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809,614, Mar. 24, 1969, now abandoned.
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93,470

[56]

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[54] **PHOTOELECTRIC READER FOR FLUORESCENT
INK IMPRINTED CODED DOCUMENT**
8 Claims, 6 Drawing Figs.

[52] U.S. Cl. 250/71 R,
250/71.5 R, 250/83.3 UV, 250/219 DC
[51] Int. Cl. G01n 21/22
[50] Field of Search 250/71 R,
71.5 R, 219 DC, 83.3 UV; 340/149 A

ABSTRACT: An apparatus for reading intelligence contained on a document in the form of information printed with fluorescent ink. To accommodate the document to be read, the reader includes a slot comprising a pair of flat plates between which the document is inserted. Formed in the plates are apertures or windows over which the document is drawn; one window effects the readout; another verifies or approves the document. A fluorescent light source is directed through the readout window and an incandescent light source is directed through the approval window. Aligned with the respective windows are light detector means comprising a plurality of photocells. A housing capable of substantially excluding light contains the document-receiving slot, the light source and photocell detector.

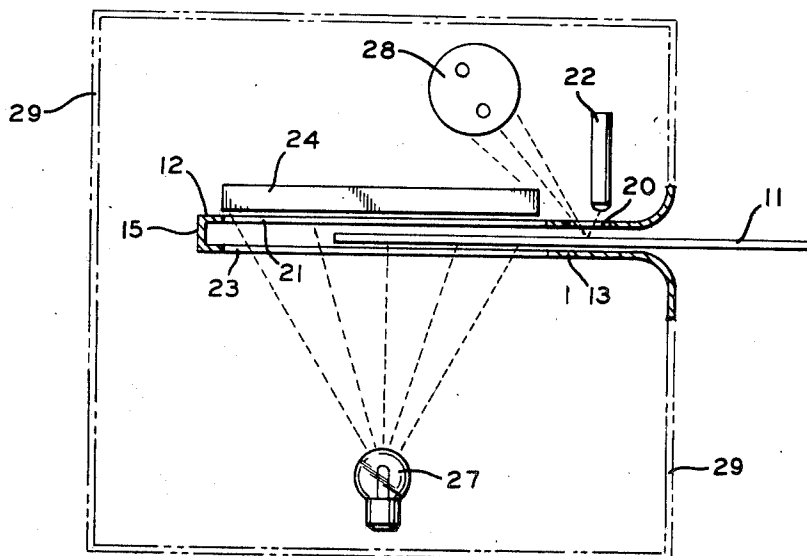


FIG. 1

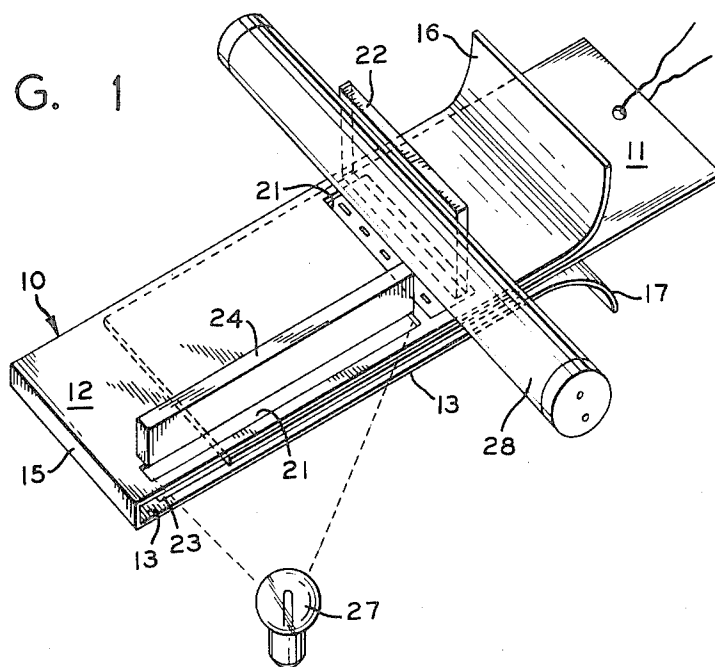
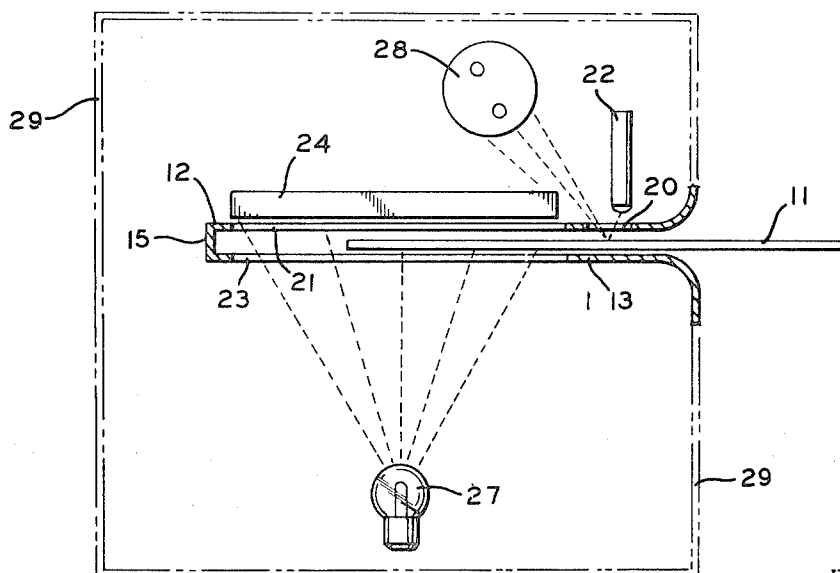


