PHOTOSensitive SENSING SYSTEM FOR A CURRENCY DETECTOR
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This invention relates to improvements in currency detectors. More particularly, this invention relates to improvements in currency detectors which optically sense inserted bills.

It is, therefore, an object of the present invention to provide an improved currency detector which optically senses inserted bills.

A number of currency detectors which optically sense inserted bills have been proposed; and some of those currency detectors have been built. Many of those currency detectors utilized lamps that were normally de-energized and that were energized only after an inserted bill was in position to be sensed. A normally de-energized lamp is desirable, in the sense that it keeps the photocell or photocells from receiving light from those portions of a bill which are not intended to be sensed but which move past the photocell or photocells as the bill is moved into position to be sensed; but a normally de-energized lamp is undesirable, in the sense that it will not attain full brilliance immediately and in the sense that it will have a shortened “life.” It would be desirable to provide a currency detector which could optically sense inserted bills and which could have the lamp or lamps thereof energized at all times. The present invention provides such a currency detector; and it is, therefore, an object of the present invention to provide a currency detector which optically senses inserted bills and which has the lamps thereof energized at all times. The currency detector provided by the present invention will grip an inserted bill and will move that bill into a testing position; and light from that bill will reach the photocells of that currency detector as that bill is being so moved. However, that light will be unable to cause those photocells to initiate the acceptance of that bill until after that bill has been moved all the way into that testing position; because the currency detector of the present invention has an inhibiting circuit which prevents positively the acceptance of a bill until after that bill has been moved all the way into the testing position. Once the bill has been moved all the way into that testing position, the inhibiting circuit can permit the photocells to initiate the acceptance of the bill if that bill is authentic, is of the proper denomination, and is properly oriented. Specifically, if the inserted bill is authentic, is of the proper denomination, and is properly oriented as it reaches the testing position, the photocells of the currency detector will receive the amounts of light which they need to initiate the acceptance of that bill. The amount of light which those photocells receive from that bill, as that bill is being moved into that testing position, will vary; but even if the amount of light which the photocell moving bill should happen to equal the amount of light which those photocells need to initiate the acceptance of an inserted bill, the inhibiting circuit will keep those photocells from initiating the acceptance of the bill until after that bill has been fully moved into the testing position. As a result, the currency detector of the present invention will keep portions of a bill, which are not intended to be sensed, from initiating the acceptance of that bill even though the said portions are moved past the photocells while the lamps are energized. It is, therefore, an object of the present invention to provide an inhibiting circuit for a currency detector which will positively keep the photocells of that currency detector from initiating acceptance of a bill until after that bill has been fully moved into the testing position.

The resistance values of commercially available photocells can vary widely, even where those photocells receive the exact same amounts of light. It would be desirable to provide a circuit for a currency detector which could enable that currency detector to optically sense bills with accuracy despite the inherent wide variations in the resistance values of commercially available photocells. The present invention provides such a circuit; and it is, therefore, an object of the present invention to provide a circuit for a currency detector which can enable that currency detector to optically sense bills with accuracy despite the inherent wide variations in the resistance values of commercially available photocells.

The circuit for the currency detector of the present invention connects the photocells of that currency detector in pairs, connects the photocells of each pair in series, and connects a potentiometer in parallel with one photocell of each pair of photocells. Adjustment of the positions of the movable contacts of the potentiometers will compensate for variations in the resistances of the photocells. Adjustment of those positions also will compensate for variations in the brilliance of the lamps. In addition, adjustment of those positions will compensate for variations in the characteristics of the components between the movable contacts of those potentiometers and the “accept” portion of the circuit. As a result, the potentiometers of the present invention enable the circuit for the currency detector to operate effectively despite variations in the resistances of the photocells, in the brilliance of the lamps, and in the characteristics of the components between the movable contacts of those potentiometers and the “accept” portion of the circuit. It is, therefore, an object of the present invention to connect the photocells of a currency detector in pairs, to connect the photocells of each pair in series, and to connect a potentiometer in parallel with one photocell of each pair of photocells.

The circuit for the currency detector of the present invention has a phase inverter connected between the “accept” portion of that circuit and the movable contact of each potentiometer that is connected in parallel with a photocell; and each phase inverter will respond to a predetermined voltage at the movable contact of its potentiometer to tend to initiate the acceptance of the inserted bill. However, that phase inverter will respond to undue displacement of the voltage at that movable contact in a predetermined direction to prevent acceptance of that bill. The circuit for the currency detector also has a circuit component, connected to the movable contact of each potentiometer that is connected in parallel with a photocell, which will respond to the said predetermined voltage at the movable contact of its poten-
tiometer to tend to initiate the acceptance of the inserted bill. However, that circuit component will respond to undue displacement of the voltage at that movable contact in the opposite direction to prevent acceptance of that bill. As a result, the circuit of the present invention will tend to permit acceptance of the inserted bill if the voltage at the movable contact of each potentiometer that is connected in parallel with a photocell is at a predetermined value but will prevent the acceptance of that bill if that voltage is displaced unduly in either direction from that predetermined value. It is, therefore, an object of the present invention to provide a circuit for a currency detector which has a phase inverter, intermediate between the "accept" portion of the circuit and the movable contact of each potentiometer that is connected in parallel with a photocell, to tend to permit acceptance of an inserted bill when the voltage at that movable contact is at a predetermined value and to prevent acceptance of that bill when that voltage is unduly displaced in a predetermined direction from that value, and which also has a circuit component connected to the said movable contact to tend to permit acceptance of the bill when the voltage at that movable contact is at the said predetermined value and to prevent acceptance of that bill when that voltage is unduly displaced in the opposite direction from that value.

The inhibiting circuit for the currency detector of the present invention includes members, such as diodes, which can be blocked. Those members will coact to permit acceptance of a bill only if all of those members are subjected to voltages within a predetermined range. This is desirable because it makes certain that a bill will be rejected if any one of the members is not subjected to a voltage within that range. It is, therefore, an object of the present invention to provide members, such as diodes, which can be blocked and which will coact to prevent acceptance of an inserted bill unless all of those members are subjected to voltages within a predetermined range.

Other and further objects and advantages of the present invention should become apparent from an examination of the drawing and accompanying description.

Additional advantages and features of the present invention will become apparent from the following description and from the appended claims.

In the drawing, FIG. 1 is a schematic diagram of a preferred form of circuit for the optical sensing system of the present invention, and FIG. 2 is a diagram showing a sub-circuit which can be substituted for any one of three sub-circuits in the circuit in FIG. 1.

Referring to FIG. 1 in detail, the numerals 206, 208, 210, 212, 514 and 516 denote lamps which can be mounted in a currency detector. While those lamps can be mounted in various currency detectors, those lamps have been mounted in the currency detector which is shown and described in the commonly-assigned, co-pending application of Calvin L. Chumley for Currency Detectors Serial No. 306,767 which was filed September 5, 1963, now Patent No. 3,265,205. Photocells 214, 216, 218, 220, 516 and 520 are located, respectively, adjacent the lamps 206, 208, 210, 212, 514 and 516; and those photocells will receive light that is directed against an inserted bill by those lamps.

The numeral 596 denotes a conductor which will be suitably connected to a source, not shown, of positive voltage; and the numeral 604 denotes a conductor which will be suitably connected to a source, not shown, of negative voltage. In one preferred embodiment of the optical sensing system of the present invention, the source of positive voltage can provide a regulated fifteen volts and the source of negative voltage can provide a regulated fifteen volts. The numeral 570 denotes a conductor which will be suitably connected to a source, not shown, of positive voltage; and, in the said preferred embodiment of the optical sensing system of the present invention, that source will provide a voltage of about one hundred and fifty volts.

The numeral 624 denotes a relay coil; and the left-hand terminal of that coil is connected to conductor 596 by junctions 1078 and 1034, a six hundred and eighty ohm resistor 1032, and a junction 983. The right-hand terminal of that relay coil is connectable to ground by a junction 1094, normally-open relay contacts 626, conductor 922, and normally-open switch 444. The relay contacts 626 will close whenever the relay coil 624 is energized; and the switch 444 will be closed by a cam or other device shortly after the initiation of a cycle of operation of the currency detector. That switch will then be kept closed until shortly before the end of that cycle of operation.

