to it under the extreme condition of infinite impedance. When the linear electrode is lifted, the plate current drops to zero and the screen current rises as shown in Figure 2. Relay 29 is adjusted to open at some predetermined value of screen current such as C in Figure 2, thus protecting the tubes from damage. When contacts 30 and 31 open the screen current limiting resistor 27 is placed in the circuit to provide this protection.



While a single embodiment of the present invention has been shown and described, many modifications will be apparent to those skilled in the art within the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. In a device for electrolytic facsmile recording the combination of at least one thermionic vacuum tube exhibiting constant-current characteristics over at least a predetermined portion of its operating characteristics, including at least a cathode, control grid, screen and anode, a source of direct current, and a pair of recording electrodes, including an electrolytic recording sheet there-between all connected in series between the cathode and plate of said tube, a source of bias and a source of facsimile signals connected in series between the cathode and the control grid of said tube, and protective means connected between said source of current and the screen grid of said tube including a relay having a pair of contacts and a resistor connected across said contacts adjusted to open said contacts at a predetermined screen current level for limiting the current to said screen grid when said recording electrodes are not in contact with said electrolytic paper.

2. A device as set forth in claim 1 and including at least a second constant current tube connected in parallel with said first tube.

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