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[56] References Cited

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2,178,304 10/1939 Holness 271/58

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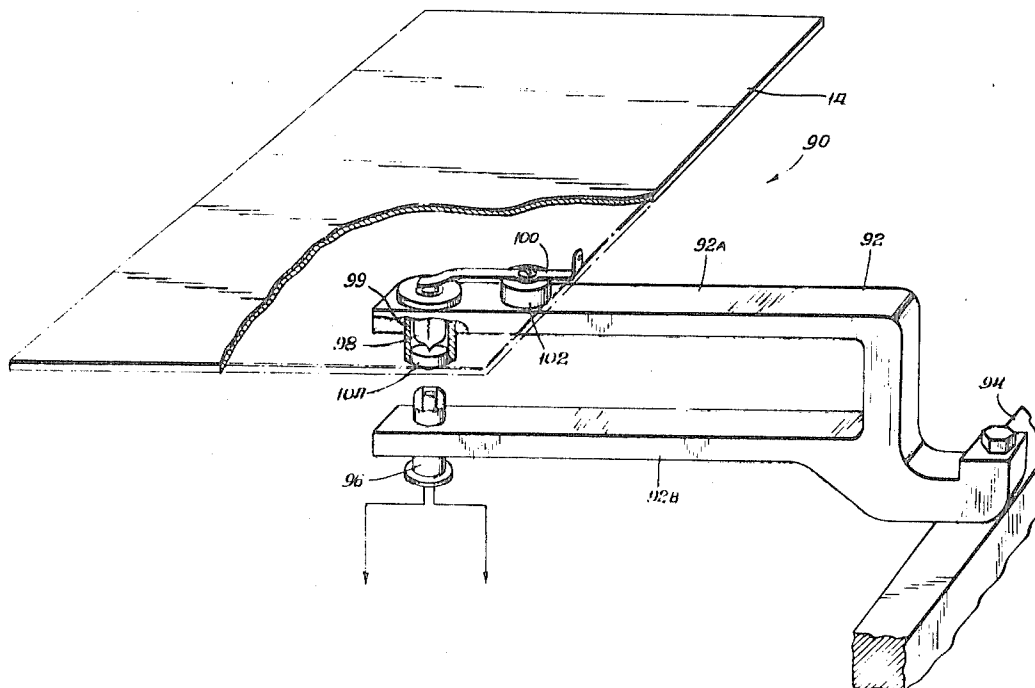
[54] PHOTOELECTROSTATIC PRINTOUT MACHINE
12 Claims, 4 Drawing Figs.

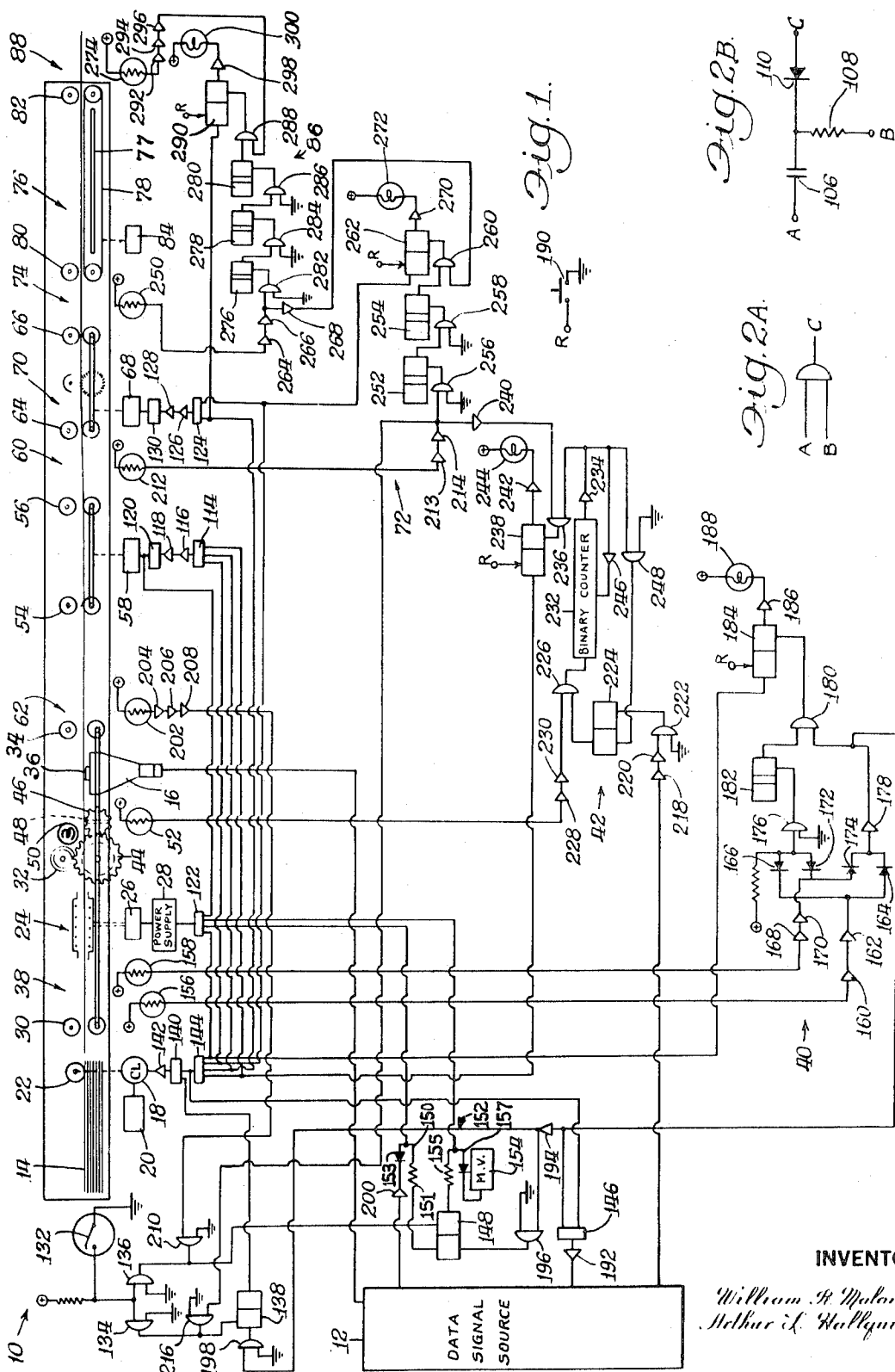
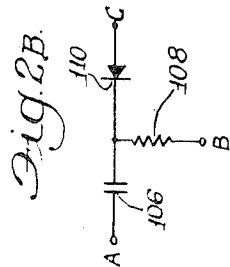
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ABSTRACT: A photoelectrostatic printout machine for computers or terminals of communication links in which logic circuits coupled to detectors located at stations spaced along the path of movement of the copy sheet detect paper jams and skewed sheets. An abnormality stops sheet feeding and inhibits the transfer of image signals to the machine. The position of the light-sensitive copy sheets is photoelectrically detected using light to which the sheet does not respond.