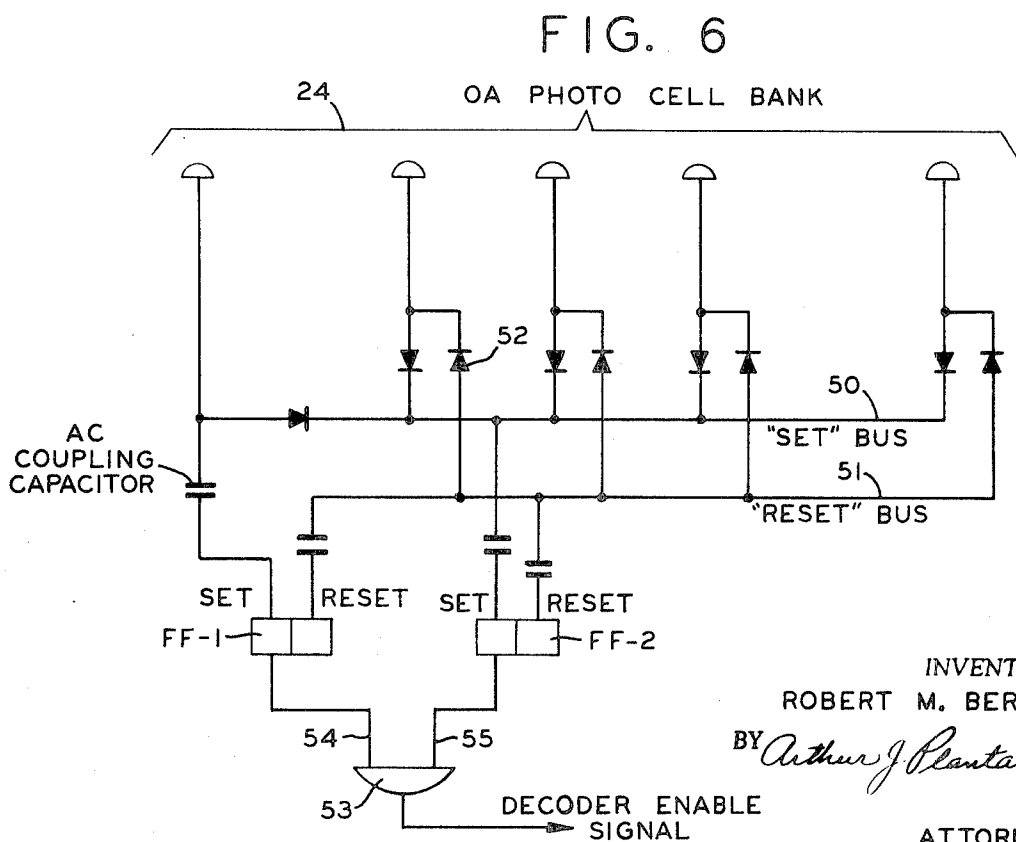
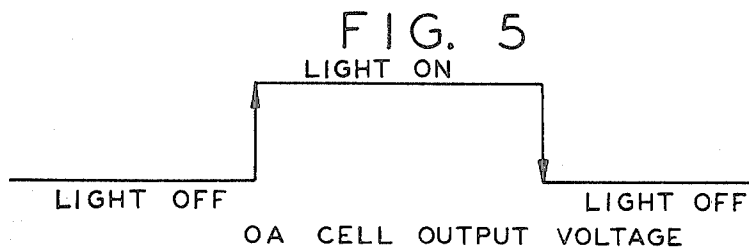
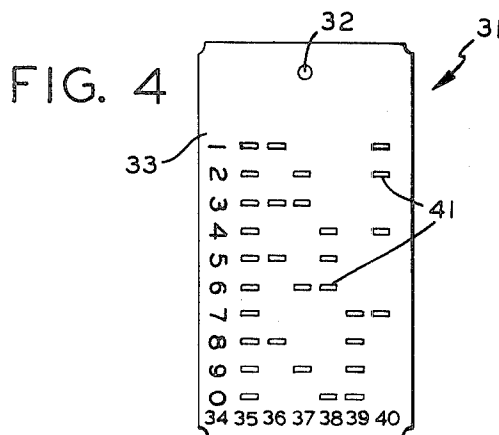
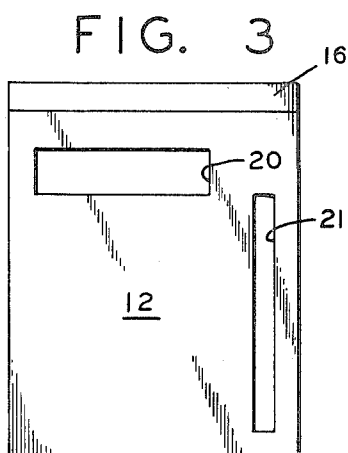
FIG. 2



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PHOTOELECTRIC READER FOR FLUORESCENT INK IMPRINTED CODED DOCUMENT

This is a continuation of application Ser. No. 809,614, filed Mar. 24, 1969, now abandoned.

This invention relates to a device for reading coded information by optical means from a document containing data imprinted on the document with fluorescent ink. The reader has no moving parts aside from the document, i.e., the ticket which is hand inserted into the reader and then withdrawn from it. It is simple in principle, free from maintenance, and inexpensive.

In use, it is contemplated that the reading device of the invention will have the capability of reading a computer printed ticket. However, by modification, within the purview of one skilled in the art following the teaching herein set forth, it is also contemplated that it is capable of reading a punched hole type ticket. For the purpose of disclosing the invention with optimum particularity, the invention will be described in connection with a device for reading a computer printed ticket which is printed with fluorescent ink and which is illuminated with ultraviolet light. The fluorescent ink is selected so as to produce the maximum response or output from a silicon photocell. Preferably for optimum results, fluorescent ink is used which has a color having a millimicron wavelength in the range of from about 580 to about 730, and preferably about 600 to 700, of the normal solar spectrum (Webster's Third New International Dictionary, G. & C. Merriam Co. 1966, Plate facing page 448). FIG. 4 illustrates one type of computer printed ticket which can be used with the reader herein described.

