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(11) Publication number:

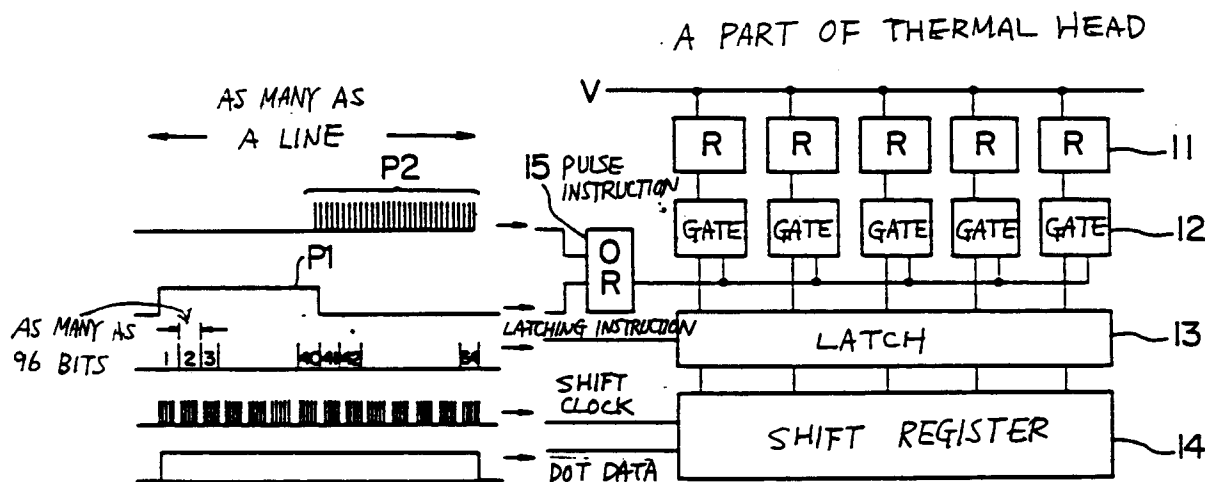
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EUROPEAN PATENT APPLICATION(21) Application number: **92108963.7**(51) Int. Cl.⁵: **B41J 2/355**(22) Date of filing: **27.05.92**(30) Priority: **27.05.91 JP 121446/91**(43) Date of publication of application:
02.12.92 Bulletin 92/49(84) Designated Contracting States:
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W-8000 München 40(DE)(54) **System for driving thermal head of dye thermal printer.**

(57) A system for driving the thermal head (10) of a dye thermal printer for controlling energizing time of heating resistors (11) by applying a drive pulse having a pulse width corresponding to a modulation density of an input data every time the data is input thereto, characterized in that the drive pulse having the pulse width corresponding to the modulation density is applied to the heating resistor (11) until

the modulation density reaches a given modulation density and repetition pulses having a given interval are applied thereto when the modulation density exceeds the given modulation density so that the high speed printing can be realized compared with the conventional system by preventing the transfer film (30) from being crumpled.

Fig.1

The present invention relates to a system for driving a thermal head of a dye thermal printer.

A conventional dye thermal printer comprises a platen roller 20, a thermal head 10 confronted with the platen roller 20 wherein a transfer film 30, on which a sublimable dye is coated, and an image receiving paper 40 having an image receiving layer thereon pass between the thermal head 10 and the platen roller 20. At that time, the sublimable dye is sublimed or evaporated so that the sublimable dye is diffused and solved into the resin of the image receiving layer, to thereby color the image receiving paper 40. When the electric current (heating energy) to be applied to the thermal head 10 is varied, the amount of the sublimable dye to be transferred is varied so that the dot density modulation is produced by utilizing this phenomenon.