The lower terminals of the lamps 210 and 212 are connected to the conductor 604 by junctions 930, 928, 926 and 924; and that conductor will supply a negative fifteen volts to those lower terminals. Junctions 924, 926, 932, 934, 936 and 938 connect the lower terminals of the lamps 206 and 208 to the conductor 604. Junctions 924, 926, 932, 934, 940, 942, 944 and 946 connect the lower terminals of the lamps 514 and 516 to the conductor 604. The upper terminals of the lamps 514, 516, 206, 208, 210 and 212 are connected to ground by junctions 962, 960, 958, 956, 954, 952, 950 and 948. As a result, those lamps will be illuminated whenever the source of negative voltage supplies fifteen volts to the conductor 604. Those lamps are preferably Sylvania ES18 lamps.

The photocells 518 and 520 are connected in series between junctions 944 and 962 by junction 970 and thus have fifteen volts applied across them. The photocells 214 and 216 are connected in series between the junctions 936 and 956 by junction 992 and thus have fifteen volts applied across them. The photocells 218 and 220 are connected between the junctions 928 and 950 by junction 1012 and thus have fifteen volts applied across them. The photocells 214, 216, 218, 220, 516 and 520 are preferably RCA C7036 phototrons; and they will conduct current whenever the source of negative voltage supplies fifteen volts to the conductor 604. The resistance of each of those photocells will increase as the amount of light striking that photocell decreases; and, conversely, the resistance of each of those photocells will decrease as the amount of light striking that photocell increases. The photocells 214, 218 and 518 will receive light that is reflected from light areas on an authentic bill disposed within the testing area of the currency detector and the photocells 216, 220 and 520 will receive light that is reflected from dark areas on an authentic bill disposed within that testing area.

A twenty-five thousand ohm potentiometer 972 is connected in parallel with the photocell 214, a twenty-five thousand ohm potentiometer 994 is connected in parallel with the photocell 216, and a twenty-five thousand ohm potentiometer 1014 is connected in parallel with the photocell 220.

The numeral 968 denotes a TI49 transistor which has the emitter thereof connected to conductor 604 by a twenty-seven hundred ohm resistor 960 and junctions 970, 940, 934, 952, 926 and 924. The collector of that transistor is connected to the conductor 896 by a junction 982, a twelve thousand ohm resistor 980 and junctions 986 and 988. The base of that transistor 968 is connected to the movable contact of potentiometer 972 by an eighteen hundred ohm resistor 976 and a junction 974.

The numeral 990 denotes a second TI49 transistor; and that transistor has the emitter thereof connected to the conductor 604 by a twenty-seven hundred ohm resistor 1002 and junctions 1006, 932, 926 and 924. The
collector of that transistor is connected to the conductor 596 by a junction 1004, a twelve thousand ohm resistor 1096, and junctions 1088, 986 and 988. The base of that transistor is connected to the movable contact of potentiometer 598 by an eighteen hundred ohm resistor 988 and a junction 1013.

The numeral 1010 denotes a third TI494 transistor; and the emitter of that transistor is connected to the conductor 604 by a twenty-seven hundred ohm resistor 1024 and junctions 1032, 1020 and 924. The collector of that transistor is connected to the conductor 596 by a junction 1026, a twelve thousand ohm resistor 1028, and junctions 1038, 986 and 988. The base of that transistor is connected to the movable contact of potentiometer 1014 by an eighteen hundred ohm resistor 1018 and a junction 1016.

The numeral 1050 denotes a fourth TI494 transistor; and the emitter of that transistor is connected to the conductor 604 by a junction 1040, an eight hundred and twenty ohm resistor 1042, and junctions 1044, 1022, 1020 and 924. The collector of that transistor is connected to the conductor 596 by a junction 1036, a fifteen hundred ohm resistor 1034, resistor 1032, and junction 988.

A one thousand ohm resistor 966 is connected to the conductor 604 by a junction 964, a thirty-three thousand ohm resistor 967, and junctions 942, 949, 934, 932, 926 and 924. The resistor 966 also is connected to the conductor 604 by junction 964, a Zytan diode 1052, a conductor 1050, junctions 1056, 1058 and 1048, a ten thousand ohm resistor 1046, the base-emitter circuit of transistor 1030, junction 1040, resistor 1042, and junctions 1044, 1022, 1020 and 924.

The collector of transistor 1050 is connected to conductor 960 by junction 982, a Zytan diode 1054, and junction 1056. The junction 974 is connected to conductor 1050 by a Zytan diode 1060 and junction 1058. The collector of transistor 990 is connected to conductor 1050 by junction 1064, a Zytan diode 1062, and junction 1064. The junction 996 is connected to conductor 1050 by a Zytan diode 1068 and junction 1066. The collector of transistor 1010 is connected to conductor 1050 by junction 1026, a Zytan diode 1072, and junction 1076. The junction 1016 is connected to conductor 1050 by a Zytan diode 1074.

The numeral 1076 denotes a fifth TI494 transistor; and the emitter of that transistor is connected to conductor 604 by junction 1040, resistor 1042, and junctions 1044, 1022, 1020 and 924. The collector of that transistor is connected to conductor 596 by junctions 1082 and 1094, relay coil 624, junctions 1078 and 1034, the six hundred and eighty ohm resistor 1032, and junction 988. The base of that transistor is connected to the movable contact of a five thousand ohm potentiometer 1038; and the upper terminal of that potentiometer is connected to the collector of transistor 1030 by junction 1086, a twelve thousand ohm resistor 1084, and junction 1038. The lower terminal of that potentiometer is connected to the junction 1044 by a forty-seven hundred ohm resistor 1092. A shunt 1090 is connected between the upper terminal and the movable contact of the potentiometer 1038 by the junction 1086. The transistors 1030 and 1076 and the resistors associated with them constitute a Schmitt trigger. While the Schmitt trigger is very desirable, because of its rapid switching action, other flip-flop circuits could be used in lieu of the Schmitt trigger shown in the drawing.

The numeral 1060 denotes a Zytan diode which has the anode thereof connected to the right-hand terminal of the relay coil 624; and junctions 1092 and 1094 and which has the cathode thereof connected to the left-hand terminal of that relay coil by junction 1078.

The upper terminal of the resistor 966 is connected to the conductor 570 by a sixty-eight thousand ohm resistor 788; and that upper terminal is selectively connectable to ground by a switch 790, a resistor 791, and a conductor 792. While that switch is shown in FIG. 1 as a single pole single throw switch, that switch will preferably be a thyratron, as shown by the said Chumley applications; and, whenever that switch is closed, it will, effectively, serve as a open switch. However, when that thyratron "fires," it will effectively serve as a closed switch and will connect the upper terminal of resistor 966 to ground via the resistor 791 and conductor 792. The resistor 791 is intended to represent the relatively low plate-cathode impedance of the thyratron after that thyratron has been "fired." With the exception of the switch 444, the switch 790, and the resistor 791, the components in FIG. 1 are identical to the similarly-numbered components in the said Chumley application.