The reader of the present invention finds utility in the field of data handling, particularly in connection with the control of merchandise inventory, and while it will be apparent that the reader may find advantageous applications in various other areas which are confronted with a burdensome volume of activity, the present invention will be primarily described in conjunction with articles of merchandise displayed for sale and bearing tags imprinted with coded information, for example.

It is an object of this invention to provide an improved reader for data handling systems which utilizes simple optics and no moving parts.

It is another object of the invention to provide a document reader especially adapted to read cards, tickets or other documents with information imprinted with fluorescent ink.

It is still another object of the invention to provide a card or ticket reader which may be used manually and which is capable of accepting information from a ticket or card which may remain fastened to merchandise.

It is another object of the invention to provide a reader which is reliable and has built-in safeguards against accidental erroneous or illegal manipulation.

It is a further object of the invention to provide a static-type, nonstatic reader, i.e., a reader which uses only a single detector per line for each code bar position rather than a detector for each position of a code bar over the entire coded area.

It is another object of the invention to provide a reader with good signal-to-noise ratio.

These and other objects of the present invention will become more fully apparent from the following specification and claims when considered in conjunction with the accompanying drawing wherein:

FIG. 1 is a schematic diagram in perspective of the functional elements of the reader of the invention.

FIG. 2 is a side elevational view further illustrating the functional elements of the reader and representing, in phantom, a housing for the reader.

FIG. 3 is a plan view depicting the slits or windows in the upper plate over which the photocell bank is mounted.

FIG. 4 is one form of a conventional ticket with coded information which may be inserted into the reader of the invention.

FIG. 5 illustrates diagrammatically the voltage output from the bank of photocells employed to prevent an incorrect document readout.

FIG. 6 is a block diagram of the reader logic circuit which functions in conjunction with the approval or validating cell bank of the reader.

The reader of the present invention is not a static reader yet it functions similarly to a static-type card reader. In a static reader, a card is placed into a reader, then it is removed. There are no moving parts at work (outside of contact closures in some readers.) With the reader of this invention, a card is placed into its slot, then it is removed; again, there are no moving parts inside of the reader. Additionally, the reader of this invention has no contacts whatever; all sensing is done photoelectrically.

In essence, the reader comprises an arrangement of elements in combination including a slot which is made to accept a particular sized ticket. When the ticket dimension is varied, a suitable slot can be supplied to accommodate that particular ticket, and the spacing of the coded bars as well as the number of columns to be read are rearranged.

Referring to the drawing, the reader will be described in detail in conjunction with a document or card including the type shown in FIG. 4. The reader comprises an assembly of a receptacle or slot 10 adapted to receive a document or ticket 11 which is imprinted with coded information. The slot 10 comprises a suitable structure and may consist of a pair of spaced plates or sheets 12 and 13 between which the ticket 11 may be inserted. Preferably the plates 12 and 13 are provided with an end 15 against which the insert ticket 11 bottoms and preferably they incorporate outwardly flared ends 16 and 17 forming a throat which facilitates the insertion of the ticket.

The upper plate 12 shown more clearly in FIG. 3, is provided with a pair of slits or windows 20 and 21 over which banks 22 and 24 of photoelectric cells are mounted. The lower plate 13 is provided with a single window or slit 23 similar to and in alignment with the window 21 of the upper plate 12.

Situated below the lower plate 13 and arranged to project light through windows 23 and 21 is an incandescent lamp 27. Positioned contiguous to photocell bank 22 and arranged to illuminate the window 20 is an ultraviolet fluorescent lamp 28. When a ticket 11, imprinted with fluorescent ink, preferably orange or red, is inserted into the slot 10 the fluorescent print, appearing in registration with window 20 is activated by lamp 28, its fluorescent glow will illuminate the photocells of bank 22. Shown in phantom in FIG. 2 is the outline 29 of a suitable housing capable of excluding stray light from the photoelectric sensors 22 and 24. The slot 10 is made to accept the ticket easily and guides it during insertion and withdrawal, accurately past the two banks of photocells 22 and 24. The bank or group 22 of photocells are the optical readout (OR) cells and are used for sensing the coded information on the ticket 11. The second group of photoelectric cells 24 are the optical approval (OA) cells used to aid in validating the reading of the document including the determination of the following:

1. Whether the ticket 11 is pushed all the way into, i.e., bottomed in the slot 10.
2. Whether the ticket 11 is inserted into the slot only partially.
3. Whether the ticket is jiggled back and forth during ticket withdrawal.