Fig. 7 shows an electric arrangement of the thermal head 10 of the line type dye thermal printer which comprises line arranged heating resistors (Rs) 11 the number of which corresponds to the number of all the dots of an input data, gates 12 the number of which corresponds to that of the heating resistors (R), a latch circuit 13 and a shift register 14 serving as a data input portion. A drive pulse (energizing instruction) P, which is applied to the gate 12, has a pulse width (energizing time) corresponding to the number of modulation density modes of the input data and the pulse width is determined by a drive voltage V. That is, when the drive voltage V is determined, a graph as illustrated in Fig. 8 can be prepared in which a vertical axis represents density and a lateral axis represents the pulse width (energizing time). If the density is divided into 64, supposing that the maximum density is set to be, e.g. 2 in the optical density, the pulse width for realizing each of the modulation density mode 1 to mode 64 can be determined. When the modulation density are represented in 64 modes, the same input data should be latched 64 times in the latch circuit 13.

When the drive pulse P having the thus determined maximum pulse width (pulse width for obtaining the maximum density) is given to the gate 12 connected to the heating resistors 11, the number of which corresponds to the number of the input data having the modulation density modes 1 to 64, the drive voltage V is applied to the heating resistors 11 for the period of the maximum pulse width so that the heating resistors 14 are heated at the maximum temperature.

In case the transfer film 30 comprises a thermoplastic polyester resin which is generally employed as the transfer film, it has the softening temperature of 250 to 300 °C. If the drive voltage V is increased to thereby supply the requisite quantity of heat within a short time so as to drive the printer at high speed, the maximum temperature

exceeds the softening temperature whereby the heating area of the transfer film 30 is softened. Inasmuch as the transfer film 30 is stretched in its feeding direction, the softened heating area expands whereby distortion is generated at the boundary between the heating area and a non-heating area so that the transfer film is crumpled.

Since the transfer film 30 is crumpled when the requisite quantity of heat is supplied to the thermal resistors, there was a problem that the high speed of the printer was restricted because of the temperature characteristics of the transfer film 30.

The present invention has been made to solve the problem of the conventional dye thermal printer and to provide a system for driving a dye thermal printer capable of printing at high speed compared with the conventional dye thermal printer by preventing the transfer film from being crumpled.

To achieve the above object, the system for driving the thermal head of the dye thermal printer according to the present invention for controlling energizing time of heating resistors by applying a drive pulse, to a gate connected to the corresponding heating resistor, the drive pulses each having a pulse width corresponding to a modulation density of an input data, every time the data is input thereto, characterized in that the drive pulse having the pulse width corresponding to the modulation density is applied to the gate until the modulation density reaches a given modulation density and repetition pulses are applied to the gate when the modulation density exceeds the given modulation density.

In the system of the second aspect of the invention, a continuous drive pulse is applied to the gate within a given time and repetition pulses are applied to the gate after the given time elapsed.

In the system of the third aspect of the invention comprising a temperature sensor in which a continuous drive pulse is applied to the gate until an output of the temperature sensor reaches a given value and repetition pulses are applied to the gate after the output of the temperature exceeds the given value.

According to the present invention, the continuous energization is switched to an ON/OFF (intermittent) energization when the energizing time of the heating resistors exceeds the given time at the given high order modulation density mode so that the heating resistors are repetitively heated and cooled, whereby the transfer film is prevented from rising in its temperature after the switching.

Fig. 1 is a block diagram showing an arrangement of a system for driving the thermal head of a dye thermal printer according to a preferred embodiment of the present invention;

Fig. 2 is a graph showing the temperature characteristics of a transfer film employed in the

system of Fig. 1;

Fig. 3 is a graph showing the relation between the transmittance and the modulation density of the transfer film and the relation between the absorption factor and the modulation density of the transfer film;

Fig. 4 is another graph showing the relation between the transmittance and the modulation density of the transfer film and the relation between the absorption factor and the modulation density of the transfer film

Fig. 5 is a graph showing the relation between the damage and the modulation density of the transfer film;

Fig. 6 is a view showing a thermal head of a conventional dye thermal printer;

Fig. 7 is a block diagram showing an arrangement of a conventional dye thermal printer; and

Fig. 8 is a graph showing the relation between energizing time and the modulation density.

A system for driving the thermal head of a dye thermal printer according to a preferred embodiment of the present invention will be described with reference to the attached drawings.

In Fig. 1, a drive pulse to be applied to the gate 12 comprises a pulse P1 having a pulse width corresponding to the modulation density of the input data and a repetition pulse P2 wherein the pulse P1 is applied to the gate 12 when the modulation density is below the given density K and the repetition pulses P2 are given to the gate 12 when the modulation density is higher than the density K. The continuous pulses P1 or the repetition pulses P2 are applied to the gate 12 via an OR gate 15.