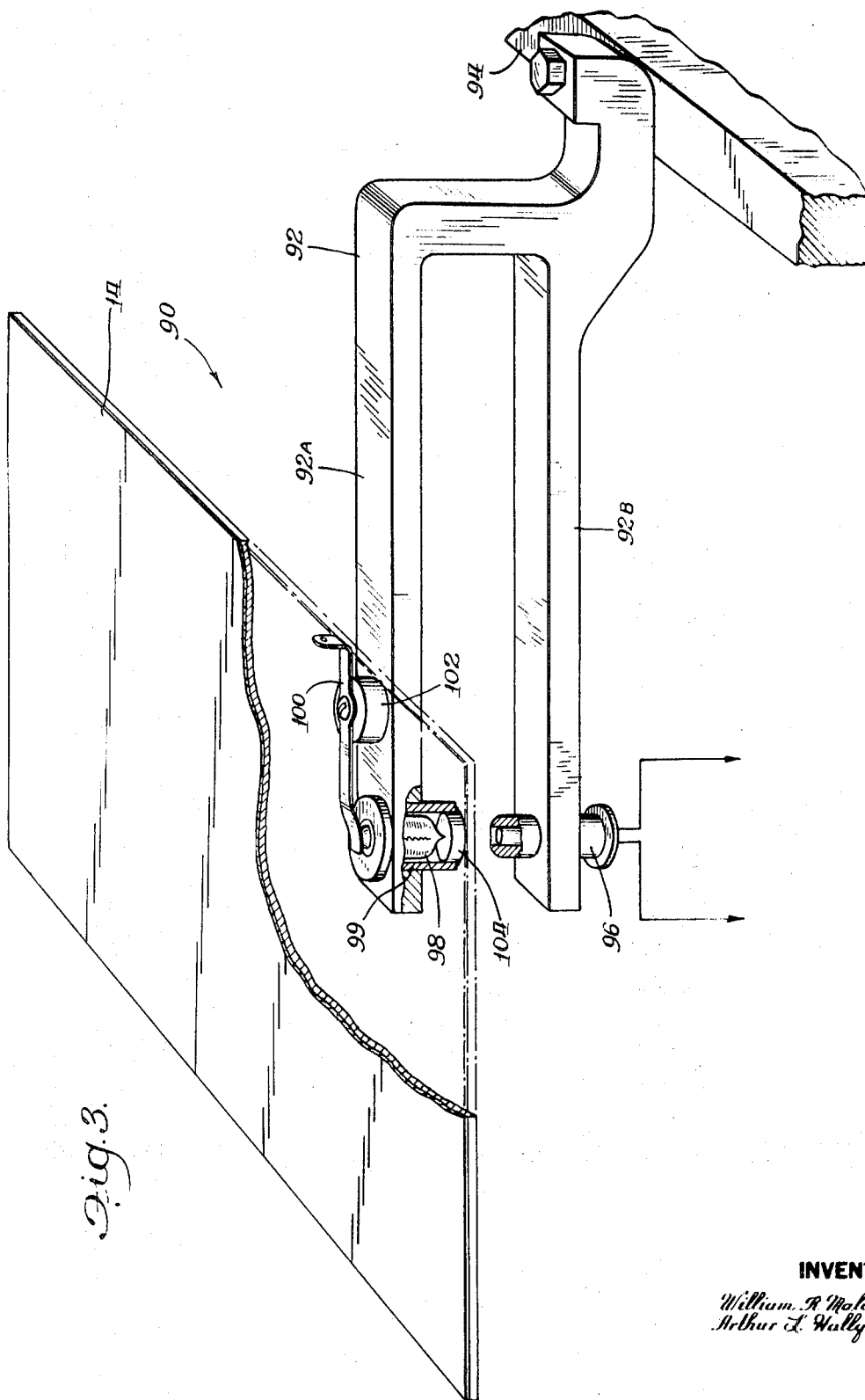




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PHOTOELECTROSTATIC PRINTOUT MACHINE

This application is a division of application Ser. No. 617,094, filed Feb. 20, 1967, now U.S. Pat. No. 3,501,236.

This invention relates to a photoelectrostatic recorder or printout apparatus and, more specifically to such an apparatus including new and improved means for monitoring and controlling the movement of copy sheet or web material through the apparatus.

Considerable effort has been expended in the past to develop a recorder whose operating speed is capable of approaching the speed at which data can be transmitted over communication channels or recovered from data handling units. The speed of photoelectrostatic printing processes is such that machines employing these processes offer a substantial advance in printout equipment. Machines using photoelectrostatic recording techniques generate an electrostatic image which is converted into a toner image and then fixed or placed in permanent form. In some machines, the image is developed on a printing element and transferred to web or sheet material, and, in other machines, the image is produced directly on the copy sheet or web material. In all of these machines, the satisfactory operation of the machines is dependent on the synchronized movement of the web or sheet material through the machine. In applications in which electrostatic image is formed under the control of an electrical input signal, as from a data-handling unit or communication link, it is necessary for the machine to be in a fully operative condition when the signal is supplied to avoid a possible loss of the image. This is a problem that is not presented when copies are made from graphic originals. A common source of machine malfunction, particularly when high-speed copying and sheet feeding is involved, is the failure of the sheet- or web-feeding means in the machine to advance the sheet or web material to the spaced machine stations in a proper timed sequence.

Accordingly, one object of the present invention is to produce a new and improved photoelectrostatic printout machine.

Another object is to provide a photoelectrostatic printout apparatus including new and improved means for controlling and monitoring the movement of sheet or web material through the apparatus.

A further object is to provide a system for monitoring and controlling the movement of sheet or web material along a path and past a plurality of stations spaced along the path.

A further object is to provide a system of this type in which the sheet or web material is intermittently moved relative to one station and continuously moved relative to another one of the stations.

Another object is to provide a system for monitoring and controlling the movement of sheet or web material along a path and past a plurality of stations spaced along the path in which the successful completion of movement along one portion of the path automatically inhibits the monitoring of the completed portion of the movement and initiates the monitoring of the movement of the sheet or web material along the next portion of the path.

Another object is to provide a photoelectrostatic printout apparatus in which the transmission of signals used to control the development of images is interlocked with the movement of sheet or web material through the apparatus.

A further object is to provide a system for controlling a photoelectrostatic printout unit including new and improved means for detecting a skewed condition of sheet or web material.

A further object is to provide a new and improved control for monitoring the intermittent movement of sheet or web material between two spaced points on a path of movement.

Another object is to provide a new and improved unit for sensing or detecting the position of light-sensitive sheets along a path of movement thereof.

Another object is to provide a sensing or detecting unit for photoelectrically detecting the presence of copy material having a light sensitive characteristic.

In accordance with these and many other objects an embodiment of the invention comprises a photoelectrostatic printout or recording machine that is adapted to produce copies or prints in accordance with electrical input signals derived, for instance, from a central data processor or a communication link. The photoelectrostatic printout machine includes a supply of photoelectrostatic copy sheets which are fed in sequence through a charging station in which a uniform electrostatic charge is placed on the photosensitive surface of the sheet, an exposing station at which a latent electrostatic image is formed by means such as a cathode-ray tube in dependence on incoming electrical signals representing the material to be recorded, a developing station in which the latent electrostatic image is developed to provide a powder image by the selective deposition of toner powder, and a fusing station in which the powder image is placed in permanent form by the application of heat. The present invention is directed to a new and improved system for monitoring and controlling the movement of the copy material through the various stations in a synchronized and interlocked relation with the incoming signals representing the material to be recorded. The system establishes a predetermined program of movement for the copy material and detects deviation therefrom as an indication of abnormalities or malfunctions.

A first feeding assembly in the machine feeds a copy sheet from the supply thereof to a first detecting station at which the sheet is checked to determine whether it is fed in a proper position or in a skewed position. The new and improved skew detecting assembly inhibits further operation of the machine if the sheet is fed in a skewed condition. If the sheet has been properly fed, control over sheet movement is transferred to the data signal source and a second feeding means is rendered effective to advance the copy sheet through the corona charging station at which a uniform electrostatic charge is imparted to both surfaces of the copy sheet. This sheet is then fed past the face of a cathode-ray tube at an exposure station to generate a latent electrostatic image on the copy sheet in dependence on the electrical signals received from the data signal source. During this movement, the second sheet-feeding means is operated intermittently by the data source to synchronize the movement of the sheet past the cathode-ray tube with the received signals.

