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Allen et al.

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[54] SUPERPOSED SHEET DETECTOR

[76] Inventors: **James H. Allen,** 17 Maryvale Dr., Webster; **Demetrios Polyzoes,** 12 Buttermilk Hill, Pittsford, both of N.Y.

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[51] **Int. Cl.** **B65h 7/12,** G06f 7/38

[58] **Field of Search** ..... 271/57; 209/74 R, 209/82; 83/371; 235/92 SB

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Primary Examiner—Edward A. Sroka

Attorney—James J. Ralabate et al.

[57] **ABSTRACT**

Improved superposed sheet detecting apparatus is provided in accordance with the teachings of the present invention. Transducer means disposed in operable location to sheet feeding mechanism is adapted to produce signals proportional to the thickness of sheets of material fed past the operable location. A multibit binary signal representative of the thickness of an initially fed sheet of material is gated into storage means whereat said multibit binary signal is stored. Multibit binary signals representative of the thickness of subsequently fed sheets of material are compared to the stored multibit binary signal by comparison means. When the thickness of a subsequently fed sheet of material exceeds the thickness of an initially fed sheet of material the comparison means produces an error signal, which error signal is detected by activatable detecting means. Detection of the error signal may result in the deflection of the subsequently fed sheet of material from the sheet feeding mechanism.

17 Claims, 2 Drawing Figures

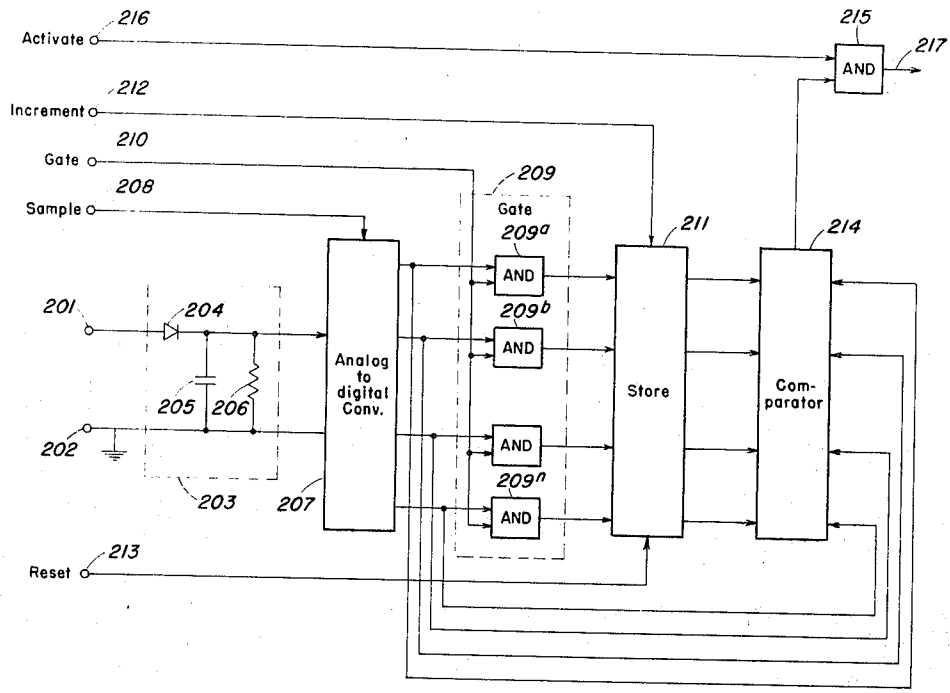
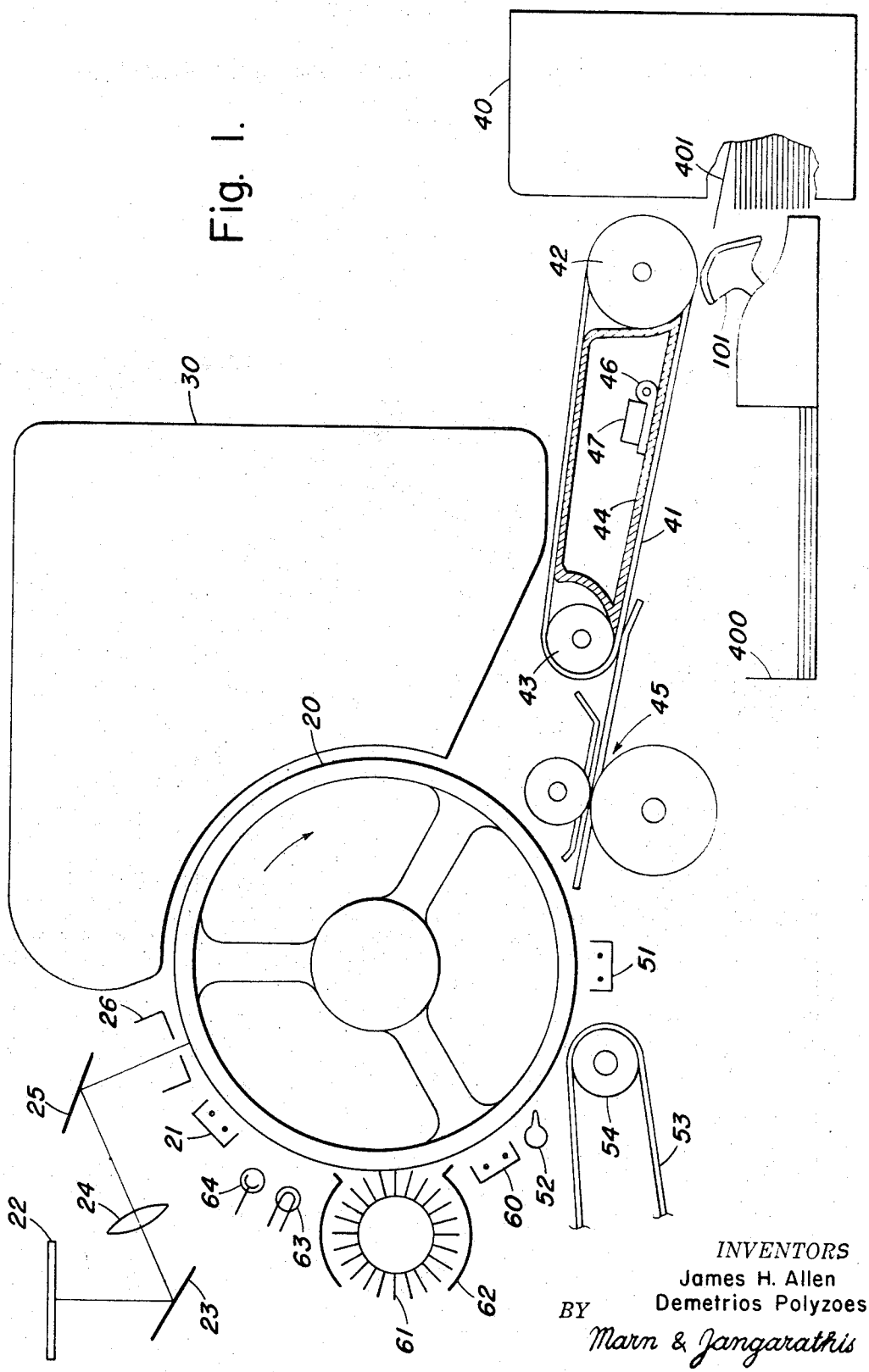