Figs. 3 and 4 are graphs showing the relation between transmittance and the modulation density (represented by x) of the transfer film and the relation between the absorption factor and the modulation density (represented by •) of the transfer film respectively tested for yellow and magenta. Fig 5 is a view prepared by the combination of Figs. 3 and 4 and showing the relation between the damage such as a crumple and the dot density modulation of the transfer film 30.

The transmittance lowers at about the mode 40 and the transfer film 30 is crumpled as shown in Figs. 3 to 5. That is, when the temperature of the heating resistor reaches at the temperature where the modulation density at the mode 40 can be realized, the heated area of the transfer film 30 reaches to the softening temperature. The transmittance rises at about the density 50, which shows that the degree of sublimation is increased and the color fading in the film is enlarged.

Supposing that the given density K of the modulation density is mode 40, if the modulation density mode is, e.g., 64, the pulse P1 having the pulse width determined on the basis of the test as

illustrated in Fig. 7 is given to the gate 12 until the mode 39 where the transfer film 30 is not softened while the repetition pulse P2 is applied to the gate 12 when the mode exceeds 40.

When the repetition pulses P2 are applied to the gate 12, the heating resistor 11 is ON for a given short time and is OFF for another given time, namely is repetitively ON/OFF whereby the thermal resistor is cooled when it is OFF. The temperature of the heating area of the transfer film 30 is suppressed under the softening temperature by appropriately setting the ON and OFF times as illustrated in Fig. 2, whereby the printing up to the mode 64 (maximum density) can be realized. The temperature of the film in the conventional dye thermal printer is illustrated in dotted lines in Fig. 2.

As described above in detail, since the continuous energization is switched to the ON/OFF energization when the energization time of the heating resistor exceeds the given time, it is possible to prevent the heating area of the transfer film 30 from being softened even if the drive voltage V is high so that the high printing can be performed compared with the conventional system accordingly.

Although the switching between the continuous pulse P1 and the repetition pulses P2 is made based on the modulation density of the input data, it can be made based on an output value of a temperature sensor when provided in the dye thermal printer or based on an output value of a timer means when provided in the dye thermal printer.

As described above in detail, since the continuous energization is switched to the ON/OFF energization when the energization time of the heating resistor exceeds the given time, it is possible to suppress the temperature rising of the transfer film. Even if the drive voltage is increased to thereby increase the amount of the heat generated in the heating resistor per unit time, the heating area of the transfer film can be prevented from being softened so that the restriction or the problem caused by the temperature characteristics of the transfer film is eliminated, whereby the high printing can be realized accordingly.

The features disclosed in the foregoing description, in the claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

Claims

1. A system for driving the thermal head of a dye thermal printer for controlling energizing time of heating resistors (11) by applying a drive pulse, to a gate (12) connected to the corresponding thermal resistor, the drive pulses

each having a pulse width corresponding to a modulation density of an input data, every time the data is input thereto, characterized in that the drive pulse having the pulse width corresponding to the modulation density is applied to the gate (12) until the modulation density reaches a given modulation density and repetition pulses are applied to the gate (12) when the modulation density exceeds the given modulation density.

2. A system according to Claim 1, wherein a continuous drive pulse is applied to the gate (12) within a given time and repetition pulses are applied to the gate (12) after the given time elapses.
3. A system according to Claim 1 further comprising a temperature sensor in which a continuous drive pulse is applied to the gate (12) until an output of the temperature sensor reaches a given value and the repetition pulses are applied to the gate (12) when the output of the temperature exceeds the given value.