To provide means for detecting paper jams in the portion of the path of movement of the copy sheet in which the electrostatic image is formed, a pulse generator operated in synchronism with the second feed means supplies a series of signals to a counter representing the increments of movement imparted to the copy sheet. These signals are counted, and an output signal is developed by the counter when the number of signals received indicates that the leading edge of the sheet should be at a second detecting station. A logic device coupled to the output of the counter and the second detecting station provides an alarm indication that a paper jam has occurred if the copy sheet does not reach the second detecting station at the expected time indicated by the output signal from the counter. This places the machine in an alarm condition to prevent further attempts to record subsequent information until the paper jam has been cleared.

If the copy sheet is detected at the second detecting station at the proper time, the control circuit transfers control over the second drive means from the data signal source to the local control circuit and renders the first feeding means effective to advance another copy sheet from the supply thereof toward the corona charging and exposing stations. The copy sheet, in passing the second detecting station, enters the developer station and is advanced therethrough by an additional drive means. The second detecting station also starts the operation of a timing circuit which sets a time interval in which the copy sheet must pass through the developer to a third detecting station interposed between the developing station and the fusing station.

If the loading edge of the copy sheet passing through the developer does not reach the third detecting station within the time interval act by the timing circuit started by the second detector, a visible indication of the improper operation of the machine is provided, and the prior feeding means in the machine are rendered ineffective until such time as the jam is cleared. However, if the leading edge of the sheet reaches the third detecting station at the expected time, the alarm control indicator controlled by the first timing circuit is inhibited, and a second timing circuit is placed in operation to set a time interval in which the developed copy sheet must pass through the fusing station to a fourth detecting station. The fourth detecting station, on sensing the arrival of the leading edge of the copy sheet, inhibits the operation of the second timing circuit to provide an alarm indication. If the copy sheet is not advanced to the fourth detecting station within the time interval set by the second timing circuit, a visible alarm is provided, and operation of the prior drive means is inhibited until such time as the paper jam is cleared.

The system also includes novel means for detecting the presence of the copy sheet at the various positions along its path of movement. It would be desirable to avoid the use of sensing means such as switches because of the necessity of physically contacting the copy sheet. Photoelectric sensing means avoids physical contact with the sheet, but since the sheet has a light-sensitive characteristic, conventional photoelectric sensing or detecting units are likely to alter or deface the image. Accordingly, the novel photoelectric sensing or detecting means of the present invention comprises light sources and a light-responsive means operating in a portion of the spectrum to which the light-sensitive coating of the copy sheet does not respond.

Many other objects and advantages of the present invention will become apparent from considering the following detailed description thereof in conjunction with the drawings in which:

FIG. 1 is a schematic circuit diagram of a photoelectrostatic printout unit embodying the present invention;

FIGS. 2A and 2B illustrate a logic symbol and a typical circuit of a trigger circuit used in the circuit diagram shown in FIG. 1; and

FIG. 3 is a perspective view illustrating a photoelectric sensing or detecting unit used in the system shown in FIG. 1.

Referring now more specifically to FIG. 1 of the drawings, therein is illustrated a photoelectrostatic printout unit or recorder which is indicated generally as 10 and which is adapted to record or print data or information received from a data signal source 12 on a copy sheet or web 14 (FIGS. 1 and 3). The data signal source 12 can comprise a termination for a communication link or equipment for interfacing the printout recorder 10 with a central data processing unit. The data signal source 12 supplies an intelligence signal to an electroluminescent transducer, such as a cathode-ray tube 16, representing the intelligence or data to be recorded and also supplies other control signals for controlling and synchronizing the movement of the copy sheet 14 during the period in which intelligence signals are supplied to the cathode-ray tube 16. The operation of the printout recorder 10 is interlocked with the data signal source 12 in such a manner as to prevent loss of intelligence signals due to malfunctioning of the recorder 10.

When a copy or a printout is to be made, a clutch 18 interposed between a drive motor 20 and one or a plurality of feed rollers 22 is energized to feed a copy sheet 14 from a stack thereof toward a corona charging station 24. The copy sheets 14 could also be cut from a roll of web stock as required. A drive system including a motor 26 which is selectively energized by a power supply 28 and which is coupled to a plurality of spaced sets of drive rollers 30, 32, and 34 receives the leading edge of the copy sheet 14 advanced by the rollers 22 and feeds the copy sheet 14 past the charging station 24 and an exposing station indicated generally as 36 at which the uniform charge previously imparted to the copy sheet 14 is selectively varied by the cathode-ray tube 16 to develop a latent electrostatic image.

The drive system actuated by the motor 26 is intermittently operated under the control of a circuit forming a part of the printout recorder 10 until the leading edge of the copy sheet 14 is advanced through the nip of the drive rollers 30 to a skew detecting station 38 at which the sheet 14 is checked by a skew detecting circuit 40 to determine whether the sheet has been fed by the rollers 22 in a proper or skewed position. If the sheet 14 has been fed in a skewed condition, the drives actuated by the motors 20 and 26 are disabled, an inhibiting signal is supplied to the data signal source 12 to prevent further attempts to record information, and a visible indication of the malfunction is provided. When the skewed condition has been corrected and the control system reset to a normal condition, or if the sheet 14 is fed in a proper position, the skew-detecting circuit 40, upon detecting the proper feeding of the copy sheet 14, disables further operation of the copy sheet feeder actuated by the motor 20 and transfers control over the operation of the drive motor 16 to the data signal source 12.

The signal source 12 now controls the energization of the motor 26 to advance the copy sheet 14 through the corona charging station 24 and the exposure station 36 in synchronism with the application of signals representing intelligence to be recorded to the cathode-ray tube 16. Because of the nature of the information-representing signals supplied by the data signal source 12, the motor 26 is intermittently operated to advance the copy sheet 14 through the exposure station 36.

It is desirable to insure that the copy sheet 14 is properly moved through the charging station 24 and the exposing station 36 so that intelligence signals supplied to the cathode-ray tube 16 are not lost as a result, for instance, of a jammed copy sheet 14. Further, since the copy sheet 14 is intermittently moved by the drive means actuated by the motor 26, the proper transit of the copy sheet 14 through these stations cannot be determined on the basis of elapsed time. Accordingly, the printout apparatus 10 includes a jam-detecting circuit indicated generally as 42 which is enabled under the control of the data signal source 12 when the production of a copy of a copy is initiated. The input of the control circuit 42 is provided with a series of input pulses representing the increments of movement imparted to the copy sheet 14 by the motor 26 by a pulse generator including a gear element 44 which is driven by and in synchronism with the motor 26 and which is coupled to a gear element 46. The gear element 46 includes an opening 48 lying along its diameter and interposed between an electric lamp 50 and a light responsive means or photocell 52. The photocell 52 is illuminated twice for each cycle of rotation of the gear 46 and thus provides a series of pulses to the input of the jam detecting or monitoring circuit 42 proportional to the increments of movement imparted to the copy sheet 14 by the drive system powered by the motor 26. The circuit 42 counts these pulses as an indication of the movement that should be imparted to the copy sheet 14.

As the leading edge of the copy sheet 14 passes beyond the last set of rollers 34 driven by the motor 26, it is fed between the first of two pairs of rollers 54 and 56 which are continuously driven by a drive motor 58 at all times during the operation of the machine 10 at which a jam or a malfunction has not occurred. Thus, the leading edge of the copy sheet 14 is further transported by the rollers 54 and 56 to a detecting station 60. When the leading edge of the copy sheet 14 reaches the detecting station 60, a signal is fed to the control circuit 42 to indicate that the copy sheet has reached this station. The control circuit 42 is set so that it supplies an output signal when enough pulses have been received from the generator including the photocell 52 to advance the copy sheet 14 to the detecting station 60. The signal supplied by the detecting station 60 provides an inhibit to prevent the output signal from the circuit 42 from actuating an alarm when the copy sheet 14 has reached the detecting station 60 at the expected time. On the other hand, if the leading edge of the copy sheet 14 has not reached the detecting station 60 at the time that the circuit 42 provides an output signal, a visual indication is provided, in-

dicating that a paper jam has occurred between the stations 38 and 60, and a signal is supplied to the data signal source 12 to prevent further attempts to produce copies.