Fig. 1.



INVENTORS
James H. Allen
Demetrios Polyzoes
BY
Marn & Jangarathis
ATTORNEYS

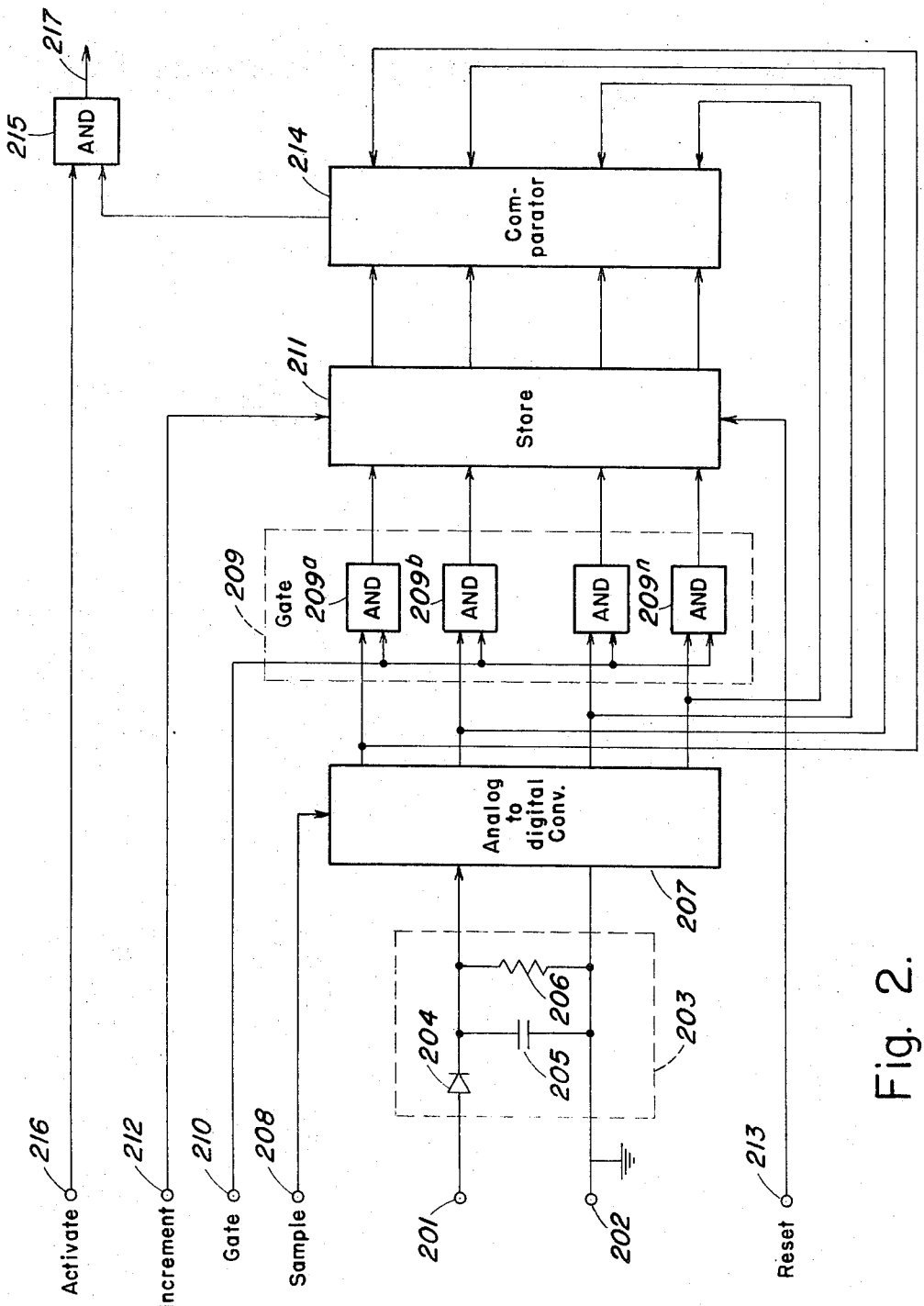


Fig. 2.

