May 17, 1960 G. J. HARMON 2,936,886

STAMP SENSING LETTER SORTER

Filed Oct. 5, 1954 3 Sheets-Sheet 1

Fig. 1

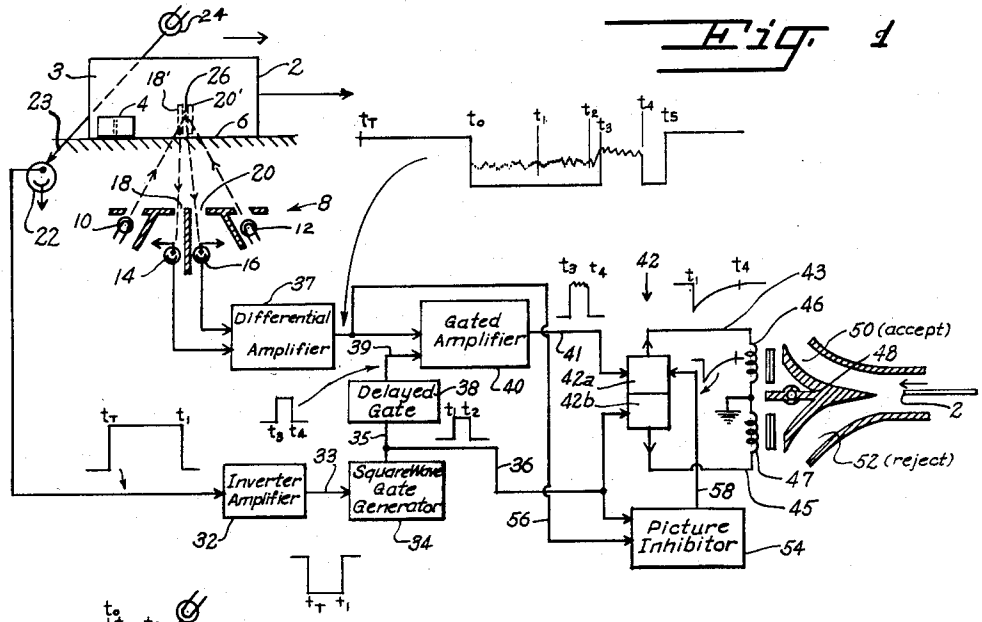
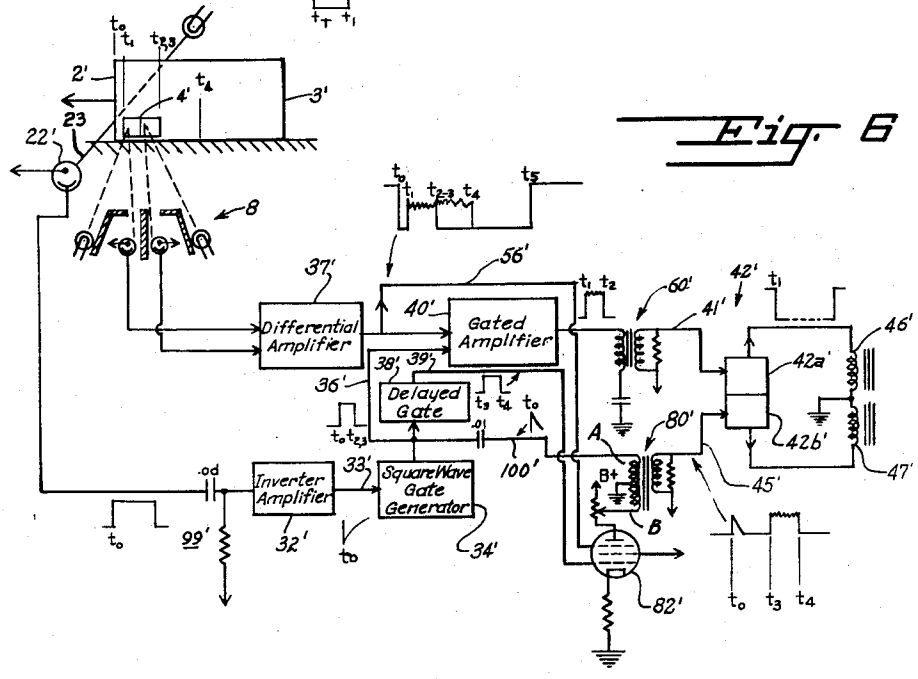


Fig. 6



INVENTOR

Gregory J. Harmon

BY Mart L. Libman

ATTORNEY

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Filed Oct. 5, 1954 3 Sheets-Sheet 2