To permit further copies to be made under control of signals from the source 12 during the interval in which the electrostatic image on the copy sheet 14 that has just reached the station 60 is developed and fixed, a detecting station 62 actuated by the trailing edge of the copy sheet 14 bearing the electrostatic image supplies a signal that transfers control over the motor 26 to the control circuit in the printout apparatus 10 and also enables the drive or feeding system controlled by the motor 20 to start the movement of another copy sheet 14 toward the corona charging station 24.

A copy sheet feeding system including two pairs of drive rollers 64 and 66 driven by a motor 68 during all periods of operation of the printout apparatus 10 in which an abnormality has not been detected receives the copy sheet 14 from the detecting station 60 and moves this copy sheet through a developer station 70 in which the electrostatic image is converted into a toner image. The developer apparatus at the station 70 is of a conventional construction and preferably comprises a magnetic brush developer. The movement of the copy sheet 14 through the developer station 70 is monitored by a timing circuit indicated generally as 72 which is placed in operation by the output signal derived from the detecting station 60. At the end of a predetermined time interval sufficient for the copy sheet 14 to have moved through the station 70 under the control of the continuously driven rollers 64 and 66, the circuit 72 provides an output signal for operating an abnormal condition indicator. If the leading edge of the copy sheet 14 has reached a detecting station 74, the station 74 supplies an inhibit signal to the output of the circuit 72 and prevents the abnormal indication. If the sheet 14 has not reached the detecting station 74 at the time that the circuit 72 times out, this circuit provides a visual indication that a paper jam has occurred between the detectors 60 and 74 and also supplies an inhibit signal to the drive means located prior to the drive actuated by the motor 68 and to the data signal source 12 to prevent any further attempts to make copies.

The leading edge of the copy sheet 14 on passing the detector station 74 enters a fusing station 76 in which the toner particles are fused or placed in permanent form by the application of heat. A drive system including an endless belt 78 and spaced sets of drive rollers 80 and 82 driven by a motor 84 advances the copy sheet 14 through the fuser station 76. To monitor the passage of the copy sheet 14 through the fuser station 76, the detection station 74 initiates the operation of a timing circuit 86 which supplies an output signal at the end of the time interval required for the copy sheet to pass through the fuser station 76 under normal operating conditions. A detecting station indicated generally as 88 at the outlet of the fuser station 74 supplies an inhibit signal to the output of the timing circuit 86 and thus prevents establishment of an alarm condition if the copy sheet 14 reaches the detecting station 88 in the expected time interval. Alternatively, if the copy sheet has not reached the detecting station 88, the timing and control circuit 86 disables the prior sheet feeding means and supplies an inhibit signal to the data signal source 12 to prevent further attempts to make copies until the jam in the machine between the detectors 74 and 88 has been cleared.

It is desirable to detect the presence of the copy sheet 14 at the various stations along the path of movement of the sheet through the printout machine 10 by an assembly or structure which does not require physical contact with the sheet. FIG. 3 of the drawings illustrates a novel sensing or detecting assembly 90 which permits the position of the copy sheet 14 to be photoelectrically sensed even though the sheets 14 are light sensitive. This is done by utilizing light-responsive means and light sources that are operative in a spectrum other than that to which the light-sensitive coating of the sheet 14, commonly zinc oxide, responds.

More specifically, the assembly 90 includes a bifurcated bracket or support 92 having two arms 92A and 92B between

which the copy sheet 14 is moved along its path of movement through the printout machine 10. The bracket 92 is suitably secured on a fixed supporting structure 94. A photoelectric cell 96 is mounted on the arm 92B underlying the path of the movement of the sheet 14, and a light source or electric lamp 98 in a lighttight housing 99 is mounted on the arm 92A overlying the path of movement of the sheet 14. One side of the filament of the lamp 98 is returned to the conductive support or bracket 92, and the other side of the filament is connected to a suitable source of potential through a spring terminal 100 carried on a dielectric member 102 secured to an upper surface of the arm 92A.

To prevent response of the coating on the sheet 14 to the radiation of the light source 98, the spectrum of the light emitted by the source 98 is confined to a range of wavelengths outside of the range to which the coating on the sheet 14 responds. This can be done by selecting a lamp 98 that provides emission, for instance, in the infrared range which is beyond the response range of the coating for the copy sheet 14. Alternatively, a filter element 104 can be mounted on the housing 99 interposed between the lamp and the copy sheet and photoelectric cell 96, which filter 104 passes only radiation in the infrared range. A suitable filter element 104 can comprise a Corning filter No. 2540 C 57-56 manufactured by Corning Glass Co.

The detecting assembly 90 can be used to provide the detecting elements at the stations 60, 62, 74, and 88, and a pair of the sensing or detecting assemblies 90 disposed along a line perpendicular to the path of movement of the copy sheet 14 through the rollers 30 can be used to provide the detecting means at the skew detecting station 38.

In the schematic circuit diagram shown in FIG. 1, a symbol for only the photocell or light responsive element 96 of the assembly 90 is illustrated. At each of the detecting stations, the photocell corresponding to the photocell 96 is illuminated by the light source 98 to be in its low-impedance state except in the intervals in which the copy sheet 14 passes between the light source 98 and the photocell 96. During these intervals, the light-responsive means or cell 96 is in its high-impedance or low-conductivity state.

The control circuit of the printout machine 10 illustrated in the schematic diagram in FIG. 1 is shown in logic block form and comprises conventional bistable circuits, monostable circuits, free-running multivibrators, inverters or amplifiers, and AND gates. This circuit also includes a number of trigger circuits, the logic symbol for which is shown in FIG. 2A, and a typical circuit for which is shown in FIG. 2B. Two input terminals A and B are selectively connected to ground or a more positive potential in different combinations in dependence on the application of the logic device in the circuit and control the trigger to supply a negative-going pulse to an output terminal C when a predetermined combination of signals is applied to the input terminals A and B.

More specifically, with the input terminal B returned to ground potential and a more positive potential applied to the input terminal A, a capacitor 106 is charged to a positive potential in series with a resistance element 108. If the input terminal B remains at ground potential and the input terminal A is then returned to ground potential, a negative-going output pulse is supplied through a diode 110. This negative-going signal is generally used in the circuit shown in FIG. 1 as an input signal for changing the state of bistable circuits or for triggering the operation of monostable circuits.

When the printout machine 10 is to be placed in operation, power is supplied thereto to prepare such components as the various corona charging assemblies for operation and to initiate the heating of the elements 77 of the fuser station 76. This energization also places the drive motor 84 in operation so that the belt 78 and the rollers 80 and 82 driven thereby are placed in operation. Further, if the feeding components of the machine are in operating condition and none of the control circuits 40, 42, 72, and 86 are in an alarm state, the drive motors 58 and 68 are placed in operation to rotate the sheet-feeding rollers 54, 56, 64, and 66.

More specifically, the output of an AND gate 114 is connected through two amplifiers 116 and 118 to the input of a control relay 120. All of the inputs to the AND gate 114 are enabled when the three jam-monitoring circuits or control circuits 42, 72, and 86 are in a normal state. Thus, the amplifiers 116 and 118 are enabled to operate the control relay 120 so that the drive motor 58 is energized to rotate the rollers 54 and 56. The operation of the relay 120 also supplies an enabling potential to one input of an AND gate 122, the output of which is connected to the input of the controlled power supply circuit 28.

With respect to the drive motor 68, an AND circuit 124 is connected through two amplifiers or inverters 126 and 128 to a control relay 130. The relay 130 controls the energization of the drive motor 68. When both of the control circuits 72 and 86 are in a normal state indicating an absence of a malfunction in the feed paths through the developing station 70 and the fuser station 76, both of the inputs to the gate 124 are enabled, and the amplifiers 126 and 128 operate the relay 130 to energize the motor 68.