INVENTORS
James H. Allen
Demetrios Polyzoes

BY
Marn & Jangarathis
ATTORNEYS

SUPERPOSED SHEET DETECTOR

This invention relates to improved superposed sheet detecting apparatus, and more particularly, to improved apparatus for detecting the transporting of superposed sheets of material admitting of selectively variable thicknesses.

The successful operation of devices such as printing presses, copy reproducing machines and the like that operate upon sheets of material serially fed thereto is dependent upon the feeding of single sheets of material. In addition, it is preferable that these devices exhibit the capability of operating upon sheets of material admitting of various weights and thicknesses. Most sheet feeding mechanisms developed by the prior art, although designed to transport single sheets of material, occasionally convey superposed sheets.

Thus it has been necessary to employ a superposed sheet detector in conjunction with sheet transport means to prevent superposed sheets from being operated upon by the aforementioned devices. Conventional detecting means heretofore utilized by the prior art employ mechanical members that are preset to specific tolerances. Single sheets having a thickness that correspond to such tolerances are passed through the detecting means while superposed sheets are diverted therefrom. These detectors however, limit the sheets that may be employed therewith to specific thicknesses. If material admitting of a thickness that does not correspond to the preset specific tolerances is to be utilized, a skilled technician must effect the necessary mechanical adjustments. Hence, these detectors do not permit rapid interchangeability between various types of material. Moreover, it has been found that these prior art superposed sheet detectors are not responsive to superposed sheets of relatively thin material whereas single sheets of relatively thick material erroneously activate the detector.

In U.S. Pat. application Ser. No. 180,973 entitled Superposed Sheet Detection, filed on Sept. 16, 1971 by James H. Allen and assigned to Xerox Corporation, the assignee of the present invention, there are described various techniques that successfully overcome the foregoing disadvantages. The present invention is drawn to improve superposed sheet detecting apparatus for detecting superposed sheets of material admitting of selectively variable thicknesses.

Therefore, it is an object of the present invention to provide improved superposed sheet detecting apparatus.

It is a further object of this invention to provide improved superposed sheet detecting apparatus capable of detecting a multiple of sheets admitting of selectively variable thicknesses.

It is a further object of the present invention to provide improved superposed sheet detecting apparatus adapted to prevent the feeding of single sheets of material having an undesired thickness.

Still another object of the present invention is to provide electrical apparatus for detecting superposed sheets of material, which apparatus does not require mechanical adjustment.

Yet another object of this invention is to provide improved apparatus for detecting superposed sheets of various types of material.

It is an additional object of the present invention to provide improved superposed sheet detecting apparatus employing digital circuitry.

Various other objects and advantages of the invention will become clear from the following detailed description of an exemplary embodiment thereof, and the novel features will be particularly pointed out in connection with the appended claims.

In accordance with this invention, improved superposed sheet detecting apparatus for detecting the superposition of transported sheets of material admitting of selectively variable thicknesses is provided wherein multibit binary signals representative of the thickness of transported sheets of material are generated; the multibit binary signal representative of the thickness of an initially transported sheet of material is stored in storage means; comparison means compares the content of the storage means with each generated multibit binary signal and produces an error signal when a multibit binary signal exceeds the contents of the storage means; and activatable detecting means responds to an activating signal supplied thereto to detect a produced error signal.

The invention will be more clearly understood by reference to the following detailed description of an exemplary embodiment thereof in conjunction with the accompanying drawings in which:

FIG. 1 schematically illustrates a portion of a reproducing device wherein the improved superposed sheet detecting means of the present invention may be employed; and

FIG. 2 is a diagram in partial schematic and partial block form of a digital circuit in accordance with the present invention.

Referring now to the drawings, and in particular to FIG. 1, there is shown automatic reproducing apparatus such as an electrophotographic reproducing machine which comprises a photoreceptive plate **20** including a photoconductive layer or a light receiving surface on a conductive backing and formed in the shape of a drum, adapted to rotate in the direction indicated by the arrow to cause the drum surface to sequentially pass a plurality of processing stations. It is noted herein that FIG. 1 corresponds to an identical figure in aforementioned application Ser. No. 180,973. Accordingly, reference may be had to that application for a more detailed description of the illustrated apparatus. Briefly, however, the several processing stations in the path of movement of the drum surface comprise a charging station **21** for depositing a uniform electrostatic charge on the photoreceptive drum **20.** An exposure station including an object mirror **23,** image mirror **25** and light shield **26** is provided to dissipate the electrostatic charge in accordance with a projected light image of a document **22.** A developing station **30,** provided with conventional developing material such as toner particles, is provided to form a powder image in the configuration of the electrostatic latent image formed on the surface of the photoreceptive drum **20.** The powder image is transferred from the surface of drum **20** to the surface of a sheet of material in intimate contact therewith, said sheet of material being transported to a transfer station by sheet feeding mechanism soon to be described. The transfer station includes a corona transfer device **21** adapted to produce an electrostatic field which is capable of attracting the toner particles from the surface of the drum **20** to the surface

of the sheet of material. Stripping apparatus **52** is adapted to remove a sheet of material from the surface of the drum **20** and to direct the sheet of material onto endless movable belt means **53,** whereby the sheet of material is carried to a fixing station (not shown). A cleaning station including a corona pre-cleaning means **60,** rotating brush **61** and discharge lamp **63** is provided to remove residual powder from the surface of drum **20** and to flood the drum with light to cause dissipation of any residual electric charge remaining on the surface thereof.