Fig. 1

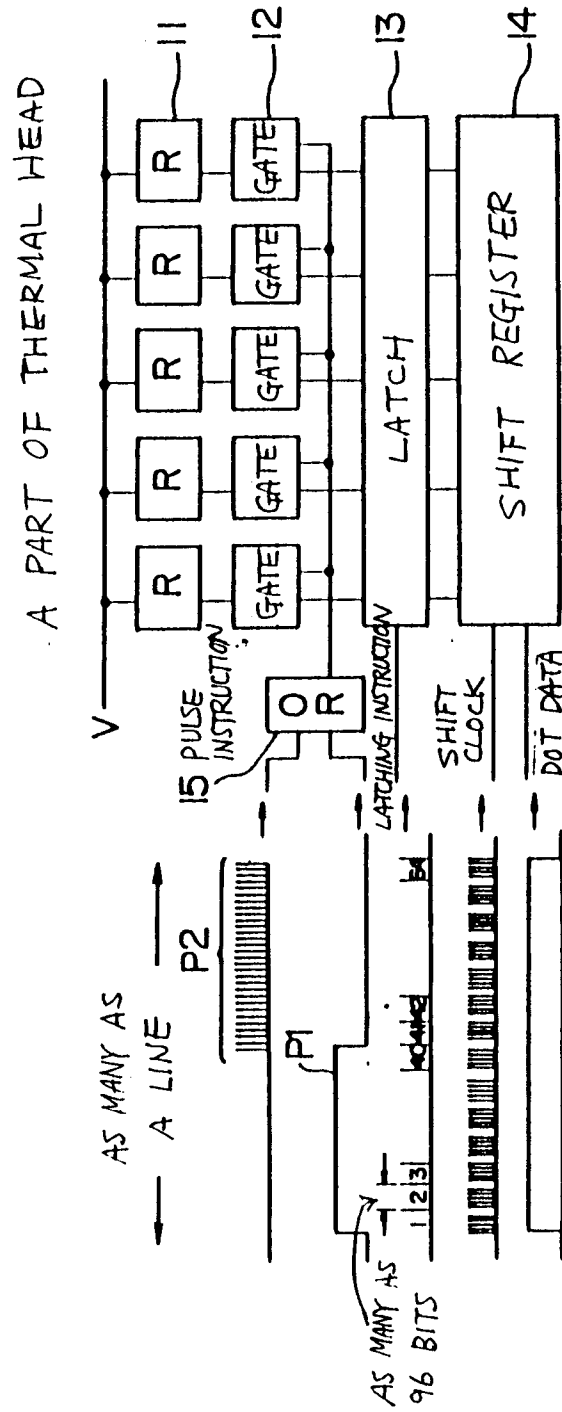


Fig. 2

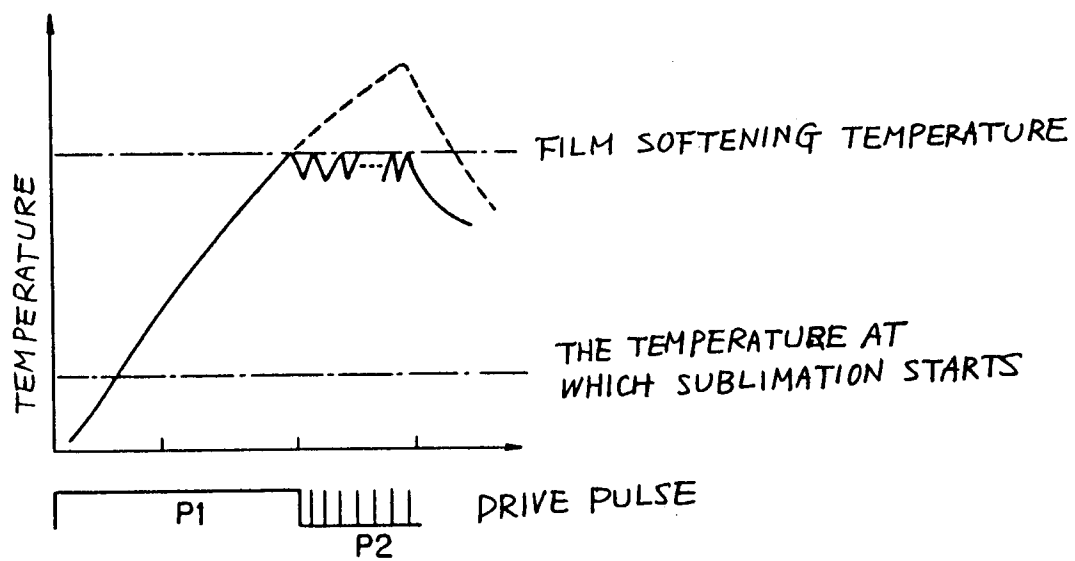