After a time delay sufficient to bring all of these components into an operating condition and sufficient to permit the heat at the fusing station 76 to rise to an operative level, a thermal switch 132 associated with the fusing station 76, but shown at the upper left-hand corner of FIG. 1, closes to apply ground to the resistive inputs of two trigger circuits 134 and 136. The ground applied to the input of the trigger circuit 134 controls this circuit to supply a negative operating signal to a flip-flop or bistable circuit 138. This sets the flip-flop 138 so that an enabling signal is applied to one input of an AND gate 140, the output of which is connected through an amplifier 142 to the clutch 18. The other input to the AND gate 140 is connected to the output of an AND gate 144. The four inputs to the AND gate 144 are fully enabled when all of the monitoring or control circuits 40, 42, 72, and 86 are in a normal condition. Thus, when the flip-flop 138 is set, the gate 140 is fully enabled, and the amplifier 142 energizes the clutch 18 to couple the drive motor 20 to the rollers 22. This initiates rotation of the rollers 22 to feed a copy sheet 14 toward the pair of rollers 30 at the inlet to the copy-feeding means actuated by the drive motor 26. The output of the AND gate 144 is also supplied to one input of an AND gate 146 to partially enable this gate.

The ground signal applied to the resistive input of the trigger circuit 136 by the closure of the thermal switch 132 controls the trigger 136 to forward a negative-going signal to a flip-flop or bistable circuit 148 to set this circuit. When the flip-flop 148 is set, an inhibiting signal is applied to the lower input of an AND gate 150 including a diode 153 and a resistor 151, including a diode 157 and a resistor 155, and an enabling signal is applied to the upper input of an AND gate 152. The other input to the AND gate 152 is connected to the output of a free-running multivibrator 154. The output of the gate 152 is connected to one input of the AND gate 122. The right-hand input of the gate 122 is enabled from the control relay 120, and the left-hand input of the gate 122 is supplied with enabling potential from the output of the skew detecting circuit 40. The inhibiting potential supplied by the flip-flop 148 to the AND gate 150 controls the AND gate 150 to supply an enabling potential to another input of the AND gate 122. Thus, as the output of the AND gate 152 is pulsed between ground and a more positive potential, a gate 122 is alternately enabled and inhibited so that the power supply circuit 28 intermittently energizes the motor 26 to intermittently rotate the plurality of pairs of drive rollers 30, 32, and 34, thereby providing intermittent or step-by-step movement of the copy sheet 14 as soon as it is fed between the nip of the rollers 30 by the rollers 22.

As the loading edge of the copy sheet 14 being fed by the motors 20 and 26 passes beyond the pair of rollers 30, it moves into the detecting station 38 at which the position of the sheet 14 is checked for skew. As set forth above, the detecting station 38 includes two sensing units 90 disposed along a line transverse to the direction of movement of the sheet 14.

Two light-responsive means or photocells 156 and 158 in the two detecting assemblies 90 are illustrated in FIG. 1 of the drawings. The photocell 156 is connected through two inverters or amplifiers 160 and 162 to a pair of diodes 164 and 166. The photocell 158 is connected through a pair of inverters or amplifiers 168 and 170 to two diodes 172 and 174. The diodes 166 and 172 form an OR gate for ground signals, the output of which is connected to the capacitive input of a trigger 176. The diodes 164 and 174 form an AND gate for ground signals, the output of which is connected to the input of an amplifier 178. The output of the amplifier 178 is connected to the resistive input to a trigger circuit 180, and the output of the trigger circuit 176 is connected to the input of a monostable circuit 182.

Whenever the leading edge of the copy sheet 14 is interposed between the light source and either one of the photocells 156 and 158, one of the pairs of amplifiers 168, 170 or 160, 162 will ground the upper input of the trigger circuit 176 through one of the diodes 166 or 172. This controls the trigger circuit 176 to set the monostable circuit 182 so that a short duration positive-going pulse is applied to the capacitive input to the trigger circuit 180. When the monostable circuit 182 times out, the upper input to the trigger 180 is returned to ground potential. If the lower input or resistive input to the trigger 180 remains at ground potential at the time that the upper input is returned to ground by the monostable circuit 182, the trigger 180 will develop a negative-going output signal which will set an alarm flip-flop 184. The amplifier 178 and the AND gate including the diodes 164 and 174 hold the resistive input to the trigger 180 at a positive potential when the monostable circuit 182 times out to prevent the development of an output signal by the trigger 180 when the sheet 14 is in a proper position. Alternatively, if the copy sheet 14 is in a skewed position, the AND gate including the diodes 164 and 174 and the amplifier 178 return the lower input of the trigger 180 to ground so that the trigger 180 sets the bistable circuit 184.

More specifically, if either one of the photocells 156 and 158 and only one of these photocells is in its high-impedance state, the gate including the diodes 164 and 174 is not completely enabled, and the amplifier 178 remains in a conductive condition so that ground is applied to the lower input of the trigger 180. Thus, when the monostable circuit 182 times out, the flip-flop 184 is set. When the flip-flop 184 is set, a lamp amplifier 186 is placed in a conductive condition to illuminate a lamp 188 and provide a visible indication that the copy sheet 14 has been fed in a skewed condition. The setting of the flip-flop 184 also forwards an inhibiting signal to one input of the AND gates 122 and 144 so that the drive motors 20 and 26 are no longer operative. Since control has not been transferred from the printout unit 10 to the data signal source 12, there is no possibility of losing image controlling signals when the copy sheet 14 is fed in a skewed condition. When the skewed copy sheet 14 has been removed from the machine or placed in a proper condition, the alarm indication can be removed and the printout machine 10 returned to its normal condition by momentarily closing a reset switch 190 to apply ground to a reset terminal R. This terminal R is connected to the flip-flop 184 and to similar flip-flops in the schematic circuit shown in FIG. 1 as indicated. The momentary application of ground to the reset terminal R of the flip-flop 184 resets this flip-flop to return an enabling potential to the gates 122 and 144 and to terminate conduction through the lamp amplifier 186 so that illumination of the lamp 188 is terminated.

Assuming that the transmission of light to both of the photocells 156 and 158 has been terminated at the time that the monostable circuit 182 times out, the AND gate connected to the input of the amplifier 178 is fully enabled, and the output of the amplifier 178 rises to a more positive potential which disables the trigger circuit 180. Thus, the flip-flop 184 remains in its normal condition. In view of the fact that the photocells 156 and 158 remain darkened for the period that the copy sheet 14 is passing through the rollers 30, the

output of the amplifier 178 remains at a more positive potential and forwards an enabling potential to the upper input of the AND gate 146. This completes the enabling of this gate, the output of which is connected to an input to the data signal source 12 through an amplifier 192. The receipt of an output signal from an amplifier 192 advises the data signal source 12 that a copy sheet has been advanced to a ready position and that imaging operations or the transfer of data from the source 12 to the cathode-ray tube 16 can be initiated on demand by the signal source 12.

The positive-going signal provided at the output of the amplifier 178 is also inverted in an amplifier 194 and applied to the capacitive input of a trigger 196, the output of which is connected to the flip-flop 148. This signal controls the trigger 196 to reset the flip-flop 148 to its normal condition so that the enabling potential supplied to the upper input of the AND gate 151 is removed. This inhibits the gate 152 and prevents the application of pulsating signals to the power supply 28 through the AND gate 122 under the control of the free-running multivibrator 154. The resetting of the flip-flop 148 also applies an enabling signal to the lower input of the AND gate 150 so that this gate can now control energization of the drive motor 26 under the control of signals supplied by the data signal source 12. The ground potential provided at the output of the amplifier 194 is also supplied to the input of a trigger circuit 198, the output of which is connected to the flip-flop 138. The output signal supplied by the trigger circuit 198 resets the flip-flop 138 and thus removes the enabling potential applied to one input of the gate 140. This releases the clutch 18 so that the motor 20 is no longer coupled to the drive rollers 22, and the feeding of additional copy sheets 14 from the supply thereof is interrupted. Further operation of the printout unit 10 is controlled from the data signal source 12.