The sheet feeding mechanism includes a sheet feed device **40** adapted to feed the top sheet **401** of a stack of sheets to roller means **42.** Endless movable belt means **41** is deployed about roller means **42** and serves to transport the sheet fed to roller means **42** to a sheet registration device **45.** The sheet transported by endless belt means **41** is adapted to adhere thereto by means of vacuum shoe **44.** The sheet transport device includes sensing means **47** disposed at a fixed location therein and adapted to sense the leading edge of a sheet transported by endless belt means **41.** Sensing means **47** may comprise a conventional switch including a depending lever interposed in the path of the transported sheets. Contact between the leading edge of a sheet and the depending lever is effective to close the switch. Alternatively, sensing means **47** may include a photoelectric device wherein a light beam may be interrupted by the leading edge of a transported sheet, resulting in the closing of a switch or generation of a pulse signal. The sheet transport device further includes reject fingers **46** which are adapted to protrude into the path of a conveyed sheet upon being actuated. The movement of reject fingers **46** into the path of a conveyed sheet is effective to deflect the sheet into an abort or reject tray **400** located beneath the sheet transport device.

Transducer means **101** is disposed at a predetermined location in the sheet feeding mechanism and is adapted to produce signals proportional to the thickness of the sheets of material transported past the predetermined location. Transducer means **101** may comprise a rotatable member in spaced registration from roller means **42** whereby the rotatable member is angularly displaced by an amount dependent upon the thickness of a sheet of material interposed between the rotatable member and the roller means **42.** The rotatable member may be operably coupled to variable impedance means such that the impedance of the variable impedance means is varied in accordance with the angular displacement of the rotatable member. The variable impedance means may, in turn, be coupled to a detecting network capable of producing an analog signal having a magnitude that varies in accordance with the impedance of the variable impedance means. The foregoing transducer means comprised of the rotatable member, variable impedance means and detecting network is described in more detail in the aforementioned U.S. Pat. application Ser. No. 180,973.

Transducer means **101** may comprise other conventional means adapted to produce a signal proportional to the thickness of a sheet of material. Accordingly, the transducer means **101** may comprise a proximity detector wherein a change in the separation between transducer means **101** and a reference such as roller means **42** caused by the feeding of a sheet of material therebetween effects a corresponding change in the amplitude of an analog signal. Conventional proximity detectors employing capacitive or inductive coupling are well known in the prior art and need not be further described herein. A further alternative of transducer means **101** may comprise a conventional weight detector wherein the weight of a sheet of material placed thereon depresses the transducer means and an analog signal proportional thereto is produced.

The signal produced by transducer means **101** is applied to the digital circuitry illustrated in FIG. **2** which comprises binary signal generating means **207,** selectively activatable gating means **209,** storage means **211,** comparison means **214** and activatable detecting means **215.** Binary signal generating means **207** is adapted to generate a multibit binary signal comprised of any convenient number of bits in response to the analog signal produced by transducer means **101.** Accordingly, the binary signal generating means may comprise a conventional analog to digital converter well known to those of ordinary skill in the art and capable of producing a multibit binary signal representative of the analog signal applied thereto when a sample pulse is supplied to terminal **208.** In addition, the multibit binary signal generated thereby may be a serial binary signal comprised of a train of binary ones and zeros or a parallel binary signal wherein the binary ones and zeros are generated simultaneously. It will soon become apparent that it is preferable to employ an analog to digital converter wherein the multibit binary signal generated thereby is comprised of a plurality of parallel binary ones and zeros. Binary signal generating means **207** is coupled to input terminals **201, 202** via filter means **203.** The filter means **203** functions as a low pass filter for removing rapid variations in the analog signal applied to terminals **201, 202** by transducer means **101.** It will be appreciated by those of ordinary skill in the art that such signal variations correspond to small surface irregularities in the sheet of material transported past the transducer means. In addition, filter means **203** produces a signal corresponding to the thickest portion of the transported sheet of material. Hence, filter means **203** may include a conventional amplitude modulation detector comprised of diode **204** having an anode coupled to input terminal **201** and a cathode coupled to parallel connected capacitance means **205** and resistance means **206.** The time constant of the parallel connected capacitance means **205** and resistance means **206** may be chosen such that capacitance means **205** is capable of charging to the maximum amplitude applied to input terminal **201.** In the configuration illustrated in FIG. **2** it is assumed that the analog signal produced by transducer means **101** and applied to input terminal means **201, 202** is a positive signal. If, however, the analog signal is a negative signal, diode **204** may be oppositely poled such that the cathode thereof is coupled to input terminal **201** and the anode thereof is coupled to the parallel connected capacitance means **205** and resistance means **206.**

Binary signal generating means **207** is coupled to selectively activatable gating means **209** which performs a switching function adapted to apply the multibit binary signal supplied to the input terminals thereof to the output terminals thereof in response to a gating signal applied to terminal **210** at selected intervals of time. Selectively activatable gating means **209** is comprised of a plurality of AND gates **209***a* – **209***n* corresponding in number to the number of parallel binary bits included in each multibit binary signal. Each of the AND

gates **209***a* – **209***n* includes a first input terminal coupled to the binary signal generating means **207** for receiving an associated one of the bits included in the multibit binary signal and a second input terminal coupled to terminal **210**. As illustrated herein, the second input terminals of AND gates **209***a* – **209***n* are connected in common relationship. It is appreciated that if the multibit binary signal is comprised of a train of serially generated bits, the selectively activatable gating means **209** may comprise a single AND gate.