Fig. 3

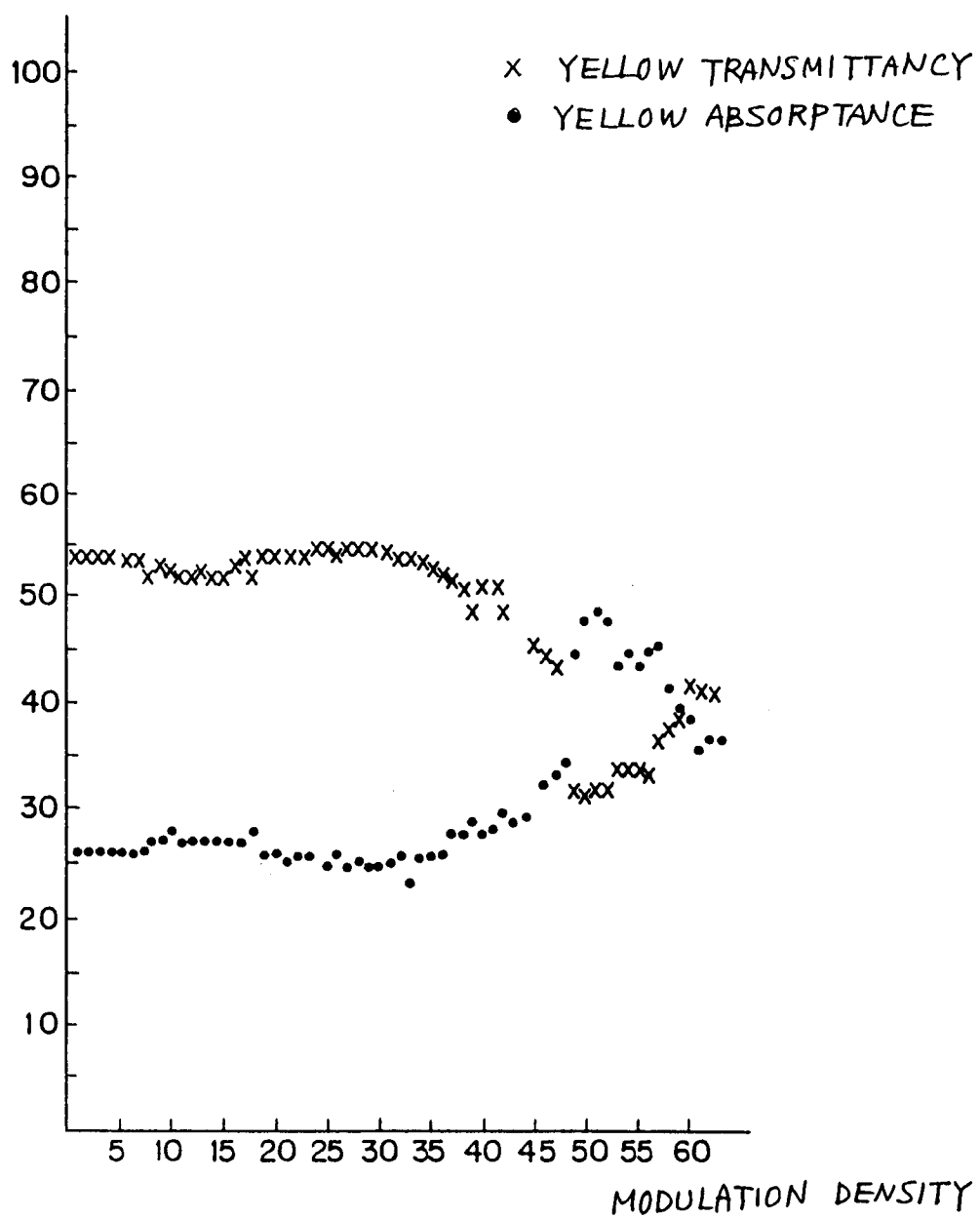


Fig. 4

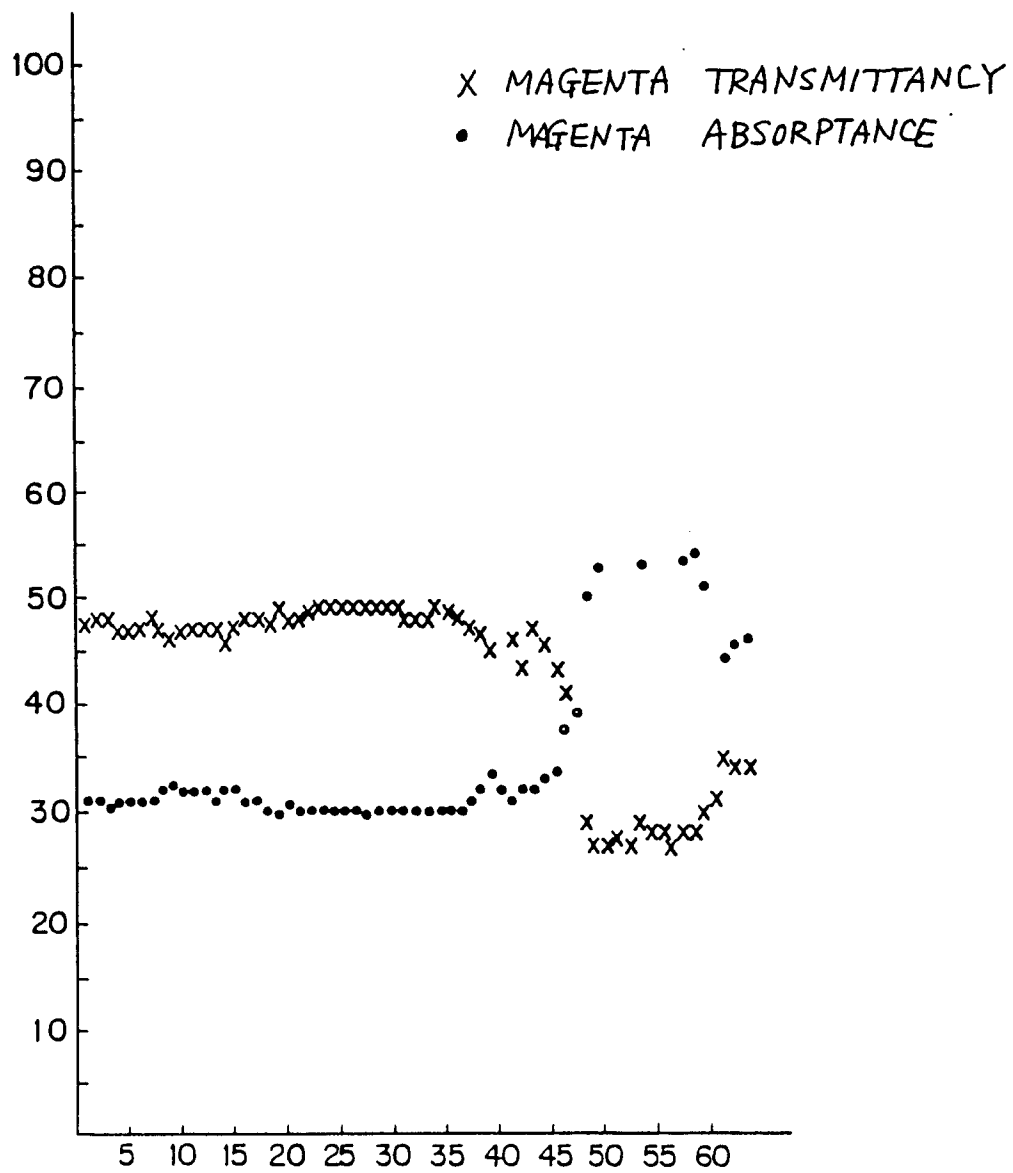