With control over operation of the printout machine 10 now transferred from the local control circuits to the data signal source 12, the signal source 12 can place the printout machine 10 in operation whenever a copy is to be produced on the copy sheet 14 whose leading edge is disposed at the skew-detecting station 38. Thus, whenever signals are available from a remote or local source, such as a record reader, communication link, or central data processing unit, the data signal source forwards an enabling signal to the upper input of the AND gate 150 through an amplifier or inverter 200. The output of the gate 150 completes the enabling of the gate 122 and controls the power supply circuit 28 to place the motor 26 in operation so that the drive system actuated by the motor 26 advances the copy sheet 14 through the corona charging station 24 to a position at which the leading edge of the copy sheet 14 is disposed in proximity to or in alignment with the face of the cathode-ray tube 16. At this time, the data signal source 12 supplies a series of signals to the cathode-ray tube 16 representing the data to be recorded. The light emitted from the face of the cathode-ray tube 16 selectively discharges the uniformly charged surface of the sheet 14 to produce an electrostatic image. Since the image or data representing signals supplied by the source 12 may be intermittent or time spaced, the data signal source 12 selectively supplies inhibiting and enabling signals through the amplifier 200 to the gate 150 so that the AND gate 122 and the power supply 28 are controlled to intermittently operate the drive motor 26. If the nature of the signal supplied to the tube 16 is such as to permit continuous operation, the power supply 28 can be controlled by the AND gate 122 to provide continuous operation of the motor 26 during the signal-receiving interval.

When the trailing edge of the copy sheet 14 enters the corona charging unit 24 and passes beyond the skew-detecting station 38, both of the photocells 156 and 158 are again fully illuminated. This controls the AND gate including the diodes 164 and 174 to place the amplifier 178 in a conductive condition so that its output drops to ground potential. This ground potential applies an inhibit to one output of the gate 146 and controls the amplifier 194 to prepare the trigger circuits 196

and 198 for subsequent operation. With gate 146 inhibited, the source 12 is given an indication not to place a subsequent or second print order until the successful completion of the first order at which time a second sheet will be advanced by rollers 22 to station 38.

As the leading edge of the copy sheet 14 passes beyond the tube 16 and enters the detecting station 62, the illumination of a photocell or light-responsive means 202 in a sensing assembly similar to the assembly 90 is terminated, and three series connected amplifiers 204, 206, and 208 connected to the capacitive input of a trigger circuit 210 connect this capacitor to a more positive potential to initiate the charging of this capacitor. The trigger 210 does not produce an output at this time.

The drive system actuated by the motor 26 further advances the copy sheet 14 so that the leading edge thereof is received in the nip of the continuously operated rollers 54 driven by the motor 58. The space between the rollers 34 and 54 is equal to the length of a copy sheet 14 so that the copy sheet is not torn or damaged when the leading portion thereof is subjected to the continuous drive imparted by the rollers 54. Alternately, the rollers 54 and 56 as well as 30, 32 and 34 could all be initially operated intermittently, and then be switched by means of a clutch to a continuous mode of operation when the trailing edge of the sheet cleared station 62. Once the leading edge of the copy sheet is received between the rollers 54, it is quickly advanced by these rollers and the rollers 56 to a position in which the leading edge of the copy sheet intercepts the beam of light normally falling on a photocell 212 at the detecting station 60, the photocell 212 being a part of a sensing or detecting assembly similar to the assembly 90. The arrival of the leading edge of the sheet 14 at the station 60 indicates the satisfactory movement of the copy sheet through the charging station 24 and the exposing station 36.

When the trailing edge of the sheet 14 leaves the rollers 34 as the sheet 14 is rapidly conveyed by the rollers 54 and 56 to the detecting station 60, light again impinges on the photocell 202 so that the capacitive input to the trigger circuit 210 is returned to ground by the amplifiers or inverters 204, 206, and 208. The trigger circuit 210 supplies a negative-going pulse to the flip-flop 148 so that this flip-flop is again set to apply an inhibiting potential to the lower input of the AND gate 150 and thus prevent further control over the power supply 28 by the data signal source 12. Further, the setting of the flip-flop 148 enables the upper input of the AND gate 152 so that the power supply 28 is periodically driven by the multivibrator 154 to permit a sheet fed by the rollers 22 to be advanced to the skew detecting station 38. The sheet feeding assembly including the rollers 22 is selectively placed in operation in dependence on the satisfactory arrival of the copy sheet 14 at the detecting station 60.

More specifically, when the leading edge of the copy sheet 14 reaches the station 60, the illumination of the photocell or light-responsive means 212 is terminated, and a pair of amplifiers or inverters 213 and 214 remove positive potential from the capacitive input to a trigger circuit 216 and apply ground potential thereto. This controls the trigger circuit 216 to supply an output signal that sets the flip-flop 138. When the flip-flop 138 is set, an enabling potential is returned to one input of the AND gate 140, and this AND gate causes the energization of the clutch 18 so that the motor 20 again advances a copy sheet 14 from a stack thereof toward the rollers 30 by rotation of the rollers 22. The drives actuated by the motors 20 and 26 advance a copy sheet to the skew-detecting station 38 in the manner described above. Thus, in response to the trailing edge of the exposed copy sheet 14 passing the detecting station 22, and the arrival of the leading edge of this sheet at the detecting station 60, control over movement of the copy sheet 14 is removed from the data signal source 12 and returned to the local control circuits in the printout machine 10.

As set forth above, it is necessary to determine whether the copy sheet 14 has passed from the skew-detecting station 38

to the detecting station 60 in accordance with the predetermined program of movement, i.e., whether the copy sheet has been advanced from the skew-detecting station 38 to a point at which the trailing edge of the sheet clears the rollers 34 by the movement-directing signals supplied to the AND gate 122 from the data signal source 12. Since the length of the copy sheet 14 is known and since the distance between the skew detecting station 38 and the rollers 34 is known, the number of cycles of rotation of the motor 26 required to effect this movement is known. As set forth above, the pulse generator including the photocell 52 provides a series of pulses representing the increments of movement applied to the copy sheet 14 by the operation of the motor 26, and these pulses are used to control the operation of the monitoring or control circuit 42 which provides an indication of whether the copy sheet 14 has properly passed from the skew-detecting station 38 to the detecting station 60.

More specifically, when the data signal source 12 receives control over the movement of the copy sheet 14 at the satisfactory conclusion of the skew-detecting operation, the signal source 12 supplies a signal through a pair of amplifiers 218 and 220 to a trigger circuit 222, which signal controls the trigger circuit 222 to supply a setting signal to a flip-flop or bistable circuit 224. This signal sets the flip-flop 224 so that ground potential is applied to the resistive input of a trigger circuit 226. The capacitive input of the trigger circuit 226 is connected to the photocell 222 through a pair of amplifiers 228 and 230. The output of the trigger circuit 226 is connected to the input of a binary counter 232 of conventional construction. Thus, as soon as the data signal source 12 starts to advance the copy sheet 14 from the skew detecting station 38, the photocell 52 supplies a series of pulses representing increments of movement of the copy sheet 14 which are applied to the input of the counter 232 and serve to advance this counter to successive settings representing the sum of the increments of movement.