The lamps 206, 208, 210, 212, 514 and 516 could be so related to the photocells 214, 216, 218, 220, 518 and 520 that each photocell would, prior to the insertion of a bill, receive light from its associated lamp. On the other hand, those lamps could be so related to those photocells that each photocell would, prior to the insertion of a bill, receive no light from its associated lamp. If desired, some of those photocells could be arranged to receive light from their associated lamps while the rest of those photocells received no light from their associated lamps prior to the insertion of a bill. In the currency detector application, the lamps 206 and 214 are so mounted so that the light from the lamp 206 will be directed toward the lamp 214, and vice versa; and hence substantially no light will initially fall upon the photocells 214 and 514. Light from the lamp 208 will initially fall upon the lamp 516, and vice versa; and hence the two photocells 216 and 520 will receive substantially no light prior to the insertion of a bill into the currency detector. Light from the lamp 210 will initially be directed away from the photocell 218; and hence that photocell will receive substantially no light until a bill is inserted. However, a substantial amount of light will pass from the lamp 212 to the photocell 220 before a bill is inserted. This means that until a bill is inserted in the currency detector, the photocells 214, 216 and 514 will receive substantially no light; although those photocells will receive substantial amounts of light from an inserted bill if that bill is authentic and of the proper denomination. Until a bill is inserted in the currency detector, the photocells 216 and 520 also will receive substantially no light; although those photocells will receive some light from an inserted bill if that bill is authentic and of the proper denomination. Until a bill is inserted in the currency detector, photocell 220 will receive a substantial amount of light; although that photocell will receive only a little light from an inserted bill if that bill is authentic and of the proper denomination. The optical sensing system of FIG. 1 will be set to permit the transistor 1030 to be rendered non-conductive only when the photocells 214, 216 and 518 receive substantial amounts of light; and the photocells 216, 220 and 520 receive only small amounts of light; and hence that sensing system will not permit that transistor to become non-conductive whenever the currency detector is at rest.

In setting the optical system of FIG. 1, the movable contact of potentiometer 1038 was held in position by a weight not down to the lower end of that potentiometer to make sure that the transistor 1076 will be non-conductive. Also, the switch 790 will be closed; and, where that switch is a thyratron, that thyratron will be suitably rendered conductive, as by reducing the negative bias on the control grid of that thyratron. As long as the switch 790 is open, current will flow from conductor 570 via resistors 788 and 966, junction 964, resistor 967, and junctions 942, 940, 934, 932, 926 and 924 to the conductor 604; and that flow of current will enable the resistors 788, 966 and 967 to establish a positive voltage of about five volts at the junction 964. However, whenever the switch 790...
is closed, current also will flow from conductor 570 via resistor 788, switch 790, resistor 791, and conductor 792; and the resistance of resistor 792 will be so small that the voltage at the junction 964 will become negative and will be greater than eight and one-half volt. Once the switch 790 has been closed, an authentic bill of the proper denomination, with average cleanliness and light reflectivity, will be set in the testing area of the currency detector.

At this time, a D.C. voltmeter will be connected between junctions 982 and 924, and the movable contact of potentiometer 972 will be moved to provide a minimum reading on that voltmeter. The settings of the movable contacts will be proportional to the significant while the voltmeter is so connected; and hence those movable contacts can have random settings. Once the movable contact of potentiometer 972 has been set to establish a minimum voltage between junctions 982 and 924, the voltmeter will be connected between junctions 1004 and 924; and then the movable contact of potentiometer 994 will be moved to provide a minimum reading on that voltmeter. The setting of the movable contact of potentiometer 1014 is not significant while the voltmeter is so connected; and hence that movable contact can have random settings. After a minimum voltage has been established between junctions 1004 and 924, the voltmeter will be connected between junctions 1026 and 924; and then the movable contact of potentiometer 1014 will be moved to provide a minimum reading on that voltmeter. Once that minimum reading has been established, the movable contact of potentiometer 1014 will be shifted until the reading on the voltmeter increases by about one to about one and two-tenths volts. At this time, the movable contact of potentiometer 1088 will be moved upward just far enough to render transistor 1076 conductive. Thereafter, the switch 790 will be open, and the voltage at the junction 964 will become about five volts positive. Current will then flow from conductor 570 via resistors 788 and 966, junction 964, diode 1052, collector 1050, junctions 1056, 1958 and 1048, resistor 1046, the base-emitter circuit of transistor 1030, junction 1040, resistor 1042, junctions 1044, 1022, 1020 and 1024 to the conductor 604. The resulting flow of current through the base-emitter circuit of transistor 1030 will render that transistor conductive; and, as that transistor becomes conductive, the transistor 1076 will again become non-conductive. Thereupon, the voltmeter will again be connected between junctions 1026 and 924; and the movable contact of potentiometer 1014 will again be moved to provide a minimum reading on that voltmeter. At this time, the optical sensing system of FIG. 1 will be properly set; and the inserted bill will be removed.

The setting of the movable contact of potentiometer 1014, and the setting of the movable contact of potentiometer 1088 while the former movable contact is offset, make it possible for the currency detector to accept authentic bills which have values of cleanliness and light reflectivity that are greater or less than average but that fall within a predetermined range, and to reject all bills with values of cleanliness and light reflectivity outside of that range.

With no bill in the testing area of the currency detector, the photocells 518 and 520 will establish a negative voltage of about four volts 970; and a negative voltage of less than seven and eight-tenths volts will appear at the junction 974. Because the junction 1044 is fifteen volts negative, current will tend to flow from ground via junction 962, photocell 518, junction 970, the upper section of potentiometer 972, junction 974, diode 1060, junctions 1058 and 1048, resistor 1040, the base-emitter circuit of transistor 1030, junction 1040, resistor 1042, and junctions 1044, 1022, 1020 and 924 to conductor 604 and such a flow of current would keep that transistor conductive. The negative voltage at the junction 974 will be more positive than the negative fifteen volts at junction 970, and hence current will flow from ground via junction 962, photocell 518, junction 970, the upper section of potentiometer 972, junction 974, resistor 976, the base-emitter circuit of transistor 968, resistor 980, and junctions 978, 940, 934, 932, 926 and 924 to the conductor 604. That flow of current will render transistor 968 conductive. The resulting current flow from the conductor 956 via junctions 988 and 986, resistor 984, junction 982, transistor 968, resistor 980, and junctions 978, 940, 934, 932, 926 and 924 to the conductor 604 will provide a negative voltage at the junction 982 which is greater than eight volts. Such a voltage is too negative to cause current to flow through the base-emitter circuit of transistor 1030; and hence the voltage at junction 982 will tend to permit transistor 1030 to become non-conductive. However, because the voltage at junction 974 is sufficiently positive to tend to cause current to flow through the base-emitter circuit of transistor 1030, the negative voltage at junction 982 can not cause the transistor 1030 to become non-conductive.

With no bill in the testing area of the currency detector, the photocells 214 and 216 will establish a negative voltage of about four volts 970; and a negative voltage of less than seven and eight-tenths volts will appear at the junction 974; and a negative voltage of more than seven and eight-tenths volts will appear at the junction 996. Because the junction 1000 is fifteen volts negative, current will tend to flow from ground via junctions 962, 966, 958 and 956, photocell 214, junction 992, the upper section of potentiometer 994, junction 996, resistor 998, the base-emitter circuit of transistor 990, resistor 1002, and junctions 1000, 932, 926 and 924 to conductor 604. If the voltage at the base of transistor 990 is not too negative, that transistor will be slightly conductive; but if that voltage is about nine volts negative, that transistor will be biased beyond cut-off. The transistor 990 is conductive, current will flow from the conductor 956 via junctions 988, 986 and 1008, resistor 1006, junction 1004, transistor 999, resistor 1002, and junctions 1000, 932, 926 and 924 to the conductor 604 and make the junction 1004 more positive than minus eight volts. If the transistor 990 is biased beyond cut-off, the voltage at junction 1004 will be even more positive. Because the junction 1044 is fifteen volts negative, current will tend to flow from the conductor 956 via junctions 988, 986 and 1008, resistor 1006, junction 1004, diode 1062, junctions 1064 and 1048, resistor 1046, the base-emitter circuit of transistor 1030, junction 1040, resistor 1042, and junctions 1044, 1022, 1020 and 924 to the conductor 604; and such a flow of current would keep that transistor conductive. The negative voltage at the junction 996 is too negative to cause current to flow through the base-emitter circuit of transistor 1030; and hence the voltage at junction 996 will tend to permit that transistor to become non-conductive. However, because the voltages at junctions 974 and 1004 are sufficiently positive to tend to cause current to flow through the base-emitter circuit of transistor 1030, the negative voltage at junction 996 can not cause the transistor 1030 to become non-conductive.