Storage means **211** includes a plurality of input terminals coupled to selectively activatable gating means **209**, and is adapted to store the multibit binary signal generated by binary signal generating means **207** and gated thereto by selectively activatable gating means **209**. The storage means **211** may comprise a conventional buffer register having a number of stages corresponding to the number of bits included in the multibit binary signal. If the multibit binary signal is comprised of a plurality of parallel bits, the storage means **211** simultaneously stores each of the bits in an associated register stage. Alternatively, if the multibit binary signal is comprised of a train of serially generated bits, the storage means **211** may comprise a conventional shift register through which the train of bits is serially shifted. For a purpose to be described, it is preferable that storage means **211** comprises a settable counting means capable of being set to a binary count corresponding to the multibit binary signal gated thereto, and wherein the binary count may be incremented in response to counting pulses supplied to terminal **212**. Thus, the storage means **211** may comprise a parallel/serial shift register wherein the output of selectively activatable gating means **209** is stored therein in parallel as a binary number, and the binary number is serially increased in accordance with the incrementing pulses applied to terminal **212**.

Storage means **211** additionally includes a reset input terminal coupled to input terminal **213**. A reset pulse applied to input terminal **213** is effective to clear the contents of storage means **211**, thereby resetting the storage means to a quiescent condition.

Comparison means **214** includes a first plurality of input terminals coupled to the storage means **211** and a second plurality of input terminals coupled to the binary signal generating means **207**. Comparison means **214** is adapted to compare the contents of the storage means **211** with each multibit binary signal generated by the binary signal generating means **207** and to produce an error signal when the generated multibit binary signal exceeds the contents of the storage means. Accordingly, comparison means **214** may comprise a logic subtractor circuit formed of a plurality of AND gates and OR gates such as described at page 158 of *Design of Digital Computers* by H. W. Gschwind, 1967, capable of performing the aforenoted function. Those of ordinary skill in the art are clearly competent in constructing an alternative circuit such as an analog comparator including digital-to-analog converters coupled to storage means **211** and binary signal generating means **207**, respectively. Since the precise structure of the comparison means **214** forms no part of the present invention per se, further description thereof is not necessary for a complete understanding of the present invention. The output terminal of comparison means **214** to which an error signal is applied is coupled to activatable detecting means **215**. The activatable detecting means **215** is adapted to detect the error signal supplied thereto and to energize further means coupled to lead **217** in response to the detected error signal. The activatable detecting means **215** may comprise a conventional AND gate including a first input terminal coupled to terminal **216** to which an activating signal is applied, such that error signals supplied to the second input terminal of the AND gate are detected at selected intervals of time. Lead **217** may be connected to a conventional solenoid means (not shown) which solenoid means is operably coupled to reject fingers **46** of FIG. **1**. Thus, it may be appreciated that the detection of an error signal by activatable detecting means **215** results in the projection of reject fingers **46** into the path of travel of a sheet of material transported by the sheet feeding mechanism.

The operation of the digital circuit illustrated in FIG. **2** will now be described in conjunction with FIG. **1**. When operation of the apparatus employing the sheets of material is initiated, the top sheet **401** is fed to the sheet transport device by sheet feeding means **40**. Transducer means **101** senses the presence of the transported sheet of material and produces an analog signal having an amplitude proportional to the thickness of the sensed sheet of material. The analog signal is applied to terminals **201, 202** and filter means **203** removes the rapid variations therein such that binary signal generating means **207** is supplied with a signal representing the actual thickness of a transported sheet. A sample pulse is applied to terminal **208** once during each transporting cycle of the sheet feeding means **40**. Accordingly, a multibit binary signal is generated by the binary signal generating means **207** at each sample pulse time, which multibit binary signal is representative of the thickness of each transported sheet of material. A gating signal is applied to terminal **210** in time delayed relationship with respect to the application of the sample pulse to terminal **208** whereby selectively activatable gating means **209** is activated to gate the multibit binary signal generated by binary signal generating means **207** into storage means **211**. It should be noted that the gating signal is applied to terminal **210** only when an initially transported sheet of material is fed by the sheet feeding mechanism. Thus, only the multibit binary signal representative of the thickness of an initially transported sheet of material is stored in storage means **211**.

The multibit binary signal is stored as a corresponding binary count by the storage means **211**. The contents of the storage means **211** are compared in comparison means **214** to the multibit binary signal generated by the binary signal generating means **207**. Since only the initially generated multibit binary signal is stored in storage means **211** it is readily seen that the initial signal is compared to each subsequently generated multibit binary signal. Hence, comparison means **214** effects a comparison between the thickness of an initially transported sheet of material and the thickness of each subsequently transported sheet of material. When the thickness of a subsequently transported sheet of material exceeds that of the initially transported sheet of material, comparison means **214** applies an error signal to activatable detecting means **215**. It is understood that when an initial sheet of material is transported, the multibit binary signal applied to comparison means **214** by binary signal generating means **207** is equal to the multibit binary signal stored in storage

means **211** and applied to comparison means **214.** Accordingly, it is expected that comparison means **214** will not produce an error signal at this time. However, it has been found that the digital circuitry illustrated in FIG. **2** exhibits inherent time delay characteristics such that the multibit binary signal generated by binary signal generating means **207** might be applied to comparison means **214** before storage means **211** is able to complete its storage operation of that multibit binary signal. Hence, it is possible that comparison means **214** might produce an error signal during the feeding of an initial sheet of material. Activatable detecting means **215** however, cannot respond to the error signal supplied thereto unless an activating signal is applied to terminal **216.** Accordingly, it is contemplated that terminal **216** will receive an activating signal during the transport of each sheet of material except the initially transported sheet of material. Consequently, the production of an error signal by comparison means **214** in response to the feeding of an initially transported sheet of material past the transducer means **101** will have no effect on the operation of the apparatus illustrated in FIGS. **1** and **2.**