The binary counter is set to provide an output signal when a predetermined number of increments of movement have been imparted to the copy sheet 14 by the drive system actuated by the motor 26. This sum of increments of movement is equal to the movement required to move the copy sheet from a position in which the leading edge is at the skew-detecting station 38 to one in which the trailing edge of the copy sheet 14 leaves the rollers 34, the sheet thereafter being continuously advanced by the motor 58 to the point at which the leading edge intercepts the beam of light at the detecting station 60. Accordingly, when the binary counter 232 has received input signals representing this length of movement, the counter 232 provides an output signal which is forwarded through an amplifier 234 to ground the capacitive input of a trigger circuit 236. The trigger circuit 236 will set an alarm flip-flop 238 if the leading edge of the copy sheet 14 has not reached the detecting station 60 at this time.

More specifically, the resistive input of the trigger 236 is connected to the output of the amplifier 214 through an amplifier 240. If the leading edge of the copy sheet 14 does not reach the station 60 at the time that the capacitive input to the gate 236 is dropped to ground potential by the amplifier 234, the amplifier 240 holds the resistive input to the trigger 236 at ground potential, and the flip-flop is set to apply an inhibit signal to the gates 144 and 114 and, through the gate 114, to the gate 122. Thus, additional copy sheets cannot be fed from the supply thereof to the skew-detecting station 38, and the drives powered by the motors 26 and 58 are disabled. The inhibit placed on the gate 144 also inhibits the gate 146 to prevent transfer of control to the data source 12. Further, the setting of the flip-flop 238 places a lamp amplifier 242 in conduction to illuminate a lamp 244. The illumination of the lamp 244 provides a visible indication that the copy sheet 14 has not been properly fed from the skew-detecting station 38 to the detecting station 60. The flip-flop 238 is reset by momentarily closing the switch 190. If the leading edge of the copy sheet has reached the detecting station 60 at the proper time, the

output of the amplifier 240 is at a more positive potential, and the trigger circuit 236 is inhibited so that the flip-flop 238 cannot be set.

The ground signal provided at the output of the inverter 234 is also returned to the binary counter 232 through an amplifier 246 to reset the counter 232 to a normal condition. The ground signal provided at the output of the amplifier 234 is also supplied to the capacitive input of a trigger circuit 248 to control this circuit to supply an output signal for resetting the flip-flop 224 to its normal condition. When the flip-flop 224 is reset to its normal condition, an inhibiting signal is supplied to the lower input to the trigger circuit 226 to prevent the application of further input signals to the binary counter 232.

From the detecting station 60, the leading edge of the copy sheet 14 next passes through the rollers 64 to the developing station 70 at which the latent electrostatic image produced by the tube 16 is developed, as by a magnetic brush developer. The copy sheet 14 is driven through the developing station 70 by the rollers 64 and 66 actuated by the drive motor 68 so that the leading edge of the copy sheet 14, on passing beyond the rollers 66, intercepts the beam of light normally impinging on a photocell 250 in a detecting assembly similar to the assembly 90 at the detecting station 74. The interception of the beam of light normally impinging on the photocell or light-responsive means 250 indicates that the copy sheet 14 has passed through the developer station 70. When the trailing edge of the sheet 14 passes the photocell 212, the amplifiers 213, 214, and 216 are restored to a normal condition.

As set forth above, the timing circuit 72 is provided for monitoring the passage of the copy sheet 14 through the developer station 70 and provides an indication if the sheet is not moved through the station 70 in the set time period of the program. Since the copy sheet 14 is of a known length and is continuously moved from the detecting station 60 to the detecting station 74, the proper passage of the copy sheet 14 through the developer station can be determined by measuring the time required for this passage. Accordingly, the timing circuit 72 includes two monostable timing circuits 252 and 254 providing a time delay equal to the expected transit of time of the copy sheet 14 between the stations 60 and 74.

The circuit 72 is placed in operation when the leading edge of the copy sheet 14 intercepts the beam of light at the detecting station 60 and controls the amplifier 214 to supply a ground signal to the upper input of a trigger circuit 256. This controls the trigger circuit 256 to set the monostable circuit 252 and apply a positive potential to a trigger circuit 258. When the monostable circuit 252 times out, ground is applied to the capacitive input of the trigger circuit 258 to control this circuit to set the monostable circuit 254. The monostable circuit 254 provides a positive potential to the capacitive input of a trigger circuit 260 during its timing interval and returns this capacitive input to ground potential at the end of its time delay. Thus, at the end of the delay period during which the sheet 14 should have satisfactorily passed from the detecting station 60 to the detecting station 74, an attempt is made to set an alarm flip-flop 262 under the control of the trigger circuit 260.

The resistive input of the trigger circuit 260 is connected to the photocell 250 through three series-connected inverters or amplifiers 264, 266, and 268. If the leading edge of the copy sheet 14 has reached the detecting station 74, the amplifier 268 holds the resistive input of the trigger circuit 260 at a positive potential when ground is applied to the capacitive input by the monostable circuit 254. Thus, the flip-flop 262 cannot be set. Alternatively, if the copy sheet 14 has failed to reach the detecting station 74, the amplifier 268 holds the resistive input of the trigger circuit 260 at ground potential, and the flip-flop 262 is set.

When the flip-flop 262 is set, a lamp amplifier 270 is placed in a conductive condition to illuminate a lamp 272 and provide a visible indication that the copy sheet 14 has not been properly advanced from the detecting station 60 to the detecting station 74. The setting of the flip-flop 262 also applies an

inhibiting potential to the gates 114, 124, and 144, and, through the gate 114, to the gate 122. Thus, all of the drive or feeding systems in the printout machine 10 located prior to the developing station 70 and including the drive system associated with the developer station 70 are placed in an inoperative condition. The inhibit placed on the gate 144 also disables transfer of control to the data source 12 through the gate 146. Whenever the machine malfunction has been remedied, the momentary closure of the switch 190 resets the flip-flop 262 and restores the printout machine 10 its normal condition.

As the copy sheet 14 passes through the detecting station 74, it enters the fusing station 76 through which it is advanced by the rollers 80 and 82 and the conveying belt 78 driven by the motor 84. When the trailing edge of the sheet passes the detecting station 74, the amplifiers, 264, 266, and 268 are restored to their normal condition. As the copy sheet 14 leaves the fusing station 76, it intercepts the beam of light normally illuminating a photocell or light-responsive means 274 at the detecting station 88, the detecting station being substantially the same as the detecting assembly 90 shown in FIG. 3. Since the sheet feeding system driven by the motor 84 is continuously operative, the satisfactory passage of the copy sheet 14 between the detecting stations 74 and 88 can be determined by measuring the length of time elapsed between the interception of the beam of light at the detecting station 74 and the interception of the beam of light at the detecting station 88.

Accordingly, the timing circuit 86 which monitors the passage of the copy sheet 14 through the fusing station 76 includes three monostable timing circuits 276, 278, and 280, the first of which is coupled to the output of the amplifier 266 through a trigger circuit 282. When the photocell 250 detects the presence of the leading edge of the copy sheet 14, ground is applied to the capacitive input of the trigger circuit 282 so that the trigger circuit 282 sets the monostable circuit 276. The monostable circuit 276 provides a positive-going pulse of a given time duration, at the termination of which a trigger circuit 284 coupled to the output of the monostable circuit 276 sets a monostable 278. When the monostable 278 times out, a trigger circuit 286 coupled to the circuit 278 sets the monostable circuit 280. The output of the monostable circuit 280 is connected to the capacitive input of a trigger circuit 288, the output of which is connected to an alarm flip-flop 290. The resistive input of the trigger circuit 288 is connected to the photocell 274 through three series-connected inverters or amplifiers 292, 294, and 296. If the leading edge of the copy sheet 14 intercepts the beam of light at the detecting station 88 at the time that the monostable 280 times out, a positive inhibiting potential is applied to the resistive input of the trigger circuit 288, and the control circuit for the printout machine 10 remains in its normal state.