The reader decodes the information on the ticket 11 as the ticket is being manually withdrawn from the slot. The operation of manually withdrawing the ticket 11 from the slot 10 provides the scanning action necessary for reading out the coded information.

In FIG. 4 one type of computer ticket or document 31 which is imprinted with fluorescent ink, usable in conjunction with the reader of the invention is depicted. In the specific embodiment shown, a multicolumn printer will be used with seven active columns. The standard printer prints 10 characters per inch and six lines per inch. The ticket will use every other column printout. This will allow a 1/10th-inch clear space between adjacent code bars. All wheels or columns will print bars 0.1 inch long and 0.05 inch thick except the first column 34 which will print human readable characters or

numbers. The human readable numbers of column 34 correspond to the coded information printed out in fluorescent ink on that same line as the number in each of columns 35-40. The blank space 33 at the top of the ticket 31 is the part of the ticket grasped by the fingers of the person when inserting the card into the reader. This space may be used for printing other human readable information such as the name of the store, etc. When desired, the ticket might have a hole 32 punched at the top for a string (not shown) as when it is used as a tag fastened to an article of merchandise, for example. The hole 32 may also serve as a photoelectric index during computer printout in lieu of an inked indexing mark. If the ticket is not to be used with a string attached to it, or if the hole is preferably omitted, for example, because of a human readable printout, an index hole may be punched out instead at the perforations which are the tear-off line and which separate one ticket from the next.

In operation, the bank 24 of photoelectric cells referred to as the optical approval cells (OA) provide safeguards from incorrect readout due to improper ticket insertion or withdrawal such as incomplete ticket insertion or jerky withdrawal action. This erratic action could make it possible for the same bars of code to be read out by optical readout (OR) cells of bank 22 more than once, giving a false readout. The output of the OR cells are fed into the computer in a conventional manner. The computer, through its logic circuits, can determine if the number read out is acceptable, i.e., a legitimate one or not, or whether the ticket was inserted upside down or backwards. The combination of checks provided by the OR and OA cell systems can then operate a "Go, No-Go" signal or alarm to the operator. In the case of a No-Go signal, the operator will reinsert the ticket again. If a "No-Go" signal persists e.g. the ticket might have been misprinted or it might have been mutilated in some manner, the operator may then enter the information into the computer manually.

As noted hereinabove, the OR cells sense the fluorescent imprint on the ticket 11 through window 20 which is formed in the upper plate 12 of the card slot 10. The OA cells sense the ticket when it obstructs the passage of light from lamp 27 through windows 23 and 21 which are in registration. While the slot 10 is shown schematically and exposed for better illustration, it will be apparent that as a practical structure both the sides and bottom of the ticket slot are enclosed.

The ticket in FIGS. 1 and 2 is purposely shown partially inserted into the slot to illustrate how it interrupts the light from the incandescent lamp to some cells of the OA bank while it permits the light to enter other cells of the OA bank. Since the lines printed on the ticket are spaced 0.167 inch apart, i.e., six to the inch, (FIG. 4) the protection afforded by the OA bank insures that the ticket reading is safeguarded when jiggling back and forth not exceeding more than one line space overall. The cell spacing used in the OA bank is 0.1 inch. This spacing should insure a good safety factor since it is approximately two-thirds of one line space.

The ultraviolet fluorescent lamp 28 is situated so that it will illuminate a portion of the ticket with coded printing in fluorescent ink through the top window under the OR cell bank. As the ticket 11 is extracted from the slot, the fluorescent markings or code bars 41 will pass under the respective OR photocell in the bank 22 corresponding to each column. This information sensed from the imprinted marks will be fed conventionally into the computer decoder and logic circuits. While the invention herein depicted and described shows a specific embodiment wherein each of the lamps 27 and 28 are positioned on opposite sides of the slot 10, it will be apparent that the order may be reversed, or that both lamps, with appropriate shielding, may be positioned on the same side, or that even a single lamp may be utilized.

As noted hereinabove, the OA photocell bank 24 and its associated circuitry provide safeguards which prevent an incorrect readout of the ticket due to its improper insertion or withdrawal from the slot 10, or being jerked back and forth, either purposely or accidentally.

The theory of operation of the reader is considered in conjunction with FIG. 5, as follows:

Although the polarity of the signals may be reversed in the actual case, for purpose of discussion, it is assumed that when light to an OA cell is cut off, the voltage output from the cell goes in a negative direction. When the cell is lighted, its output voltage goes in a positive direction. The spacing of each individual OA cell in bank 24, center-to-center, is approximately 0.1 inch. When a ticket is inserted into the throat of the slot 10 and pushed in until it bottoms, it will cover the OA cells one at a time, until they are all cut off from the illumination. As each OA cell loses its light, its output voltage will go in a negative direction. It is thus seen that as each cell is turned off, it will produce a negative pulse. When the ticket is withdrawn from the slot, each of the OA cells will be turned on in turn, each producing a positive pulse in the process.

Referring to FIG. 6, a block diagram of the logic circuit which operates in conjunction with the OA cell bank 24 is considered.

The logic employed prevents a nonbottoming ticket, or a jiggled ticket from being decoded. Only a properly bottomed ticket which is then withdrawn in a normal manner, i.e., essentially in a uniform stroke, will be decoded. The operation of the logic will be as follows:

When there is no ticket in the slot 10, all OA cells of bank 24 will be illuminated. There are two busses, a set bus 50 and a reset bus 51. A ticket 11 is now inserted into the slot 10. As it is pushed into the slot, light is progressively cut off to each OA cell of bank 24 causing its voltage to go negative in step voltage style. Each OA cell is connected to the reset bus 51 through an isolation diode 52 of the correct polarity to pass negative pulses. These negative pulses are AC coupled into the reset inputs both flip-flops FF1 and FF2. Thus, when the ticket is being inserted, FF1 and FF2 will always be in the reset condition. With the flip-flops in a reset condition, their outputs will supply a disable voltage to the AND-gate 53. The decoder will be disabled.

When the ticket has cut off light to all OA cells, i.e., the ticket 11 is bottomed in the slot 10, the ticket 11 can now be withdrawn. As the bottom cell is uncovered, it will receive light, causing its output voltage to go positive. This positive step will cause both FF1 and FF2 to be set. The AC coupling capacitors block DC (direct current). The result of this action is to place enabling voltages on both input legs 54 and 55 of the AND-gate 53. The decoder (not shown) will now be enabled and be able to translate the information on the ticket as it is being withdrawn. As each cell of the bank 24 is uncovered, it will produce a set pulse which will maintain FF2 in a set condition. The decoder will also remain enabled. If during the process of ticket withdrawal, the ticket direction should be reversed as in a jerk, so that a previously uncovered cell was again covered up, a negative pulse will be generated by that cell causing both FF1 and FF2 to be reset, disabling the gate as well as the decoder. When this happens, a No-Go alarm signal will show. The card 11 must again be pushed to the bottom of the slot and withdrawn again in order to get a Go signal and decoding action.

If the ticket 11 is inserted into the slot 10 but not all the way to the bottom, FF1 will remain in the reset condition, causing gate input 54 to be disabled, thereby disabling the decoder. Even though the ticket is withdrawn, the decoder will remain disabled. FF2 will be set but FF1 will remain in reset condition; a No-Go signal will be produced. If the ticket should be properly bottomed, then withdrawn part way out, and then allowed to stop where it is, and then pulled the rest of the way out, and if more than the correct number of clock pulses were generated, a No-Go signal would again be produced, voiding the ticket readout. The same thing would also occur if less than the correct clock pulse count occurred.