Fig. 5

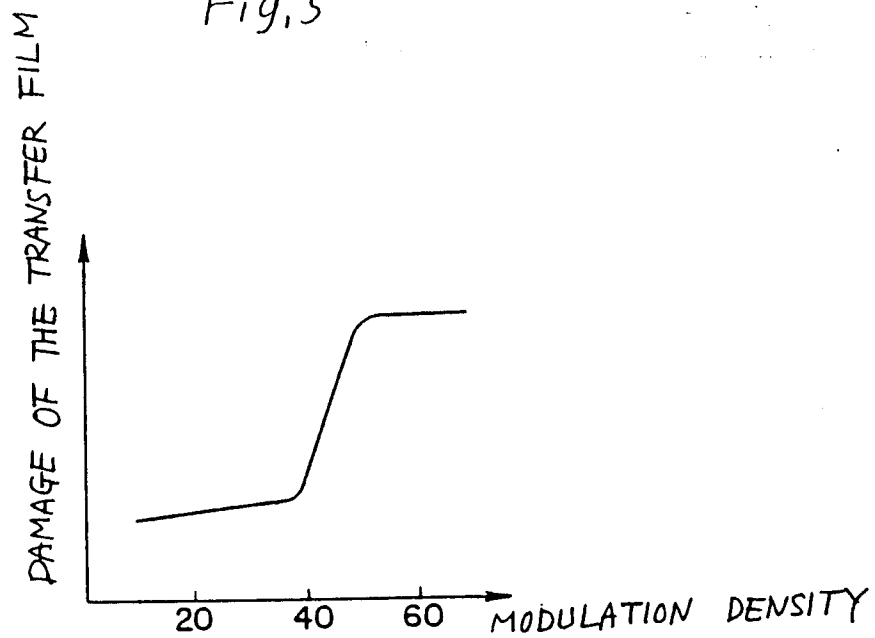


Fig. 6