With no bill in the testing area of the currency detector, the photocells 218 and 220 will establish a negative voltage of about four volts 970; and a negative voltage of more than ten volts will appear at the junction 1016. As a result, the transistor 1010 will be biased beyond cut-off; and hence the voltage at junction 1026 will be more positive than minus eight volts. Because the junction 1044 is fifteen volts negative, current will tend to flow from the conductor 956 via junctions 988, 986 and 1008, resistor 1028, junction 1026, diode 1072, junctions 1070, 1066, 1064 and 1048, resistor 1046, the base-emitter circuit of transistor 1030, junction 1040, resistor 1042, and junctions 1044, 1022,
1020 and 924 to the conductor 604; and such a flow of current would keep that transistor conductive.

The negative voltage at the junction 1016 is too negative to cause current to flow through the base-emitter circuit of transistor 1030; and hence the voltage at junction 1016 would tend to permit that transistor to become non-conductive. However, because the voltages at junctions 974, 1004 and 1026 are sufficiently positive to tend to cause current to flow through the base-emitter circuit of transistor 1030, the negative voltage at junction 1016 can not cause the transistor 1030 to become non-conductive.

Also, with no bill in the testing area of the currency detector, the switch 790 will be open, and the voltage at the junction 964 will be positive and will have a value of about five volts. If that voltage is more positive than the voltages at the anodes of diodes 1060, 1062 and 1072, it will block those diodes; and it will also cause current to flow through the base-emitter circuit of transistor 1030, thereby keeping that transistor conductive.

All of this means that while the photocells 214, 216, 218, 220, 518 and 520 coact, when no bill is present in the testing area of the currency detector, to establish voltages at junctions 982, 996 and 1016 which would tend to keep the transistor 1030 non-conductive, those photocells also coact to establish voltages at junctions 974, 1004 and 1026 which would tend to keep the transistor 1030 conductive; and the switch 790 establishes a positive voltage at junction 964 which also tends to keep that transistor conductive.

When an authentic bill of the proper denomination is properly disposed within the testing area of the currency detector, the photocells 518 and 520 will coact to develop a negative voltage of about seven and eight-tenths volts at junction 974, the photocells 214 and 216 will coact to develop a smaller voltage at junction 996, and the photocells 218 and 220 will coact to develop a similar voltage at the junction 1016. The transistors 965, 990 and 1010 will respond to those voltages to develop negative voltages of about eight volts at the junctions 982, 1004 and 1026; and the resulting voltages at the anodes of diodes 1065, 1068, 1062, 1068, 1072 and 1074 will be sufficiently negative to tend to cause the transistor 1030 to become non-conductive. However, until the switch 790 is closed to permit the voltage at the junction 964 to become negative and to have a value greater than eight volts, the positive voltage at junction 964 will keep current flowing through the base-emitter circuit of transistor 1030 and will thus keep that transistor conductive.

If a bill, which is inserted in the currency detector, causes too much light to strike photocell 518, the resistance of that photcell will be too low, and the voltage at junction 974 will be more positive than minus seven and eight-tenths volts. That Voltage will tend to cause current to flow through the base-emitter circuit of transistor 1030 and thereby keep that transistor conductive. However, if the inserted bill causes photocell 520 to receive too little light, the resistance of that photcell will be too high, and the voltage at junction 974 will be more negative than minus seven and eight-tenths volts. That voltage will tend to cause current to flow through the base-emitter circuit of transistor 1030 and thereby keep that transistor conductive. However, if the inserted bill causes photocell 520 to receive too much light, the resistance of that photcell will be too low and will make the voltage at junction 974 more negative than minus seven and eight-tenths volts. The transistor 968 will respond to the unduly negative voltage at the base thereof to become less conductive; and the voltage at junction 982 will become more positive than minus eight volts. That voltage will tend to cause current to flow through the base-emitter circuit of transistor 1030 and thereby keep that transistor conductive.

This means that if photocell 518 receives too much light or if photocell 520 receives too little light, the voltage at the movable contact of potentiometer 972 will be sufficiently positive to tend to cause current to flow through diode 1060 and the base-emitter circuit of transistor 1030. That current will keep that transistor conductive even if the other two pairs of photocells receive the correct amount of light and even if the switch 790 is open. If photocell 518 receives too little light or if photocell 520 receives too much light, transistor 968 will become less conductive and the voltage at the collector thereof will become unduly negative; and current will tend to flow through diode 1054 and the base-emitter circuit of transistor 1030 and thereby keep that transistor conductive.

The photocells 214 and 216, the transistor 990, and the diodes 1062 and 1068 will operate in the manner in which the photocells 518 and 520, the transistor 968, and the diodes 1054 and 1060 operate. Specifically, if the photocell 214 receives too much light or if the photocell 216 receives too little light, the voltage at the movable contact of potentiometer 994 will become unduly positive; and current will tend to flow through diode 1058 and the base-emitter circuit of transistor 1030 and thereby keep that transistor conductive. On the other hand, if the photocell 214 receives too little light or if the photocell 216 receives too much light, the voltage at junction 996 will become unduly negative and transistor 990 will become less conductive and will make the voltage at the collector thereof unduly positive. That voltage will tend to cause current to flow through diode 1062 and the base-emitter circuit of transistor 1030, and keep that transistor conductive.

The photocells 218 and 220, the transistor 1010, and the diodes 1072 and 1074 also will operate in the manner in which the photocells 518 and 520, the transistor 968, and the diodes 1054 and 1060 operate. Specifically, if the photocell 218 receives too much light or if the photocell 220 receives too little light, the voltage at junction 1016 will become unduly positive; and current will tend to flow through diode 1074 and the base-emitter circuit of transistor 1030 and thereby keep that transistor conductive. On the other hand, if the photocell 218 receives too little light or if the photocell 220 receives too much light, the voltage at junction 1016 will become unduly negative and transistor 1010 will become less conductive and will make the voltage at the collector thereof unduly positive. That voltage will tend to cause current to flow.
through diode 1072 and the base-emitter circuit of transistor 1030 and thereby keep that transistor conductive. If more than one photocell receives too much light or if more than one photocell receives too little light, the diode which has the least negative voltage on the anode thereof will tend to become conductive and will tend to cause current to flow through the base-emitter circuit of transistor 1030 and keep that transistor conductive.

The resistance values of commercially-available photocells tend to vary rather widely; and hence the resistance values of photocells 214, 216, 218, 220, 515 and 520 could vary widely even if all of those photocells received the exact same amount of light. Furthermore, widely differing amounts of light are reflected onto the various photocells 214, 216, 218, 220, 518 and 520 from an authentic bill. However, by pairing the photocells, by connecting the photocells of each pair in series, and by connecting a potentiometer in parallel with one photocell of each pair of photocells, the present invention can fully compensate for inherent differences in the resistances of the various photocells. Also, by pairing the photocells, by connecting the photocells of each pair in series, and by connecting a potentiometer in parallel with one photocell of each pair of photocells, the present invention enables adjustment of the movable contact of that potentiometer so as to compensate for differences in the characteristics of the lamps and for variations in the characteristics of the transistor and resistors associated with that movable contact.

In the operation of the currency detector with which the optical sensing system of the present invention is used, the switch 444 will be closed; and that switch will be closed prior to the closing of switch 790 and it will remain closed after the switch 790 is closed. Also, a bill will be moved into the testing area; and, as that bill moves into that testing area, that bill will interrupt the light beams from the lamps 206, 208, 210, 212, 514 and 516 and will cause the light from those lamps to reflect, respectively, onto the photocells 214, 216, 218, 220, 518 and 520. The amount of light that is reflected onto those photocells will vary as the light and dark portions of the upper and lower faces of the bill pass through the beams of light from these lamps; and hence the resistances of those photocells will vary. However, even if, while a bill is being moved toward and into the testing area, some combination or combinations of light and dark areas on the faces of that bill happened to cause negative voltages, equal to or greater than seven and eight-tenths volts, to appear at the anodes of all of the diodes 1054, 1060, 1062, 1065, 1068, 1083, 1084, 1085 and 1090, the transistor 1030 would still remain non-conductive. As pointed out hereinbefore, the current which will flow from the conductor 570 via resistors 788 and 966, junction 964, resistor 967, and junctions 942, 940, 934, 932, 926 and 924 to the conductor 604 will maintain a positive voltage of about five volts at the junction 964; and the resulting flow of current through the base-emitter circuit of transistor 1030 will keep that transistor conductive. This is desirable, because it obviates all need of keeping the lamps "off" until after the inserted bill has been fully moved into the testing area. As the bill is fully moved into the testing area, the light which is reflected from the faces of that bill onto the photocells 214, 216, 218, 220, 518 and 520 will cause the voltages at the anodes of all of the diodes 1054, 1060, 1062, 1065, 1072 and 1074 to be negative and to equal or exceed seven and eight-tenths volts. However, because the switch 790 will still be open, the voltage at the junction 964 will be about plus five volts; and the resulting current flow through the base-emitter circuit of transistor 1030 will keep that transistor conductive. This means that even though the optical sensing system of FIG. 1 tends to initiate an accept signal by tending to render the transistor 1030 non-conductive, that transistor cannot become conductive until both that system and the switch 790 simultaneously tend to render the transistor 1030 non-conductive.

During the operation of the currency detector with which the optical sensing system of the present invention is used, the switch 790 will be closed after the inserted bill has been fully moved into the testing area. In the currency detector of the said Chumley application the switch 790 is a thyatron, and that thyatron is fired if the magnetic head and the magnetic sensing system determine that the inserted bill is authentic and has the desired denomination. However, the switch 790 could be a bill-actuated switch which is to be actuated by the leading edge of the bill as that bill reaches the testing area, or it could be a relay contact visual that is used as a result of some test made on the bill by the currency detector. Also, if desired, the switch 790 could be closed by a motor-driven cam or some other timing device. In any event, the currency detector will be arranged so the switch 790 will be closed after the inserted bill has been fully moved into the testing area and before the end of the cycle of operation of the currency detector. As that switch is closed, a low resistance path will be established between the resistor 788 and ground via the resistor 791 and conductor 792; and the voltage at the junction 964 will fall until it is negative and has a value in excess of eight volts. Since these photocells in the amplifier of FIG. 1 previously established, and will be maintaining, negative voltages at the anodes of diodes 1054, 1060, 1062, 1065, 1070 and 1074 which exceed seven and one-half volts, the drop in voltage at the junction 964 will enable the voltage at the junction 1048 to become negative and to have a value equal to or in excess of seven and one-half volts. Thereupon the conductivity of transistor 1030 will decrease.

As the transistor 1030 becomes less conductive, current will flow from the conductor 596 via junction 988, resistor 1032, junction 1034, resistor 1036, junction 1038, resistor 1084, junction 1086, shunt 1090, the movable contact of potentiometer 1088, the base-emitter circuit of transistor 1076, junction 1040, resistor 1042, and junctions 1044, 1022, 1020 and 924 to the conductor 604. The transistor 1076 will respond to that flow of current to become conductive; and, because the transistors 1030 and 1076 and the associated resistors constitute a Schmitt trigger, the transistor 1030 will immediately become non-conductive and the transistor 1076 will immediately start conducting heavily. Thereupon, current will flow from the conductor 596 via junction 988, resistor 1032, junctions 1034 and 1075, relay coil 624, junctions 1094 and 1096, the transistor 1030 would still remain non-conductive. The resulting flow of current will energize relay coil 624; and that relay coil will close the contacts 626 and thereby establish a holding circuit for that relay coil. That holding circuit extends from the conductor 596 via junction 988, resistor 1032, junctions 1024 and 1078, relay coil 624, junction 1094, contacts 626, conductor 922, and switch 444 to ground; and that holding circuit will keep that relay coil energized as long as the switch 444 remains closed. The relay coil 624 will close other contacts, not shown, which will cause the bill to be moved to the cash box and which will cause the desired change, merchandise or service to be dispensed or rendered.

Shortly before the end of the cycle of operation of the currency detector, the switch 444 will be re-opened; and, thereupon, the holding circuit for the relay coil 624 will be interrupted. As that relay coil becomes energized, the contacts 626 will re-open. The diode 1080 will provide a discharge path for the inductive energy that was stored within the relay coil 624 while that coil was energized. Specifically, as the contacts 626 re-open, current will flow from the right-hand terminal of relay coil 624 via junctions 1094 and 1062, diode 1080, and junction 1078 to the left-hand terminal of that relay coil. The impedance of the path through that diode will be so small.
that substantially no current will tend to flow through the transistor 1076; and, in this way, the diode 1080 will protect the transistor 1076 from hurtful current surges when the relay coil 624 is de-energized.

During the cycle of operation of the currency detector, the bill was moved into the testing area and was optically sensed. The optical sensing system determined that the bill was acceptable; and as the switch 790 was closed, caused the transistor 1038 to become non-conductive. Thereupon, the transistor 1076 became conductive and energized the relay coil 624; and that relay coil caused the dispensing or vending of the desired change, merchandise or service. Thereafter, the currency detector completed its cycle of operation and re-opened the switches 759 and 444, in readiness for the insertion of another bill.

If a spurious bill or an authentic bill of an undesired denomination is inserted or if an authentic bill of the desired denomination is improperly oriented in the testing area, the optical sensing system should not cause the switch 790 to render the transistor 1038 non-conductive. If the bill is an authentic bill of an undesired denomination, or if the bill is authentic and of the desired denomination but has the green-ink face thereof up, the amount of light reflected onto the photocells 214, 216, 218, 220, 519 and 520 will be sufficient to cause the voltages at the anodes of all of the diodes 1062, 1068, 1072, 1074, 1054 and 1060 to be negative and to have values equal to or greater than seven and eight-tenths volts. Instead, the light falling upon those photocells will cause the voltage at the anode of at least one of those diodes to be more positive than seven and eight-tenths volts. Where that occurs, the optical sensing system will be capable of holding the voltage at the junction 1048 more positive than the negative seven and one-half volts needed to render the transistor 1038 non-conductive. Consequently, the transistor 1076 will not be able to become conductive and will thus not be able to energize the relay coil 624. Because that relay coil will not be energized, the currency detector will not dispense or vend the desired change, merchandise or service. Instead, that currency detector will return the inserted bill to the patron and will restore the components thereof to their normal position in readiness for the insertion of another bill.

Referring particularly to FIG. 2, the numeral 1200 denotes a potentiometer which can be substituted for any of the potentiometers 972, 994 and 1014 of FIG. 1. The numeral 1204 denotes T449 transistor which can be substituted for any of the transistors 908, 990 and 1016 of FIG. 1 and which can be substituted for any of the transistors 1202, 1204 and 1208 of FIG. 2 and a resistor 1206 and connect the movable contact of the potentiometer 1200 with the base of the transistor 1204; and that junction and resistor can be substituted for any one of the resistors 996 and 1016 of FIG. 1. The emitter of transistor 1204 is connected to the lower terminal of potentiometer 1200 by a resistor 1216 and a junction 1220; and that resistor and junction can be substituted for any of the resistors 988, 1002 and 1208 and junctions 978, 1600 and 1020 of FIG. 1. A junction 1210 connects a resistor 1212 with the collector of the transistor 1204 and that junction and that resistor can be substituted for any of the resistors 982, 1004 and 1026 and resistors 934, 1066 and 1028 of FIG. 1. The junction 1210 also is connected to the anode of a diode 1214; and that diode can be substituted for any one of diodes 1054, 1062 and 1072 of FIG. 1. The only difference between a sub-circuit of FIG. 2 and any of the corresponding sub-circuits of FIG. 1 are the connections for the diode 1208 in FIG. 2. That diode is identical to the diodes 1060, 1068 and 1074 of FIG. 1, and it has its anode connected in the same way in which the anodes of those diodes are connected; but, instead of having its cathode to the left-hand terminal of diode 1046, diode 1208 has its cathode connected to that terminal by junction 1210 and diode 1214.

If it is assumed that the sub-circuit of FIG. 2 is substituted for that sub-circuit of FIG. 1 which includes the potentiometer 972 and the transistor 968, the photocells 518 and 520 will establish a negative voltage of about four volts at the upper end of the potentiometer 1200 until a bill is inserted in the currency detector. Such a voltage will cause a negative voltage of less than seven and eight-tenths volts to occur at junction 1202; and, because the junction 1044 is fifteen volts negative, current will tend to flow from ground via junction 962, photocell 518, junction 970, the upper section of potentiometer 1200, junction 1202, diode 1208, junction 1210, diode 1214, junctions 1056 and 1048, resistor 1046, the base-emitter circuit of the transistor 1038, junction 1040, resistor 1042, and junctions 1044, 1022, 1020 and 924 to the conductor 604. Such a flow of current would keep that transistor conductive and prevent energization of the relay coil 624.

The negative voltage at the junction 1202 will also be more positive than the negative fifteen volts at junction 1220; and hence current will flow from ground via junction 962, photocell 518, junction 970, the upper section of potentiometer 1200, junction 1202, resistor 1206, the base-emitter circuit of transistor 1204, resistor 1216, and junctions 1220, 934, 932, 1044 and 924 to the conductor 604. That flow of current would, if the diode 1208 was not connected between junctions 1202 and 1210 and if that diode was not conductive, cause the transistor 1038 to become sufficiently conductive to make the voltage at junction 1210 negative with a value greater than eight volts. Such a voltage at that junction would tend to render the transistor 1038 non-conductive; but, because diode 1208 is connected between junctions 1202 and 1210 and because that diode is conductive, the voltage at the junction 1210 will be just slightly less positive than the voltage at the junction 1202. As a result, the voltage at the junction 1210 will be sufficiently positive to cause current to flow from conductor 596 via junctions 988 and 966, resistor 1212, junction 1210, diode 1214, junctions 1056 and 1048, resistor 1046, the base-emitter circuit of transistor 1038, junction 1040, resistor 1042, and junctions 1044, 1022, 1020 and 924 to the conductor 604; and that flow of current will keep the transistor 1038 conductive.

When an authentic bill is moved into the testing area of the currency detector, photocells 518 and 520 will coat to develop a negative voltage of about seven and eight-tenths volts at the junction 1202; and that voltage will tend to cause that flow to be reduced to that magnitude. However, via junction 962, photocell 518, junction 970, the upper section of potentiometer 1200, junction 1202, diode 1208, junction 1210, diode 1214, junctions 1056 and 1048, resistor 1046, the base-emitter circuit of transistor 1038, junction 1040, resistor 1042, and junctions 1044, 1022, 1020 and 924 to the conductor 604; and that current flow will tend to keep the transistor 1038 conductive. However, the inserted bill causes the photocell 518 to receive too little light, the resistance of that photocell will be too high; and the voltage at junction 1202 will be more negative.
than minus seven and eight-tenths volts. The unduly negative voltage at junction 1202 will make the transistor 1204 less conductive; and hence the voltage at the junction 1210 will be more positive than minus eight volts. That voltage will tend to cause current to flow from the conductor 596 via junctions 988 and 986, resistor 1212, junction 1210, diode 1214, junctions 1056 and 1046, resistor 1046, the base-emitter circuit of transistor 1030, junction 1040, resistor 1042, junctions 1044, 1022, 1020 and 924 to the conductor 604; and that current flow will tend to keep the transistor 1030 conductive. However, if the inserted bill causes photocell 520 to receive too little light, the resistance of that photocell will be too low; and will make the voltage at junction 1202 more negative than minus seven and eight-tenths volts. The unduly negative voltage at junction 1202 will make the transistor 1204 less conductive; and hence the voltage at the junction 1210 will be more positive than minus eight volts. That voltage will tend to cause current to flow from the conductor 596 via junctions 988 and 986, resistor 1212, junction 1210, diode 1214, junctions 1056 and 1048, resistor 1046, the base-emitter circuit of transistor 1030, junction 1040, resistor 1042, and junctions 1044, 1022, 1020 and 924 to the conductor 604; and that current flow will tend to keep the transistor 1030 conductive. This means that if photocell 518 receives too much light or if photocell 520 receives too little light, the voltage at the movable contact of potentiometer 1200 will become sufficiently positive to tend to cause current to flow through the diodes 1208 and 1214 and the base-emitter circuit of transistor 1030. That current will keep that transistor conductive even if the other two pairs of photocells received the correct amounts of light and even if the switch 790 was closed. If photocell 518 receives too little light or if photocell 520 receives too much light, the transistor will become less conductive and the voltage at the collector of that transistor will become sufficiently positive to tend to cause current to flow through diode 1214 and the base-emitter circuit of transistor 1030. The current would keep that transistor conductive even if the other two pairs of photocells received the correct amounts of light and even if the switch 790 was closed. It will thus be apparent that the photocells 518 and 520, the transistor 1204, and the diodes 1208 and 1214 coat to provide a dual action. Specifically, if those photocells cause the voltage at the movable contact of potentiometer 1200 to become unduly positive, the current will tend to flow through the diodes 1208 and 1214 and the base-emitter circuit of transistor 1030 and keep that transistor conductive. On the other hand, if those photocells make the voltage at the movable contact of potentiometer 1200 unduly negative, the transistor 1204 will make the voltage at the collector positive; and unduly negative; and current will tend to flow through diode 1214 and the base-emitter circuit of transistor 1030 and keep the latter transistor conductive. The resistors 788, 791, 966 and 967 will coat with the switch 790, the diode 1052, and the Schmitt trigger to serve as an inhibiting circuit. Specifically, that circuit will prevent energization of the relay coil 624 until the switch 790 is closed even if all of the photocells 214, 216, 218, 220, 518 and 520 are receiving the proper amounts of light. That inhibiting circuit is very useful because it will keep a combination or combinations of light and dark areas on a bill from effecting energization of the relay coil 624 prior to the time that bill is fully moved into the testing area of the currency detector. The diodes 1054, 1060, 1062, 1068, 1072 and 1074 also act as parts of that inhibiting circuit, and they will prevent energization of the relay coil 624 in the event any one of the photocells 214, 216, 218, 220, 518 and 520 fails to receive the proper amount of light.

Whenever an authentic bill is disposed within the testing area of the currency detector, each of the photocells 214, 216, 218, 220, 518 and 520 will receive some light, even though the photocells 216, 220 and 520 will receive less light than the photocells 214, 218 and 518 will receive. This is desirable because it means that if any one of the lamps 206, 208, 210, 212, 514 and 516 does not become illuminated, the adjacent photocell will receive too little light and will coat with the inhibiting circuit to prevent the energization of the relay coil 624. This means that the "burning out" of one or more of the lamps will not be able to effect acceptance of a bill.

While potentiometers 972, 994 and 1014 are shown in FIG. 1, it would be possible to use tapped resistors or other equivalent electrical components in lieu of those potentiometers.

The connection of the photocells in pairs, and the connecting of a potentiometer or equivalent electrical component in parallel with one of the photocells of each pair of photocells, enable the photocells to receive light from any desired portions of a bill. For example, some of the photocells could be set to receive light from the lightest areas of a bill while other of those photocells could be set to receive light from the darkest areas of those bills, and still other photocells could be set to receive light from areas of intermediate lightness and darkness.

The preferred embodiment of optical sensing system which is described hereinbefore is intended to be used with a currency detector that will accept authentic one-dollar bills of the United States and will reject all other bills. However, if desired, that optical sensing system could be adapted, by appropriate positioning of the lamps 206, 208, 210, 212, 514 and 516 and by appropriate positioning of the photocells 214, 216, 218, 220, 518 and 520 to sense other authentic bills of the United States and of foreign countries. While three pairs of photocells are used in the optical-sensing system of the present invention, more or fewer pairs of photocells could be used without any change in the basic circuit. All that need be done to add further photocells is to provide another potentiometer, another transistor and its associated resistors, and two additional diodes.

Whereas the drawing and accompanying description have shown and described two preferred embodiments of the present invention, it should be apparent to those skilled in the art that various changes may be made in the form of the invention without affecting the scope thereof.

What we claim is:

1. A sensing system for a currency detector that comprises:
   (a) a pair of photocells that are connected in series,
   (b) a first potentiometer that has a movable contact and that is connected in parallel with one of said photocells,
   (c) a Schmitt trigger,
   (d) a phase inverter which has the input thereof connected to said movable contact of said first potentiometer,
   (e) a diode that is connected between the output of said phase inverter and the input of said Schmitt trigger,
   (f) a second diode that is connected between said movable contact of said first potentiometer and said input of said Schmitt trigger,
   (g) a second pair of photocells that are connected in series,
(b) a second potentiometer that has a movable contact and that is connected in parallel with one of said photocells of said second pair of photocells,

(i) a second phase inverter which has the input thereof connected to said movable contact of said second potentiometer,

(j) a third diode that is connected between the output of said second phase inverter and the input of said Schmitt trigger,

(k) a fourth diode that is connected between said movable contact of said second potentiometer and said input of said Schmitt trigger,

(l) a Schmitt trigger normally having the first section thereof conductive and normally having the second section thereof non-conductive,

(m) said Schmitt trigger having a potentiometer that establishes the bias for said second section of said Schmitt trigger,

(n) a voltage divider,

(o) a switch that can change the effective resistance of said voltage divider,

(p) a fifth diode between said voltage divider and the input of said Schmitt trigger,

(q) a source of power that causes current to flow through each photocell of said pairs of photocells whenever said photocell is illuminated and through each of said potentiometers and through said voltage divider, that normally causes current to flow and conductively bias said first section of said Schmitt trigger after flowing through said voltage divider and said fifth diode or through part of the first said potentiometer and said second diode or through said part of the first said potentiometer and the first said phase inverter and the first said diode or through part of said second potentiometer and said fourth diode or through said part of said second potentiometer and said second phase inverter and said third diode, and that can cause current to flow through said section of said Schmitt trigger when the first said section of said Schmitt trigger becomes non-conductive,

(r) the first said pair of photocells and the first said potentiometer coating, whenever an acceptable bill is not present, with said second diode or with the first said phase inverter and the first said diode to tend to keep the first said section of said Schmitt trigger conductive,

(s) said second pair of photocells and said second potentiometer coating, whenever an acceptable bill is not present, with said fourth diode or with said second phase inverter and said third diode to tend to keep the first said section of said Schmitt trigger conductive,

(t) said voltage divider and said fifth diode coating, whenever an acceptable bill is not present, to tend to keep the first said section of said Schmitt trigger conductive,

(u) the first said pair of photocells and the first said potentiometer coating, whenever an acceptable bill is present, with said second diode and with the first said phase inverter and the first said diode to tend to render said first section of said Schmitt trigger conductive,

(v) said second pair of photocells and said second potentiometer coating, whenever an acceptable bill is present, with said fourth diode or with said second phase inverter and said third diode to tend to render said first section of said Schmitt trigger non-conductive,

(w) said voltage divider and said fifth diode coating, whenever an acceptable bill is present to tend to render said first section of said Schmitt trigger non-conductive,

(x) said first and second pairs of photocells being disposed adjacent a testing area,

(y) said switch and said diodes being parts of an inhibiting circuit that will keep said first section of said Schmitt trigger conductive until after an acceptable bill has been fully moved into said testing areas, and

(z) lamps that are illuminated continuously throughout the operation of said sensing system and that cause light from inserted bills to pass to said photocells,

(aa) one of said photocells receiving substantially no light until a bill is inserted and then receiving a substantial amount of light if said bill is acceptable,

(ab) another of said photocells receiving substantially no light until a bill is inserted and then receiving only a limited amount of light if said bill is acceptable,

(ac) still another of said photocells receiving a substantial amount of light until a bill is inserted and then receiving only a limited amount of light if said bill is acceptable.

2. A sensing system that comprises:

(a) a pair of sensing elements that are connected in series,

(b) a voltage divider that is connected in parallel with one of said sensing elements,

(c) an actutable device,

(d) a phase inverter which has the input thereof connected to a contact of said voltage divider,

(e) a member that is connected between said contact of said voltage divider and said actutable device and that can respond to a first predetermined voltage at said contact to actuate said actutable device, and

(f) a second member that is connected between the output of said phase inverter and said actutable device and that can connect with said phase inverter and with a second predetermined voltage at said contact to actuate said actutable device,

(g) the first said and said second predetermined voltages being equal or close to each other,

(h) the first said member responding to voltages displaced in one direction from the first said predetermined voltage to prevent actuation of said actutable device,

(i) said second member and said phase inverter responding to voltages displaced in the opposite direction from said second predetermined voltage to prevent actuation of said actutable device,

(j) said sensing elements being photocells,

(k) said voltage divider being a potentiometer,

(l) said members being diodes.

3. A sensing system that comprises:

(a) a pair of sensing elements that are connected in series,

(b) a voltage divider that is connected in parallel with one of said sensing elements,

(c) an actutable device,

(d) a phase inverter which has the input thereof connected to a contact of said voltage divider,

(e) a member that is connected between said contact of said voltage divider and said actutable device and that can respond to a first predetermined voltage at said contact to actuate said actutable device, and

(f) a second member that is connected between the output of said phase inverter and said actutable device and that can connect with said phase inverter and with a second predetermined voltage at said contact to actuate said actutable device,

(g) the first said and said second predetermined voltages being equal or close to each other,

(h) the first said member responding to voltages displaced in one direction from the first said predetermined voltage to prevent actuation of said actutable device,

(i) said second member and said phase inverter responding to voltages displaced in the opposite direction from said second predetermined voltage to prevent actuation of said actutable device,
(j) said members being connected in series between said contact and said actuatable device,
(k) said output of said phase inverter being connected to a junction between said members.

4. A sensing system that comprises:
(a) a pair of sensing elements that are connected in series,
(b) a voltage divider that is connected in parallel with one of said sensing elements,
(c) an actuatable device,
(d) a phase inverter which has the input thereof connected to a contact of said voltage divider,
(e) a member that is connected between said contact of said voltage divider and said actuatable device and that can respond to a first predetermined voltage at said contact to actuate said actuatable device, and
(f) a second member that is connected between the output of said phase inverter and said actuatable device and that can react with said phase inverter and with a second predetermined voltage at said contact to actuate said actuatable device,
(g) the first said and said second predetermined voltages being equal or close to each other,
(h) the first member responding to voltages displaced in one direction from the first said predetermined voltage to prevent actuation of said actuatable device,
(i) said second member and said phase inverter responding to voltages displaced in the opposite direction from said second predetermined voltage to prevent actuation of said actuatable device.

5. A sensing system for a currency detector that comprises:
(a) a photocell that is adjacent a testing area for bills,
(b) a lamp that is adjacent said testing area,
(c) means that can coact with said photocell to provide static sensing of bills introduced into said sensing area and to provide an accept signal as an acceptable bill is fully moved into said testing area and comes to rest,
(d) an inhibiting circuit that keeps said photocell and said means from providing an accept signal until after an acceptable bill has been fully moved into said testing area,
(e) whereby said lamp can be illuminated continuously during the entire time said currency detector is connected to a source of power and is in condition to accept bills, and
(f) a second means to provide a further and different test of bills inserted into said testing area,
(g) said second means being adapted to respond to the insertion of an acceptable bill into said testing area to disable said inhibiting circuit, and thereby enable said photocell and the first said means to provide an accept signal.