Alternatively, if the leading edge of the copy sheet 14 has not reached the detecting station 88 at the time that the monostable circuit 280 times out, the amplifier 296 applies ground to the resistive input of the trigger circuit 288, and this circuit sets the flip-flop 290. When the flip-flop 290 is set, a lamp amplifier 298 is placed in a conductive condition to illuminate a lamp 300 and provide a visible indication of the improper sheet feeding in the fusing station 76. The setting of the flip-flop 290 also applies an inhibit signal to the AND gates 124, 144, and 114, and, through the gate 114, to the AND gate 122. Thus, all of the drive systems prior to the drive system for the fusing station 76 are placed in an inoperative condition. Further, the inhibiting of the gate 144 places an inhibit on the gate 146 so that the data signal source 12 cannot be rendered operative to transmit data or image representing signals to the cathode-ray tube 16. The momentary closure of the contacts 190 when the jam has been cleared resets the flip-flop 290 and thus restores the printout machine 10 to an operative condition.

Although the present invention has been described with reference to a single illustrative embodiment thereof, it should

be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this invention.

What is claimed and desired to be secured by Letters Patent of the United States is:

1. In an apparatus in which an article is moved along a path, first, second, and third detecting means spaced along the path and operative to detect the presence of the article at different first, second, and third points, respectively, along the path;
 - a first control circuit coupled to and controlled by the first detecting means for producing an indication that the article has reached the first point;
 - a second control circuit coupled to and controlled by the second detecting means for producing an indication that the article has reached the second point;
 - and circuit means coupling the second detecting means to the first control circuit to inhibit the operation of the first control circuit and coupling the third detecting means to the second control circuit to inhibit the second control circuit.
2. The apparatus set forth in claim 1 in which the first control circuit includes
 - a counter operated to successive settings in response to received signals,
 - and a signal source coupled to the counter and operative to supply a series of signals to the counter synchronized with movement of the article.
3. The apparatus set forth in claim 1 in which the first control circuit includes
 - a timing circuit started by the first detecting means,
 - and an indicating means coupled to the timing circuit to be operated at the end of a predetermined time interval, the second detecting means being coupled to the indicating means to inhibit operation thereof by the timing circuit.
4. In an apparatus for feeding an article along a path,
 - first feeding means for imparting continuous movement to the article along a first portion of the path,
 - second feeding means for imparting intermittent movement to the article along a second portion of the path,
 - detecting means disposed along the path for detecting the presence of the article in the first and second portions of the path,
 - and a control circuit coupled to the detecting means for indicating an abnormality in the passage of the article along the first and second portions of the path, said control circuit including timing means for controlling indications of an abnormality in the first portion of the path and means operated in synchronism with the second feeding means for controlling indications of an abnormality in the second portion of the path.
5. In an apparatus for moving a copy sheet along a path of movement,
 - a plurality of separate sheet feeding means each moving the sheet through a different portion of the path of movement, the feeding means being disposed along the path of movement in a sequence,
 - a plurality of detecting means each adapted to monitor abnormalities in the movement of the copy sheet through one of the different portions of the path of movement,
 - and a control circuit connected between the plurality of sheet-feeding means and the plurality of detecting means and controlled by the detection of an abnormality in the movement of the copy sheet in one of the different portions for inhibiting operation of the feeding means that move the copy sheet through the portions of the path of movement that are located prior to the one portion in the sequence.
6. The apparatus set forth in claim 5, including
 - indicating means connected to and controlled by each of the detecting means for indicating the portion of the path of movement in which an abnormality is detected.

7. A monitoring device for checking the sequential movement of an item between two points, comprising first and second sensing means disposed respectively at said points with each sensing means providing a monitoring signal upon the arrival of the item at said point; circuit means including timer means coupled to said first sensing means and actuated upon receiving a monitoring signal from the first sensing element to provide a timing signal which is terminated after the elapse of a period corresponding to the time it normally takes the item to move between said sensing means; and comparator means coupled to said second sensing means and said timer means for receiving the timing signal and monitoring signal from the second sensing means, said comparator means being actuated by the timing signal to provide a control signal indicating abnormal movement of the item on termination of said timing signal unless said monitoring signal from the second sensing means is received by the comparator means before the termination of said timing signal.
8. An apparatus for detecting an abnormality in the movement of sheet material between spaced first and second positions on a path of movement comprising a first and second detector located at the first and second points, a timing circuit coupled to the first detection means and placed in operation by the detection of sheet material at the first point, said timing circuit providing an output signal at the termination of a predetermined time interval, a logic device supplied with the output signal, a bistable indicating means coupled to the logic device and operated to an abnormal indicating state by the logic device when the output signal is supplied by the timing circuit, and means coupling the second detecting means to the logic device to inhibit the logic device when the second detecting means detects sheet material at the second point.
9. A monitoring device for checking the sequential movement of an item between a first point and a second point which are a predetermined distance from each other, comprising a pulse generator operated with the arrival of the item at said first point which provides a pulse concurrent with the advancement of the item a preset unit of distance, the sum of a predetermined number of said units being equal to the predetermined distance between said points; a sensing means disposed at said second point to provide a monitoring signal when the item arrives at said second point; circuit means including a pulse responsive counter connected to said generator to receive and count said pulses, said counter upon receiving a number of pulses corresponding to said predetermined number of said units providing an output signal; and comparator means coupled to said counter and said sensing means for receiving the output signal and the monitoring signal, said comparator means providing a control signal indicating abnormal movement of the item whenever said output signal is received by the comparator means before the monitoring signal.
10. An apparatus for detecting an abnormality in the movement of sheet material along a path between spaced first and

- second points comprising a drive means for imparting intermittent movement to sheet material along the path between the first and second points, a counting circuit operated to successive settings by received signals and operable to supply an output signal when a predetermined number of signals has been received, a signal source operated in synchronism with the drive means and coupled to the counting circuit to supply a number of signals to the counting circuit representing the movement past the first point imparted to the sheet material by the drive means, means for indicating an abnormality in the movement of the sheet material, a logic device supplied with the output signal and coupled to the indicating means for controlling the operation of the indicating means, detecting means disposed adjacent the path and responsive to the presence of sheet material at the second point, and means coupling the detecting means to the logic device for inhibiting operation of the indicating means when the sheet material reaches the second point.
11. A monitoring device for checking abnormal skew movement of an item, comprising first and second sensing means spaced apart from each other and disposed along a common line which is transverse to the direction in which said item is moved so that during normal movement the item reaches both sensing means simultaneously, each of said means providing a monitoring signal upon the arrival of the item at said means; and circuit means including comparator means coupled to said first and second sensing means for receiving said monitoring signals, said circuit means including first means controlled by the receipt of one monitoring signal for presetting the comparator means to provide a control signal indicating an abnormal skew condition, said circuit means including second means operated when said monitoring signals are received simultaneously for disabling the comparator means from providing said control signal.
12. A monitoring device for checking abnormal skew movement of an item, comprising first and second sensing means spaced apart from each other and disposed along a common line which is transverse to the direction in which said item is moved so that during normal movement the item reaches both sensing means simultaneously, each of said sensing means providing a monitoring signal upon the arrival of the item at the sensing means; circuit means including timer means coupled to the first and second sensing means and responsive to monitoring signals from either of the sensing means to generate a timing signal which is terminated after a preset time interval; and comparator means coupled to the first and second sensing means and the timer means and responsive to said timing and monitoring signals to provide a control signal indicating an abnormal skew condition at the termination of said timing signal unless monitoring signals from both of said sensing means are received before the termination of the timing signal.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,603,585 Dated September 7, 1971

Inventor(s) William R. Maloney, Arthur L. Hallquist

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 18	"16" should read --26--
Column 9, line 17	"151" should read --152--
Column 11, line 24	"THis" should read --This--
Column 13, line 10	After "10" insert the word --to--
Claim 1, line 19	"fist" should read --first--
Claim 6, line 72	"not" should read --set--

Signed and sealed this 6th day of June 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents