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[54] **RECORDING SYSTEM FOR BUSINESS MACHINES**
12 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **235/61,** 235/60.4, 235/146
[51] **Int. Cl.** **G06c 17/00,** G06c 29/00
[50] **Field of Search** ..... 235/61 (IPOP), 2.23, 2.12, 2.22, 2.21, 60.4, 61A, 146, 58 (Misc.), 1 (Misc.); 340/365, 147

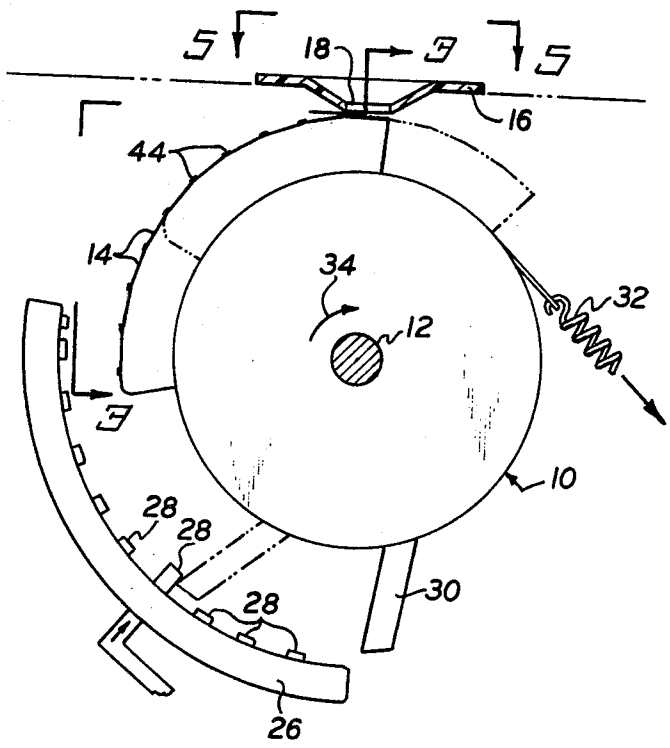
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ABSTRACT: A recording system for a business machine of the type having a plurality of character wheels, each having a set of circumferentially spaced characters thereon and being rotatable to a preselected position to display the character entered into the machine. The recording system comprises first and second signal-generating means which are adapted to produce respective sequential first and second signals as each character passes a preselected point during a rotation of a character wheel. Signal means is provided which is responsive to the sequential occurrence of said first and second signals for producing an output signal which is indicative of the character entered into the machine.



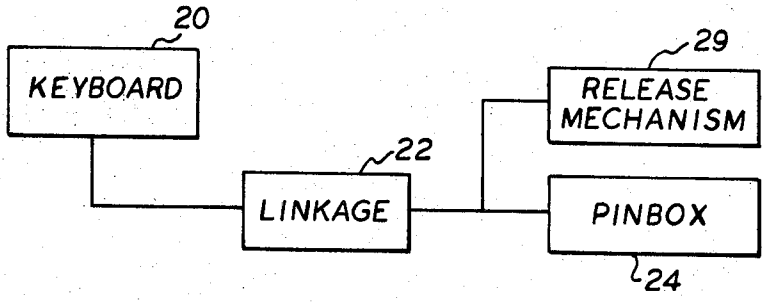


Fig. 1

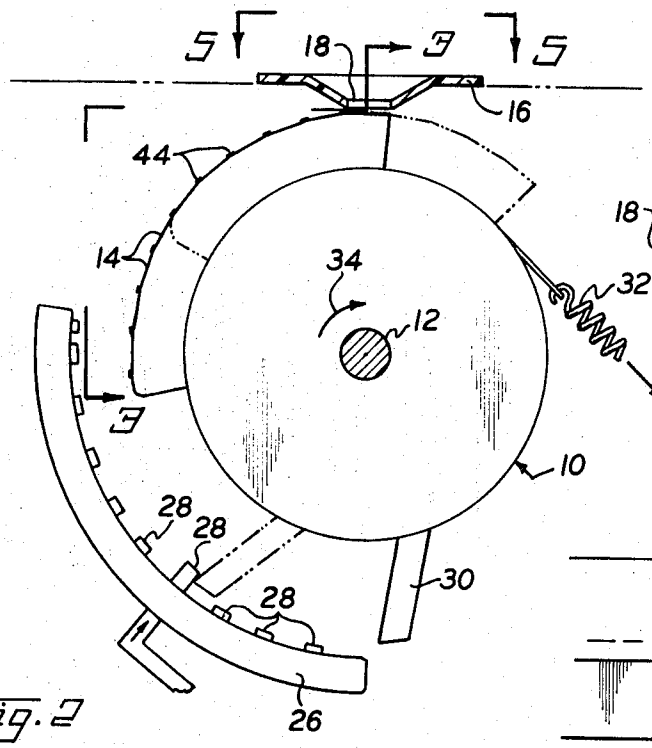


Fig. 2

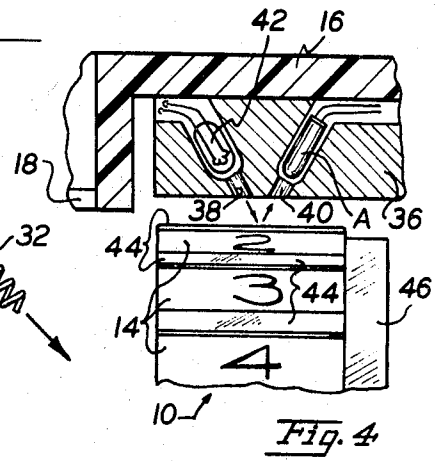


Fig. 4

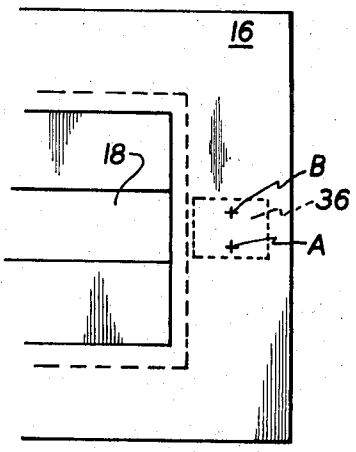


Fig. 5

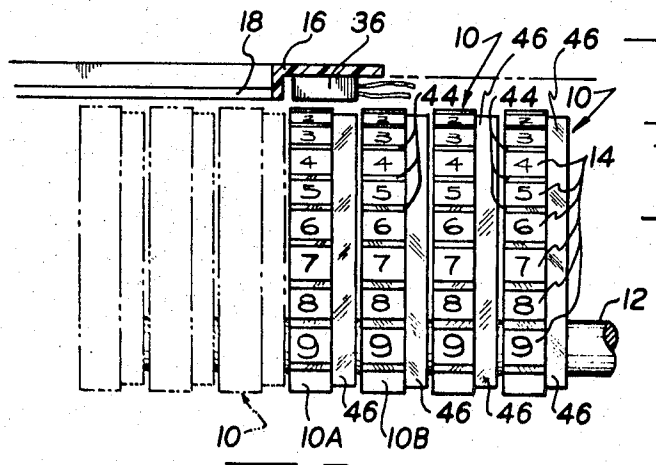


Fig. 3

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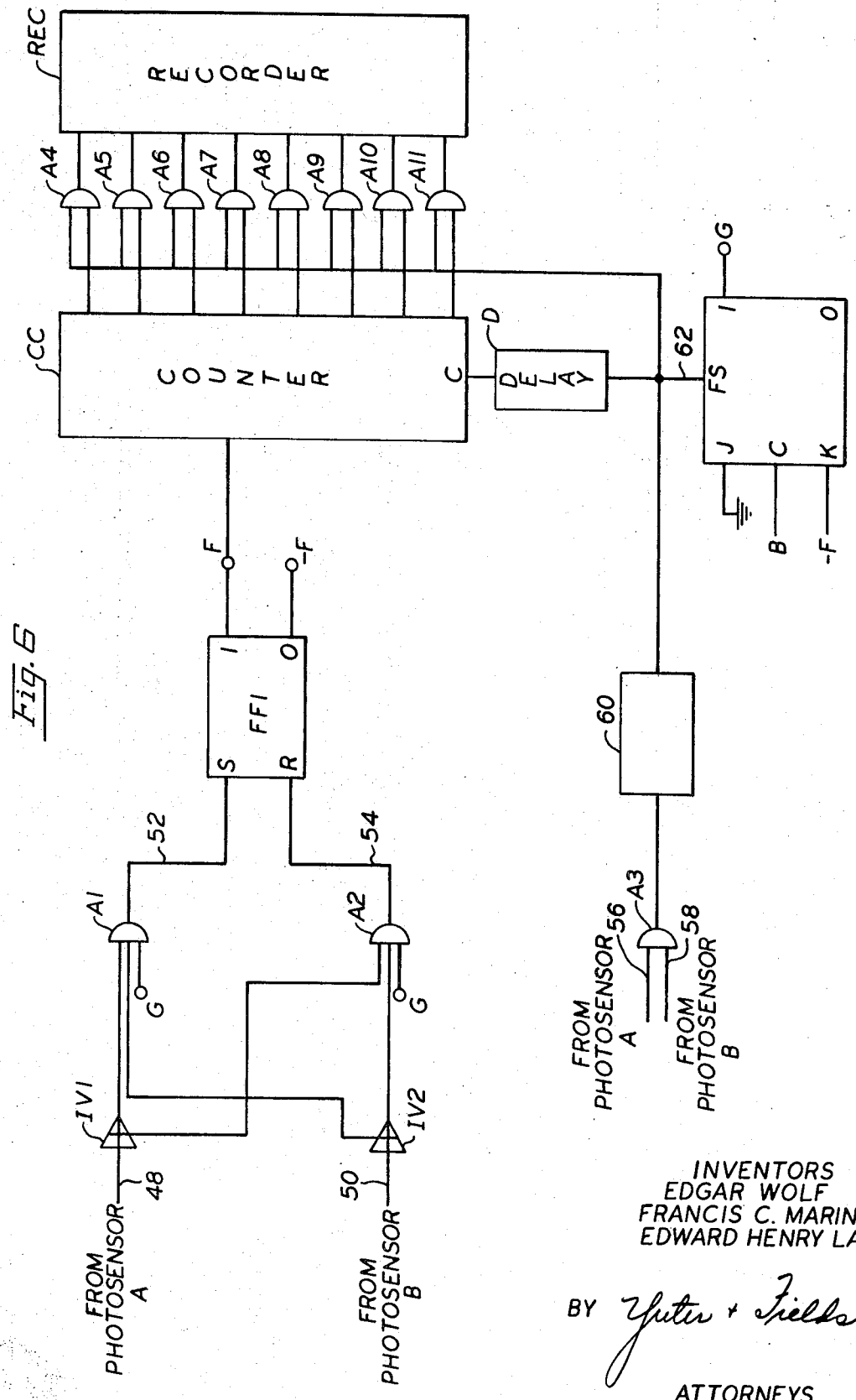


Fig. 6

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RECORDING SYSTEM FOR BUSINESS MACHINES

The present invention relates generally to recording systems and, more particularly, pertains to a recording system which is adapted to be used in conjunction with a key-stroke operated business machine for recording, on an appropriate medium, the characters entered into the machine.

Direct data communication between machines such as computers and the like is becoming more widespread as methods and facilities for accomplishing substantially error-free transmission of data are expanded. For example, telephone companies presently provide facilities for the transmission of data between machines over existing telephone lines. This service has been found to be particularly useful to those companies having, for example, a central office and a number of subsidiary or branch offices separated by relatively large distances. To be more specific, a computer may be located at a main or central office which receives data, such as accounting data or the like, from the branch or subsidiary offices. A system of this type results in a tremendous economic savings with regard to cost of equipment since only one centrally located computer is required rather than a plurality of computers, each one of which is located at a different branch office.

Presently, in order to take advantage of a communication system of the type described above conventional business machines such as adding machines, comptometers and the like are being provided with recording systems for simultaneously converting and recording the information entered into such business machines into data signals which may be applied to a computer.

Thus, the complete bookkeeping records of all the branch offices of the multidivision organization may be fed directly into a central computer so that the complete accounting picture of the business may be maintained up to date.

It will become obvious, that in a data transferral system of the type described, there must be a direct identity or correspondence between each character entered into a business machine and the corresponding character recorded by the recording system to eliminate any errors. To put this another way, if a character entered into the business machine represents the digit "3" and the corresponding character recorded by the recording system represents a digit other than "3", a gross error will be introduced into the system. Hence, it is of primary importance to assure a perfect one-to-one correspondence between the machine and the recording system entries.

Errors of the type referred to hereinabove may arise in any one of a number of different manners, primary amongst which is by an incomplete key-stroke on the part of the operator. to be more specific, an incomplete key-stroke may commit the recording system to record the character; however, the stroke may be insufficient to commit the business machine to mechanical mechanically enter the character. Hence, an intolerable discrepancy will exist between the machine entry and the recorded entry. To state the problem in another manner and to put the same in its proper perspective, the primary problem associated with presently available machines of the type under consideration is to maintain a negligible differential between the electrical takeoff commitment point wherein the recording system is actuated to record the character and the mechanical commitment point wherein the business machine receives the character. While in practice a zero differential can conceivably be approximated by the use of complex and expensive mechanical linkages, such zero differential is difficult to maintain over a period of time.

Accordingly, an object of the present invention is to provide a recording system for business machines for recording the characters entered into the machine in data form which substantially eliminates any discrepancies between the machine entries and the recorded entries.

A more specific object of the present invention resides in the novel details of circuitry which provides a recording system of the type described which records a character independently of the manner in which operator depresses the key on the business machine.

Another object of the invention is to provide a recording system of the type described which is compatible for use in conjunction with existing machines, so that a machine easily may be adapted to record entries in data form for application to computers and the like.

A further object of the invention is to provide a recording system for business machines which is economic to produce and reliable in operation.

Accordingly, a recording system for business machines constructed according to the present invention is adapted to be utilized with a machine of the type having a plurality of character wheels, each having a set of circumferentially spaced characters thereon and each being rotatable to a respective preselected angular position to indicate that a desired character has been entered into the machine. The recording system comprises first signal-generating means for producing a first signal in response to the movement of each character on one of the character wheels past a first predetermined point. Second signal-generating means is provided for producing a second signal in response to the movement of each character on said one of said character wheels past a second predetermined point. Additionally, signal means which is responsive to the occurrence of said first and second signals is adapted to produce an output signal which is indicative of the character entered into the machine.

Other features and advantages of the present invention will become more apparent from a consideration of the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a block diagram of the mechanical arrangement of an illustrative business machine adapted to be used in conjunction with the recording system of the present invention;

FIG. 2 is a side elevational view of portions of a business machine incorporating the present invention;

FIG. 3 is a sectional view thereof taken along the line 3–3 of FIG. 2;

FIG. 4 is a detailed sectional view, to an enlarged scale, illustrating the optical takeoff arrangement of a recording system constructed according to the present invention;

FIG. 5 is a top plan view as seen looking along the line 5–5 of FIG. 2, to an enlarged scale; and

FIG. 6 is a logic circuit diagram of a recording system constructed in accordance with the present invention.

As noted above, the recording system of the present invention is adapted for use in conjunction with any type of conventional key-stroke operated business machine of the type having rotatable character wheels for recording sequentially the characters entered into the machine. For purposes of illustration, the system of the present invention will be described in conjunction with the operation of an adding machine and, in particular, the Friden, Electric Adding Machine Model No. AF10, which is manufactured by Friden, Inc. of San Leandro, Calif. The construction of this machine is representative of the construction of many key-stroke operated business machines presently commercially available. Only those portions of the machine which are pertinent to a clear understanding of the recording system of the present invention will be disclosed. However, further information on this machine may be obtained from publications of Friden, Inc., such as their service manual and their catalogue of spare parts.

It is emphasized that the adding machine referred to herein is for illustrative purposes only and is not to be interpreted as being a limitation of the present invention. That is, the recording system of the present invention may be utilized with any type of key-stroke operated business machine having rotatable character wheels.

In the interest of clarity, the operation of the adding machine will be described first. This will be followed by a detailed description of the recording system.

Accordingly, the adding machine of the illustrative example includes a plurality of character wheels 10 which are rotatably supported on a shaft 12. The character wheels 10 are identical in construction and each are provided with circumferentially spaced characters 14 which are adapted to be displayed, in the

manner described below, to designate the characters entered into the machine. In the illustrative adding machine example, 10 such characters are provided over a portion of the circumference of each wheel respectively displaying the digits 0—9. The machine further includes a face plate **16** having a recessed window **18** through which the characters are visible.

Referring to FIGS. **1** and **2**, the machine further includes a keyboard **20** which includes respective keys representing each one of the digits 0—9. When it is desired to enter a digit or character into the machine such as, for example, the character 4, the appropriate key is depressed. The depression of the key operates an appropriate linkage mechanism **22** which actuates a pinbox **24**. The pinbox **24** includes an arcuate member **26** (FIG. **2**) which is spaced below the plurality of character wheels **10** and includes a row of outwardly movable pins **28** which are in one-to-one correspondence with the characters **14** on each wheel. It is to be understood that a different row of pins **28** is provided for each one of the character wheels and the pins associated with any one of the character wheels are in alignment with that particular character wheel.

Thus, upon actuation of the key, the pin **28** associated with that key is moved outwardly. To be more specific, in the example under consideration, the fourth pin **28** is moved outwardly in response to the depression of the character key representing the digit 4. Thereafter, a release mechanism **29** is operated to release the character wheel **10** associated with the operated pin. Each one of the character wheels **10** is provided with an outwardly extending arm **30** and a biasing spring **32** which causes the character wheel to rotate in the direction indicated by the arrowhead **34** when the release mechanism releases the character wheel. Accordingly, upon release of the character wheel, the character wheel will rotate until the arm **30** engages the operated pin **28** or, in the particular example under consideration, the character wheel will rotate until the arm **30** engages the fourth pin **28**. At this point, the digit 4 will be uppermost.

After the character wheel **10** has rotated to the desired position, the character wheels are moved laterally by the release mechanism **29** so that the operated character wheel has been moved to display the desired character. To be more specific, when a character is entered into the machine, the character wheel which is to display that particular digit is located just to the right of the window **18**. Thus, in FIG. **3**, the character which is to be entered into the machine will be displayed by the character wheel **10A**. After the wheel **10A** has rotated to the desired position so that the character entered into the machine is uppermost, in the manner indicated above, the character wheels are then moved laterally by the release mechanism **29** so that the uppermost character on the wheel **10A** is visible through the window **18**. The wheel **10B** will then be moved to the position formerly occupied by the wheel **10A** and the next in the same manner as indicated above. When a row of characters have been entered into the machine, it will be obvious that this row of characters will be displayed by the appropriate character wheels **10** through the window **18**.

When a function, such as an add function is performed by the machine by striking the appropriate key on the keyboard **20**, the linkage mechanism **22** is operable to cause the digits or characters entered into the machine to be stored in an appropriate storage device (not shown) in the machine and the character wheels are rotated back to their normal position and are also moved laterally so that the first character wheel is now positioned just to the right of the window **18** (i.e., the first character wheel now occupies the position formerly occupied by wheel **10A** of FIG. **3**).

Summarizing the operation of the illustrative adding machine, the depression of a character key on the keyboard **20** causes the character wheel located to the right of the window **18** to rotate through an angle such that the character corresponding to the depressed character key is uppermost. Thereafter, the character wheels are stepped or moved laterally to the left so that the rotated character wheel is now visible through the window **18** to display the character which has just been entered into the machine.

The recording system of the present invention includes a housing **36** (FIG. **4**) which is connected to the underside of the face plate **16** adjacent the window **18**. The housing **36** overlies the character wheel which is to display the next character to be entered into the machine. In other words, for the arrangement of FIG. **3**, the housing **36** will overlie the wheel **10A**. Received within the housing **36** is a tapering passage **38** which tapers upwardly and toward the left as taken in FIG. **4** and two laterally aligned tapering passages **40** (only one of which is shown in FIG. **4**) which taper upwardly and towards the right. Received within the passage **38** is a source of light or lamp **42**. Received within the aligned passages **40** are respective photo-optical sensors A and B (FIG. **5**). The sensors A and B are adapted to produce an electrical signal in response to light striking the sensors. (Such devices may comprise a photodiode which is offered for sale by Texas Instruments under the Model No. LS400).

Associated with each one of the characters **14** on each character wheel **10** is a reflective stripe or the like **44** which is connected transversely across the face of the wheel beneath each one of the characters **14**, as shown in FIG. **4**. Additionally, a reflective stripe **46** is connected to each of the character wheels **10** adjacent the right-hand side thereof about the periphery of the wheel. Additionally, as shown in FIG. **5**, the photosensor B is placed one-half of a pitch away from the photosensor A for purposes which will become apparent from a consideration of the operation of the present invention as described hereinbelow.

Thus, it will now become apparent that as a character wheel rotates below the housing **36**, the reflective strips **44** will pass below the photosensors A and B. Accordingly, as a reflective strip **44** passes below the sensor A the light from the lamp **42** will strike the strip and be reflected back through the passage **40** to the photosensor A which will then produce an electric signal. The same results will be obtained as the reflective strip passes below the photosensor B. Accordingly, the number of sequential A and B signals produced by the rotating character wheel **10** will be representative of the particular character **14** which is to be displayed.

To be more specific, in the illustrative example under consideration it has been assumed that the digit 4 is to be displayed by the character wheel **10A** of FIG. **3**. Accordingly, as the character wheel rotates to the digit 4, the reflective strips **44** associated with the digits 1, 2, 3 and 4 will rotate beneath the photosensors A and B. Accordingly, four sequential sets of signals A and B will be produced by the photo sensors. Additionally, as the character wheels **10** shift laterally so that the character uppermost on wheel **10A** is observed through the window **18**, the light from the lamp **38** (which is connected to an appropriate energizing source, not shown) will strike the reflective strip **46** connected to the periphery of the wheel **10A** and will be simultaneously reflected to both photosensors A and B. As a result, when the character wheels **10** shift laterally both photosensors A and B will produce electrical signals simultaneously.

The logic circuit diagram of the recording system of the present invention is who present invention is shown in FIG. **6**. The output signal from photosensor A is applied to the input terminal of an inverting amplifier IV1 via a lead **48**. The noninverting output terminal of the amplifier IV1 is connected to one input terminal of an AND gate A1. The inverting terminal of the amplifier IV1 is connected to one input terminal of an AND gate A2. A Similarly, the output from the photosensor B is connected to the input terminal of an inverting or paraphase amplifier IV2 via a lead **50**. The noninverting output terminal of the amplifier IV2 is connected to another input terminal of the gate A2. The inverting output terminal of the amplifier IV2 is connected to an input terminal of the AND gate A1. Additionally, another input terminal of both the AND gates A1 and A2 are adapted to receive a pulse G. The output terminal of the AND gate A1 is connected via a lead **52** to the set-to-one input S of bistable device or flip-flop FF1. Flip-flop FF1 is a conventional Eccles Jordan flip-flop which also includes a set-to-zero input R, is a **1** output and a **0**

output. The set-to-zero input R is connected to the output terminal of AND gate A2 via the lead 54. The flip-flop FF1 is set to the 1 state on the trailing edge of a positive going signal at the input S, and is set to the 0 state on the trailing edge of a positive going signal at the R input. When the flip-flop FF1 is set to the 1 state, it produces an output signal F which is applied to the input terminal of a conventional counter CC. When the flip-flop FF1 is set to the 0 state the flip-flop produces an output signal —F and the signal F disappears.

The eight output terminals of the counter CC are connected to one input terminal of respective AND gates A4—A11. The output terminals of AND gates A4-A11 are connected to the respective input terminals of a recorder REC. The recorder REC may be a magnetic tape recorder, a paper tape recorder or the like.

The output signals from photosensors A and B are also applied to both input terminals of an AND gate A3 via the leads 56 and 58. The output terminal of the AND gate A3 is connected to a conventional differentiating network 60. The output terminal of the differentiating network 60 is connected to the force set terminal FS of a so-called JK flip-flop FF2 via a lead 62. The output of the differentiating network 60 is also connected to the clear terminal of the counter CC through a delay network D and to another input terminal of the respective AND gates A4—A11.

The J terminal of flip-flop FF2 is connected to ground. The K terminal of the flip-flop FF2 is adapted to receive the —F signal and the clock or C terminal of the flip-flop FF2 is connected to receive the B signal from photosensor B. The operation of the JK flip-flop FF2 is conventional and is adapted to produce the pulse G at the 1 output terminal in response to a pulse appearing at the force set terminal FS. However, when the —F signal is present at the K terminal of flip-flop FF2 and the B signal is applied to the clock or C terminal thereof, the trailing edge of the B signal resets the flip-flop FF2 so the that the G pulse is no longer present at the 1 output terminal.

In operation, in the example under consideration, when the character 4 is entered into the machine the character wheel 10A begins to rotate. As the first reflective strip 44 passes the photosensor A a signal will be produced thereby. This signal will be applied to the inverting amplifier IV1 via the lead 48. Accordingly, this signal will be passed by the amplifier to the input terminal of the gate A1. If no signal is produced by photosensor B at this time, the terminal of the AND gate A1 connected to the inverting terminal of the paraphase or inverting amplifier IV2 will also be energized. If it is assumed that the flip-flop FF2 is set at this point so that the G signal is present, the pulse will be passed by the AND gate A1 to the set terminal S of the flip-flop FF1. Accordingly, the F signal will be produced at the 1 output of the flip-flop FF1. As the same reflective strip passes photosensor B the photosensor B will similarly produce a pulse which will be applied to the inverting amplifier IV2. Since the photosensor A will not be producing a pulse at this time, no input signal will appear on the lead 48 and, accordingly, the inverting output terminal of the amplifier IV1 will be energized so that the pulse passing through the amplifier IV2 will pass through the AND gate A2 to the set-to-zero terminal R of the flip-flop FF1. Accordingly, the flip-flop FF1 will be reset so that the signal F will no longer be present and the signal —F will appear at the 0 output. This procedure will be repeated four times corresponding to the passage of the four reflective strips past the photosensors A and B in response to the digit 4 being entered into the machine. Accordingly four F signals will be produced and applied to the input of the counter CC. Thus, the counter will register a count of four in binary notation in the conventional manner to designate that the character 4 has been entered into the machine.

Thereafter, the character wheels 10 will step laterally to the left so that the newly entered character or digit may be displayed through the window 18. Accordingly, both signals from photosensors A and B will be present simultaneously on the respective leads 48 and 50. When the signal from photosensor A is present on the lead 48 it is to be noted that the inverting terminal of the amplifier IV1 will disable the AND gate A2 and prevent the passage of any signals therethrough. Similarly, when the signal from photosensor B is present on the lead 50, the terminal of the AND gate A1 connected to the inverting terminal of the amplifier IV2 will similarly be deenergized to prevent the passage of any signals through the AND gate A1. Thus, no signals will pass through the AND gates A1 and A2 when both signals from photo sensors A and B are present simultaneously.

However, when both signals from the photosensors A and B are present on the respective leads 56 and 58, an output signal will appear at the output terminal of the AND gate A3 and be differentiated by the differentiating network 60. This signal is applied to the other input terminal of the AND gates A4—A11 thereby enabling the AND gates A4—A11 to pass the signals which may be present on their other leads to the recorder REC. Hence, the recorder REC will produce a permanent record of the character entered into the machine. The same signal produced by the differentiating network 60 is delayed by the delay network D and applied to the clear terminal C of the counter CC. Thus, after the output signal of the counter CC has been recorded the counter will be cleared to receive the succeeding information when the next character is entered into the machine.

Due to the inherent mechanics of the type of machine under consideration, it has been found that when the character wheel rotates to its stop position (i.e. when the arm 30 engages the extended pin 28) the wheel rebounds somewhat. Hence, when utilizing the recording system of the present invention, it is possible for one of the reflective strips 44 to again pass below the photosensor B in the opposite direction due to such rebounding. Thus, instead of the sequential occurrence of pulses A and B for this particular set of events the B signal will be produced twice in succession. When this occurs the gate A1 and A2 are disabled so that no further pulses can pass through to the flip-flop FF1 and thereby produce an erroneous count in the counter CC. To be more specific, as noted above when the B signal appears the flip-flop FF1 is caused to produce the —F signal. If a rebounding of the character wheel then occurs so that the reflective strip passes below the sensor B again, the trailing edge of this signal will cause the flip-flop to FF2 to be reset so that the G signal will disappear. When the G signal is no longer present the AND gates A1 and A2 will be disabled so that no pulses can pass through to the flip-flop FF1. Thus, the recording system of the present invention is completely insensitive to any rebounding or rebouncing of the character wheels and will only indicate the correct entry into the machine.

As noted above, a pulse will be produced at the output of the differentiating network 60 when the pulses A and B are present simultaneously on the leads 56 and 58 in response to the lateral movement of the character wheel after the character has rotated to the correct position. This pulse or signal, as noted above, is applied to the force set terminal FS of the flip-flop FF2. Thus, if the flip-flop FF2 has been reset due to the rebounding of the character wheel, the flip-flop will be set to produce the signal G when the character wheels are moved laterally, thereby again enabling the AND gates A1 and A2 to pass the appropriate pulses in response to signals from the photosensors A and B.

Accordingly, a recording system for a business machine of the type having rotatable character wheels has been provided which is economic to fabricate and is reliable in operation.

While a preferred embodiment of the invention has been shown and described herein it will become obvious that numerous omissions, changes and additions may be made in such embodiment without departing from the spirit and scope of the present invention.

We claim:

1. A recording system for a business machine of the type having a plurality of character wheels each having a set of circumferentially spaced characters thereon and each being

rotatable to a respective preselected angular position to indicate a desired character has been entered into the machine; said recording system comprising first signal-generating means for producing a first signal in response to the movement of each character on one of said character wheels past a first predetermined point, second signal-generating means for producing second signal in response to the movement of each character on said one of said character wheels past a second predetermined point, and signal means responsive to the occurrence of said first and second signals for producing an output signal indicative of the character entered into said machine.

2. A recording system as in claim 1, in which said signal means includes counting means for counting the number of sequential occurrences of said first and second signals during the rotation of said one character wheel to said preselected position and producing a count signal in accordance with said number of sequential occurrences.

3. A recording system as in claim 2, wherein the character wheels are adapted to move laterally, and in which said first and second signal-generating means are operable to produce said first and second signals simultaneously when said one wheel is moved laterally, said signal means including recording means for recording said count signal, and transfer means responsive to the simultaneous occurrence of said first and second signals for transferring said count signal to said recording means.

4. A recording system as in claim 1, in which said second signal-generating means is spacially displaced from said first and second signal-generating means in the direction of rotation of said one character wheel.

5. A recording system as in claim 1, and disabling means responsive to the sequential occurence of said second signal for disabling said signal means.

6. A recording system as in claim 5, in which said disabling means is responsive to the simultaneous occurrence of said first and second signals for rendering said signal means operable.

7. A recording system as in claim 1, in which said first and second signal-generating means comprise respective sensors responsive to light for producing said respective first and second signals, a light source, and respective reflecting means associated with each character comprising a set of characters on each of said plurality of character wheels positioned to reflect light from said light source to said first and second sensors as each one of said reflecting means passes said respective first and second predetermined points.

8. A recording system as in claim 7, in which said plurality of character wheels are adapted to move laterally, and a respective light reflecting means positioned along the periphery of each of said plurality of character wheels, whereby said light reflecting means reflect light from said light source to said first and second sensors simultaneously as said character wheels are moved laterally.

9. A recording system for a business machine of the type having a plurality of character wheels each having a set of circumferentially spaced characters thereon, support means for rotatably supporting said plurality of character wheels, key means for entering characters into said machine whereby said plurality of character wheels rotate to preselected positions to display the characters entered into the machine; said recording system comprising a signal-producing means associated with each character comprising each set of characters, first signal-generating means for generating respective first signals in response to the movement of each signal-producing means thereby, second signal-generating means spaced from said first signal-generating means for generating respective second signals response to the movement of each signal-producing means thereby, and output means responsive to said first and second signals for producing respective output signals representing each character entered into the machine.

10. A recording system as in claim 9, in which said output means includes a bistable device operable between a first state in response to said first signal and a second state in response to said second signal, and counting means responsive to transitions of said bistable device from said first to said second state for producing a signal representing the number of said transitions.

11. A recording system as in claim 10, in which said output means further includes respective gate means between said first and second signal generators and said bistable device, and disabling means responsive to the sequential occurrence of said first and second signals for disabling said gate means to prevent transmission of said first and second second signals to said bistable device.

12. A recording system as in claim 10, which said plurality of character wheels are adapted to be moved laterally after a character has been entered into said machine, actuating means on each of said plurality of character wheels for actuating said first and second signal-generating means to produce said first and second signals simultaneously when said character wheels are moved laterally, a recording device, and transfer means responsive to the simultaneous occurrence of said first and second signals for transferring said counting means signal to said recording device.