6. A sensing system for a currency detector that comprises:
(a) a photocell that is adjacent a testing area for bills,
(b) a lamp that is adjacent said testing area,
(c) means that can coact with said photocell to provide static sensing of bills introduced into said sensing area and to provide an accept signal as an acceptable bill is fully moved into said testing area and comes to rest, and
(d) an inhibiting circuit that keeps said photocell and said means from providing an accept signal until after an acceptable bill has been fully moved into said testing area,
(e) whereby said lamp can be illuminated continuously during the operation of said sensing system,
(f) said means including a flip-flop sub-circuit that has one section thereof held conductive until after an acceptable bill has been fully moved into said testing position and that subsequently becomes non-conductive,
(g) said inhibiting circuit being responsive to the absence of an acceptable bill to supply a voltage to said one section of said flip-flop sub-circuit to hold said section conductive,
(h) said inhibiting circuit being responsive to the presence of an acceptable bill to provide another and different voltage to said one section of said flip-flop sub-circuit to tend to cause said section to become nonconductive.

7. A sensing system for a currency detector that comprises:
(a) a photocell that is adjacent a testing area for bills,
(b) a lamp that is adjacent said testing area,
(c) means that can coact with said photocell to provide static sensing of bills introduced into said sensing area and to provide an accept signal as an acceptable bill is fully moved into said testing area and comes to rest,
(d) an inhibiting circuit that keeps said photocell and said means from providing an accept signal until after an acceptable bill has been fully moved into said testing area,
(e) wherein said lamp can be illuminated continuously during the entire time said currency detector is connected to a source of power and is in condition to accept bills, and
(f) a second means to provide a further and different test of bills inserted into said testing area,
(g) said second means being adapted to respond to the insertion of an acceptable bill into said testing area to disable said inhibiting circuit, and thereby enable said photocell and the first said means to provide an accept signal.

8. A sensing system for a currency detector that comprises:
(a) a pair of photocells that are connected in series,
(b) a first potentiometer that has a movable contact and that is connected in parallel with one of said photocells,
(c) an actuatable device that has the input thereof connected to said movable contact of said potentiometer, and
(d) a second potentiometer that is connected to said actuatable device and that can be adjusted to set the threshold value of said actuatable device.
(e) the first said potentiometer being adjustable to establish a voltage at the input of said actuatable device which corresponds to an acceptable bill of predetermined cleanliness and contrast,
(f) said first potentiometer being adjustable to establish a second voltage at the input of said actuatable device which is displaced from the first said voltage by a predetermined amount and which corresponds to said acceptable bill and to acceptable bills having cleanliness and contrast that are different from said predetermined cleanliness and contrast,
(g) said second potentiometer being adjustable to set said threshold value of said actuatable device at a level which will cause actuation of said actuatable device whenever a bill coacts with said photocells and the first said potentiometer to establish the first said or said second voltage at said input of said actuatable device.

9. A sensing system for a currency detector that comprises:
(a) a pair of photocells that are connected in series,
(b) a first potentiometer that has a movable contact and that is connected in parallel with one of said photocells,
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(c) an actuatable device,
(d) a phase inverter which has the input thereof connected to said movable contact of said potentiometer,
(e) a member that is connected between that output of said phase inverter and the input of said actuatable device,
(f) a second member that is connected between said movable contact of said first potentiometer and said input of said actuatable device, and
(g) a second potentiometer that is connected to said actuatable device and that can be adjusted to adjust the threshold value of said actuatable device,
(h) the first said potentiometer being adjustable to establish a voltage at the input of said actuatable device which corresponds to an acceptable bill of predetermined cleanliness and contrast,
(i) said first potentiometer being adjustable to establish a second voltage at the input of said actuatable device which is displaced from the first said voltage by a predetermined amount and which corresponds to said acceptable bill and to acceptable bills having cleanliness and contrast that are different from said predetermined cleanliness and contrast,
(j) said second potentiometer being adjustable to set said threshold value of said actuatable device at a level which will cause actuation of said actuatable device whenever a bill coacts with said photocells and the first said potentiometer to establish the first said or said second voltage at said input of said actuatable device,
(k) said members and said phase inverter causing said sensing system to respond to unacceptable bills to tend to supply voltages to said input of said actuatable device which will prevent actuation of said actuatable device.

10. A sensing system that comprises:
(a) a pair of sensing elements that are connected in series,
(b) a voltage divider that is connected in parallel with one of said sensing elements,
(c) an actuatable device,
(d) a phase inverter which has the input thereof connected to a contact of said voltage divider,
(e) a member that is connected between said contact of said voltage divider and said actuatable device that can respond to a first predetermined voltage at said contact to actuate said actuatable device, and
(f) a second member that is connected between the output of said phase inverter and said actuatable device that can coact with said phase inverter and with a second predetermined voltage at said contact to actuate said actuatable device,
(g) the first said and said second predetermined voltages being equal or close to each other.

11. A sensing system that comprises:
(a) a pair of sensing elements that are connected in series,
(b) a voltage divider that is connected in parallel with one of said sensing elements,
(c) an actuatable device,
(d) a phase inverter which has the input thereof connected to a contact of said voltage divider,
(e) a member that is connected between said contact of said voltage divider and said actuatable device and that can respond to a first predetermined voltage at said contact to actuate said actuatable device, and
(f) a second member that is connected between the output of said phase inverter and said actuatable device and that can coact with said phase inverter and with a second predetermined voltage at said contact to actuate said actuatable device,
(g) the first said and said second predetermined voltages being equal or close to each other,
(h) said sensing elements being photocells,
(i) said voltage divider being a potentiometer,
(j) said members being diodes.

12. A sensing system for a currency detector that comprises:
(a) a sensing element that can respond to an acceptable bill to develop a voltage,
(b) a first voltage divider that has said voltage applied to it,
(c) an actuatable device that is connected to said voltage divider to enable and voltage divider to supply a voltage to said actuatable device, and
(d) a second voltage divider, that is connected to said actuatable device to determine the level of the voltage that must be supplied to said actuatable device to actuate said actuatable device,
(e) the first said voltage divider being adjustable to supply to said actuatable device a voltage which corresponds to an acceptable bill of a predetermined cleanliness and contrast,
(f) the first said voltage divider also being adjustable to supply to said actuatable device a further voltage which corresponds to said acceptable bill and to an acceptable bill having a cleanliness and contrast different from said predetermined cleanliness and contrast,
(g) said second voltage divider being adjustable to set the level of the voltage, that must be supplied to said actuatable device to actuate said actuatable device at a level which will cause said actuatable device to become actuated when said further voltage is applied to it,
(h) said voltage dividers thereby enabling said sensing system to establish adjustable ranges of cleanliness and contrast for the bills to be accepted by said sensing system.

13. A sensing system for a currency detector that comprises:
(a) a sensing means that can respond to the insertion of a bill into a testing area to develop a voltage,
(b) an actuatable device,
(c) a second means that is connected to said actuatable device and that can tend, whenever said voltage is a predetermined value, to cause actuation of said actuatable device,
(d) said second means tending, whenever said voltage is displaced in a predetermined direction from said predetermined value, to prevent actuation of said actuatable device, and
(e) a third means that can tend, whenever said voltage is a predetermined value, to cause actuation of said actuatable device,
(f) said third means tending, whenever said voltage is displaced in the opposite direction from said predetermined value, to prevent actuation of said actuatable device,
(g) whereby said second and said third means cause said sensing system to reject bills that cause said sensing means to develop to high or too low a voltage,
(h) said second and said third means being static elements that permit only unidirectional flow of current therethrough.

14. A sensing system for a currency detector that comprises:
(a) a sensing means that can respond to the insertion of a bill into a testing area to develop a voltage,
(b) an actuatable device,
(c) a second means that is connected to said actuatable device and that can tend, whenever said voltage is a predetermined value, to cause actuation of said actuatable device,
(d) said second means tending, whenever said voltage is displaced in a predetermined direction from said predetermined value, to prevent actuation of said actutable device, and

(e) a third means that is connected to said actutable device and that can tend, whenever said voltage is a predetermined value, to cause actuation of said actutable device,

(f) said third means tending, whenever said voltage is displaced in the opposite direction from said predetermined value, to prevent actuation of said actutable device,

(g) said third means including a phase inverter.