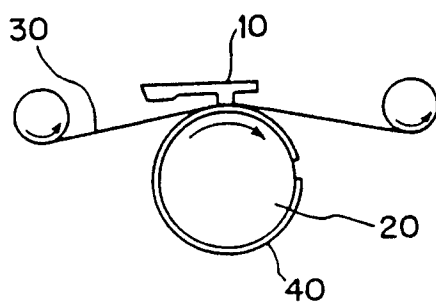


Fig. 7

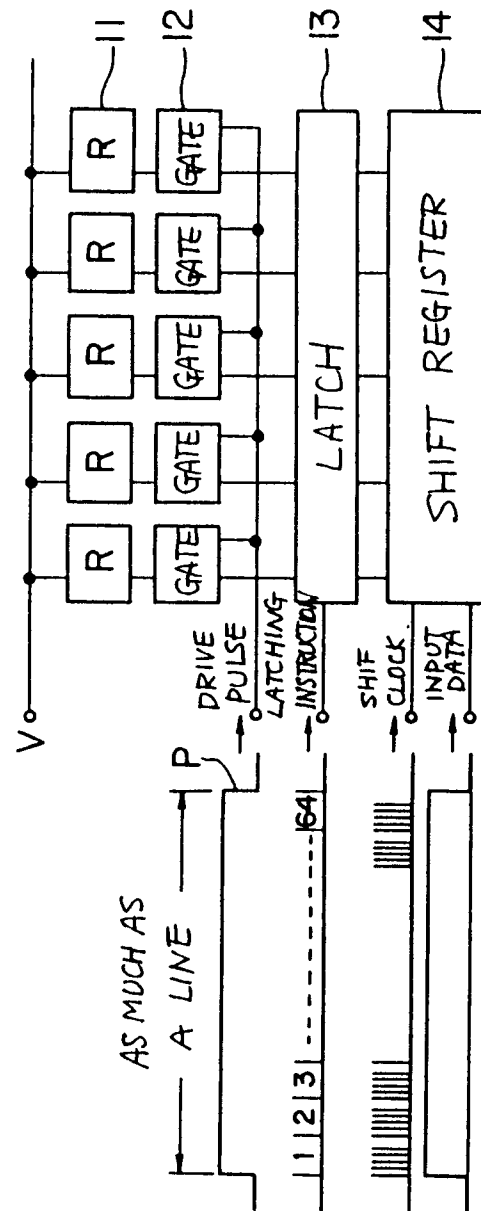


Fig. 8