Let it now be assumed that superposed sheets of material are transported by the sheet feeding mechanism. Transducer means **101** will produce an analog signal which analog signal is sampled by binary signal generating means **207** when a sample pulse is applied to terminal **208,** thereby generating a multibit binary signal representative of the total thickness of the superposed sheets. Selectively activatable gating means **209** prevents this multibit binary signal from being applied to storage means **211** because a gating pulse is applied to terminal **210** only during the transport of an initial sheet of material. The multibit binary signal is however supplied to comparison means **214** whereat it is compared to the stored multibit binary signal. Thus, the total thickness of the superposed sheets of material is compared to the thickness of a single initially transported sheet of material. It is appreciated therefore, that comparison means **214** applies an error signal to activatable detecting means **215.** Upon receiving an activating signal supplied to terminal **216,** the activatable detecting means **215** applies a pulse signal to lead **217.** The pulse signal is effective to energize reject fingers **46** of FIG. **1** to deflect the superposed sheets of material away from the sheet feeding mechanism and into reject tray **400.**

It is observed that the thickness of single sheets of material may vary throughout a permissible range of thicknesses. Consequently, if an initially transported single sheet of material admits of a relatively thin thickness and a subsequently transported single sheet of material admits of a relatively thick thickness then the multibit binary signal applied to comparison means **214** by binary signal generating means **207** will exceed the multibit binary signal supplied to comparison means **214** by storage means **211** such that an error signal is detected by activatable detecting means **215,** thereby projecting reject fingers **46** into the path of the subsequently transported single sheet of material. It is a feature of the present invention to permit single sheets of material exhibiting a range of thicknesses to be successfully transported without the erroneous rejecting thereof. Thus, a subsequently transported sheet of material is assumed to be comprised of superposed sheets if the sensed thickness thereof exceeds the thickness of an initially transported sheet by a predetermined amount. In other words, the multibit binary signal generated by binary signal generating means **207** must exceed the multibit binary signal stored in storage means **211** by a threshold amount before the activatable detecting means **215** energizes reject fingers **46.** Although various techniques may be employed to provide for the aforementioned threshold, such as by providing binary signal generating means **207** with a high degree of quantization while discarding the least significant bits of the highly quantized multibit binary signal generated thereby, it is preferred to increase the value of the multibit binary signal stored in storage means **211** by a predetermined amount. Thus, the binary count that is set in storage means **211** by the multibit binary signal supplied thereto by selectively activatable gating means **209** is incremented to a higher binary count by supplying incrementing pulses to terminal **212.** It is appreciated that the number of incrementing pulses applied to terminal **212** may be determined by the permissible range of thicknesses of single sheets of material. Thus, if a relatively wide range of thicknesses is permissible, a correspondingly large number of increment pulses is applied to terminal **212.** Conversely, if a relatively narrow range of thicknesses is permissible, a correspondingly small number of increment pulses is applied to terminal **212.** Hence, the increment pulses determine the threshold thickness which must not be exceeded by a single sheet of material. As an illustrative example, let it be assumed that the thickness of an initially transported sheet of material is represented by the count "1001" stored in storage means **211.** Those skilled in the art of binary notation will understand that this corresponds to a count of 9. Let it further be assumed that a single sheet of material admitting of a thickness corresponding to a count of 12, i.e., "1100", is a maximum permissible thickness. If now the thickness of a subsequently transported sheet of material is represented by the binary count "1010" (corresponding to the count of **10**) an error signal would be produced by comparison means **214.** Therefore, after the binary count "1001" corresponding to the multibit binary signal representative of the thickness of the initially transported sheet of material is stored in storage means **211,** three incrementing pulses are applied to terminal **212** such that the count now stored by storage means **211** is incremented to "1100". Consequently, an error signal will not be produced by comparison means **214** in response to the subsequently transported sheet of material unless the subsequently transported sheet of material admits of a thickness represented by the multibit binary signal "1101" (corresponding to a count of **13**), which thickness is assumed to be indicative of superposed sheets.

After a perdetermined number of sheets have been transported past the transducer means **101,** a reset pulse may be applied to terminal **213** to clear the multibit binary signal stored in storage means **211.** This may be accomplished by connecting a conventional counting means to sensing means **47** such that the number of sheets sensed by sensing means **47** is counted by the counting means. When a predetermined count is obtained the reset pulse may be applied to terminal **213.** Alternatively, a reset pulse might be applied to terminal **213** when the apparatus illustrated in FIG. **1** completes an operating cycle. The operating cycle might be independent of the total number of sheets transported by

the sheet feeding mechanism **40.** Thus, the contents of storage means **211** might be discarded after a predetermined number of sheets have been transported or after the completion of an operating cycle, notwithstanding the number of sheets of material that have been deflected by reject finger **46.** Another embodiment contemplates the connection of terminal **213** to lead **217** such that detection of an error signal by activatable detecting means **215** results in the clearing of the multibit binary signal stored in storage means **211.** It is appreciated that when a reset pulse is applied to terminal **213** to clear the contents of storage means **211,** the digital circuit illustrated in FIG. **2** is returned to its quiescent condition. The next sheet of material transported by the sheet feeding mechanism is assumed to be an initially transported sheet and the foregoing operation of the digital circuit illustrated in FIG. **2** is repeated. Hence, the interconnection of terminal **213** and lead **217** is effective to establish a detecting cycle for the illustrated circuit which detecting cycle is initiated by a first transported sheet of material and terminated when activatable detecting means **215** detects an error signal produced by comparison means **214.** The detecting cycle, however, does not admit of a predetermined duration, but is dependent upon the detection of superposed sheets.