It is thus seen that the reader of the present invention affords a variety of novel and useful features which includes:

1. Though nonstatic, it offers the advantages of a static reader.

2. It employs fluorescent ink which acts as light source, similar to punched tape. This provides a system wherein the area surrounding the illuminated code bars are dark and allows wider pickup cone angle for the photocell without losing light signal while the signal-to-noise ratio remains unchanged.

3. The readout function occurs only during ticket withdrawal.

4. The reader is: fast acting, i.e., as fast as the ticket is manually withdrawn; it employs simple optics; and it has no moving parts.

5. It provides safeguards against accidental or illegal ticket manipulation in the slot.

6. Unlike a static reader, which has one detector for each position of a code bar over the entire coded area, the reader of this invention uses a single detector for each code bar position per line.

While the invention has been described with reference to a number of particulars in order to give a full and clear explanation, various modifications will be apparent to those skilled in the art without departing from the scope and spirit of the invention.

What is claimed is:

1. A reader for a document upon which information is coded in a pattern imprinted on said document with fluorescent ink, said reader comprising:

Means to guide the manual insertion and manual withdrawal of a document in said reader,

A source of light positioned contiguous to said guide and arranged so as to project light on a document inserted in said guide,

A first photoelectric cell bank for sensing information coded on said document positioned contiguous to said guide means the individual cells of said bank arranged to be responsive only to the fluorescence generated from the fluorescent ink coded information imprinted on the inserted document as said light is projected on a document inserted into said reader,

A second photoelectric cell bank, electrically interconnected with said first bank, adapted to validate a document only when it has bottomed in said guide,

Electrical signal means responsive to an optical approval signal from said second photoelectric cell bank for activating said first photoelectric cell bank to produce a readout only when said document has bottomed in, and it withdrawn from, said guide means, and

A housing capable of substantially excluding stray light enclosing said means, light source and photoelectric cell banks.

2. The apparatus of claim 1 wherein the light source for the first photoelectric cell bank is ultraviolet light and a separate incandescent light source is provided for the second

photoelectric cell bank.

3. The apparatus of claim 1 which incorporates an invalidation signal for a document which is jiggled as it is manually withdrawn.

4. The apparatus of claim 1 wherein the validation means comprises the generation of a predetermined number of clock pulses.

5. An apparatus for reading a document upon which information is coded in a pattern imprinted on said document with fluorescent ink, said apparatus comprising:

A document receiving slot to guide the manual insertion and manual withdrawal of documents to be read, said slot comprising an upper and lower plate,

A readout window and a first approval window formed in said upper plate,

A second approval window in registry with said first approval window formed in the lower plate,

A source of light positioned so as to direct light through said approval windows,

A source of UV light positioned so as to project fluorescent light through said readout window,

A first photoelectric cell bank positioned contiguous to said approval window on the opposite side of said slot so as to receive light directed through said approval windows so long as said windows are not obstructed by a document inserted in said slot,

A second photoelectric cell bank for sensing information coded on said document position contiguous to said readout window arranged to sense only light projected into said window and reflected from the fluorescent ink coded information imprinted on the document inserted in said slot, electrical signal means responsive to an optical approval signal from said second photoelectric cell bank for activating said first photoelectric cell bank to produce a readout only when said document has bottomed in, and is withdrawn from, said slot, and

A housing capable of substantially excluding stray light enclosing said slot light source and photoelectric cell banks.

6. The apparatus of claim 5 wherein the light source directing light through said approval windows is an incandescent lamp and the light source projecting light through said readout window is a UV fluorescent lamp and said fluorescent lamp is positioned on the opposite side of the slot from said incandescent lamp.

7. The apparatus of claim 5 wherein the cells of the second photoelectric cell bank are selectively responsive to an orange-red fluorescent ink.

8. The apparatus of claim 5 wherein the document receiving end of said upper and lower plates are flared outward to facilitate insertion of the document into the slot.

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