It is now understood that the operation of the present invention is dependent upon the thickness of an initially transported single sheet of material. Determinations as to the superposition of subsequently transported sheets are made on the basis of the thickness of an initial sheet. Thus, a stack of thin sheets of material may be interchanged with a stack of thick sheets of material without necessitating mechanical adjustments of the present invention because the initial sheet of thin material provides a reference for the subsequently transported thin sheets and the initial sheet of thick material provides a reference for the subsequently transported thick sheets. The present invention additionally provides for the possibility that an initially transported sheet is, in fact, comprised of superposed sheets. If the reference multibit binary signal stored in storage means **211** is representative of the thickness of superposed sheets, the multibit binary signals generated by binary signal generating means **207** and representative of the thickness of subsequently transported sheets might not exceed the reference multibit binary signal and an error signal might not be produced by comparison means **214.** It will be observed however, that stripping apparatus **52** of FIG. **1** will remove only the overlying one of the superposed sheets. Consequently, the underlying sheet of material adhering to the surface of the photoreceptive drum **20** will be detected by photodetecting means **64** as described in detail in aforementioned U.S. Pat. application Ser. No. 180,973. The thus detected adhering sheet might result in the application of a reset pulse to terminal **213** whereby the contents of storage means **211** are cleared therefrom. The digital circuit illustrated in FIG. **2** is thus returned to its quiescent condition and is prepared to execute a subsequent detecting cycle. Of course, the foregoing may be obviated by insuring that the initial sheet of material is in fact a single sheet. This may be achieved by providing a sample sheet of material representing the desired thickness of subsequently transported single sheets, which sample sheet is fed to the sheet transport device by an operator.

The sample signal applied to terminal **208,** gating signal applied to terminal **210,** increment pulses applied to terminal **212** and activating signal applied to terminal **216** may be applied thereto in predetermined timed relation. These signals may be generated by preset programming means such as that described in U.S. Pat. No. 3,301,126 which issued to R. F. Osborn, et al. on Jan. 31, 1967 and assigned to Xerox Corporation.

It should be apparent to those of ordinary skill in the art that the instant invention admits of a plurality of alterations and modifications which in no way change the basic teachings thereof. For example, should the trausducer means **101** be insensitive to minor surface irregularities in the sheets of material transported by the sheet feeding mechanism, such that the analog signal produced thereby exhibits a relatively constant amplitude, then filter means **203** may be omitted. In addition, comparison means **215** may be effective to produce an error signal when the multibit binary signal stored in storage means **211** exceeds the multibit binary signal produced by binary signal generating means **207** by a predetermined amount. Thus, if a subsequently transported sheet of material admits of a thickness that is undesirably thin, i.e., the subsequently transported sheet is too thin with respect to an initial or reference sheet, such sheet will be deflected from the tranporting device illustrated in FIG. **1.** Moreover, while the invention has been particularly shown and described with reference to printing presses and to electrophotographic reproducting machines, it will be obvious that this invention may be utilized with any device wherein the thickness of material or detection of superposed sheets is desirable. Consequently, it is apparent that the foregoing and various other changes and modifications in form and details may be made without departing from the spirit and scope of the invention. It is therefore intended that the appended claims be interpreted as including all such changes and modifications.

What is claimed is:

1. Improved superposed sheet detecting apparatus for detecting the superposition of transported sheets of material, said sheets of material admitting of selectively variable thicknesses, comprising:

binary signal generating means for generating multibit binary signals representative of the thickness of transported sheets of material;

storage means for storing the multibit binary signal representative of the thickness of an initially transported sheet of material;

selectively activatable gating means interconnected between said binary signal generating means and said storage means for selectively gating a multibit binary signal generated by said binary signal generating means into said storage means;

comparison means having a first plurality of input terminals coupled to said storage means and a second plurality of input terminals coupled to said binary signal generating means for comparing the contents of said storage means with each multibit binary signal generated by said binary signal generating means and for producing an error signal when a generated multibit binary signal exceeds said contents of said storage means; and

activatable detecting means coupled to said comparison means and responsive to an activating signal supplied thereto to detect said error signal.

2. The improvement of claim 1 wherein said storage means comprises:

settable counting means having a plurality of input terminals coupled to said selectively activatable gating means, said settable counting means being set to a binary count corresponding to said multibit binary signal representative of the thickness of an initially transported sheet of material; and

increment means coupled to said settable counting means for incrementing the set binary count thereof such that predetermined variations in the thickness of subsequently transported sheets of material do not produce error signals.

3. The improvement of claim 1 wherein said binary signal generating means comprises:

transducer means for producing an analog signal proportional to the thickness of transported sheets of material;

filter means coupled to said transducer means for removing rapid amplitude variations exhibited by said analog signal; and

analog to digital converting means coupled to said filter means for generating a multibit binary signal proportional to said analog signal.

4. The improvement of claim 1 wherein said selectively activatable gating means comprises a plurality of AND gates corresponding in number to the number of bits included in each multibit binary signal; said AND gates including first input terminals for receiving associated ones of said bits included in a multibit binary signal and second input terminals connected in common relationship for receiving a gating signal supplied thereto at selected intervals of time.

5. The improvement of claim 1 wherein said activatable detecting means comprises an AND gate having a first input terminal for receiving said error signal and a second input terminal for receiving an activating signal supplied thereto at selected intervals of time.

6. In combination with a sheet feeding mechanism, improved superposed sheet detecting apparatus for detecting the superposition of sheets of material fed by said sheet feeding mechanism, comprising:

transducer means disposed at a predetermined location in said sheet feeding mechanism for producing signals proportional to the thickness of sheets of material fed past said predetermined location;

binary signal generating means coupled to said transducer means for generating multibit binary signals representative of said produced signals;

storage means for storing the multibit binary signal representative of an initially produced signal;

selectively activatable gating means interconnected between said binary signal generating means and said storage means for selectively gating a multibit binary signal generated by said binary signal generating means into said storage means;

comparison means having a first plurality of input terminals coupled to said storage means and a second plurality of input terminals coupled to said binary signal generating means for comparing the contents of said storage means with each multibit binary signal generated by said binary signal generating means and for producing an error signal when a generated multibit binary signal differs from said signal of said storage means;

activatable detecting means coupled to said comparison means and responsive to an activating signal supplied thereto to detect said error signal;

deflecting means coupled to said activatable detecting means and adapted to be interposed in the path of said sheets of material fed by said sheet feeding mechanism in response to a detected error signal for deflecting the sheets of material away from said sheet feeding mechanism; and

means for discarding the contents of said storage means.

7. The combination of claim 6 wherein said storage means comprises:

settable counting means having a plurality of input terminals coupled to said selectively activatable gating means, said settable counting means being set to a binary count corresponding to said multibit binary signal representative of the thickness of an initially transported sheet of material; and

increment means coupled to said settable counting means for incrementing the set binary count thereof such that predetermined variations in the thickness of subsequently transported sheets of material do not produce error signals.

8. The combination of claim 7 wherein said binary signal generating means comprises:

filter means coupled to said transducer means for removing rapid amplitude variations exhibited by each of said signals produced by said transducer means; and

sample means coupled to said filter means for sampling at first selected intervals of time the signal produced by said filter means and for generating a parallel multibit binary signal proportional to said amplitude.

9. The combination of claim 8 wherein said selectively activatable gating means comprises a plurality of AND gates corresponding in number to the number of bits included in each multibit binary signal; said AND gates including first input terminals for receiving associated ones of said bits included in said parallel multibit binary signal and second input terminals connected in common relationship for receiving a gating signal supplied thereto at second selected intervals of time.

10. The combination of claim 9 wherein said activatable detecting means comprises an AND gate having a first input terminal for receiving said error signal and a second input terminal for receiving an activating signal supplied thereto at third selected intervals of time; said AND gate being deactivated when an initial sheet of material is fed past said predetermined location.

11. The combination of claim 10 wherein said means for discarding comprises reset means for receiving a reset pulse when a predetermined number of sheets have been fed past said predetermined location, said reset pulse being effective to clear said multibit binary signal from said storage means.

12. The combination of claim 10 wherein said means for discarding comprises reset means for receiving a reset pulse when said error signal is detected, said reset pulse being effective to clear said multibit binary signal from said storage means.

13. In combination with a sheet feeding mechanism, improved superposed sheet detecting apparatus for detecting the superposition of sheets of material fed by said sheet feeding mechanism, comprising:

transducer means disposed at a predetermined location in said sheet feeding mechanism for producing signals proportional to the thickness of sheets of material fed past said predetermined location;

binary signal generating means coupled to said transducer means for generating multibit binary signals representative of said produced signals;

storage means for storing the multibit binary signal representative of an initially produced signal;

selectively activatable gating means interconnected between said binary signal generating means and said storage means for selectively gating a multibit binary signal generated by said binary signal generating means into said storage means;

comparison means having a first plurality of input terminals coupled to said storage means and a second plurality of input terminals coupled to said binary signal generating means for comparing the contents of said storage means with each multibit binary signal generated by said binary signal generating means and for producing an error signal when a generated multibit binary signal differs from said signal of said storage means;

activatable detecting means coupled to said comparison means and responsive to an activating signal supplied thereto to detect said error signal; and

means coupled to said activatable detecting means and responsive to said detected error signal for preventing the further feeding of said sheets of material by said sheet feeding mechanism.

14. The combination of claim **13** further including reset means for receiving a reset pulse when said error signal is detected, said reset pulse being effective to clear said multibit binary signal from said storage means.

15. The combination of claim **13** wherein said storage means comprises:

settable counting means having a plurality of input terminals coupled to said selectively activatable gating means, said settable counting means being set to a binary count corresponding to said multibit binary signal representative of the thickness of an initially transported sheet of material; and

increment means coupled to said settable counting means for incrementing the set binary count thereof such that predetermined variations in the thickness of subsequently transported sheets of material do not produce error signals.

16. The combination of claim **13** wherein said binary signal generating means comprises:

filter means coupled to said transducer means for removing rapid amplitude variations exhibited by each of said signals produced by said transducer means; and

sample means coupled to said filter means for sampling at first selected intervals of time the signal produced by said filter means and for generating a parallel multibit binary signal proportional to said amplitude.

17. The combination of claim **13** further including means for discarding the contents of said storage means when a predetermined number of sheets have been fed past said predetermined location.

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