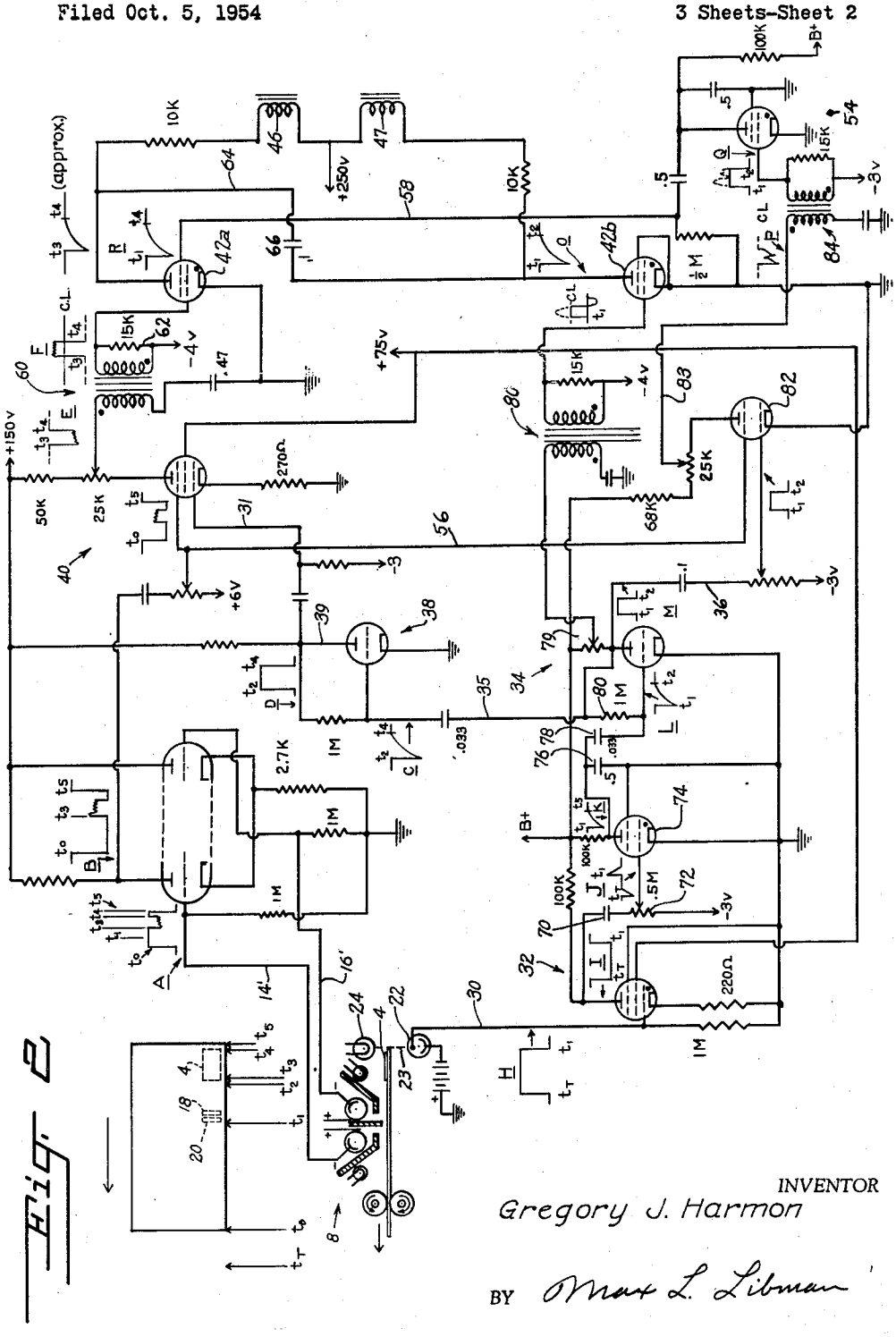


Fig. 2

INVENTOR
Gregory J. Harmon

BY Max L. Libman

ATTORNEY

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Filed Oct. 5, 1954 3 Sheets-Sheet 3

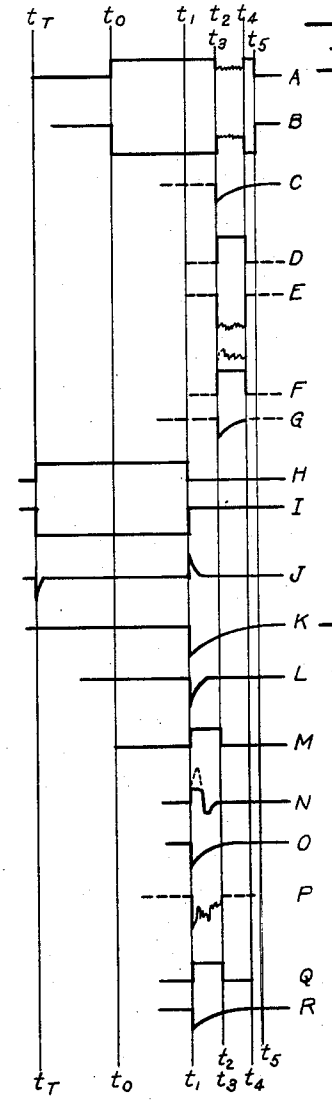
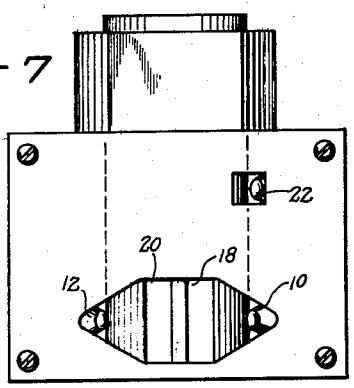


Fig. 7



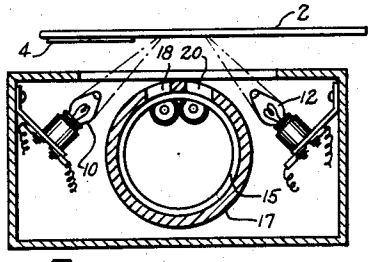


Fig. 8

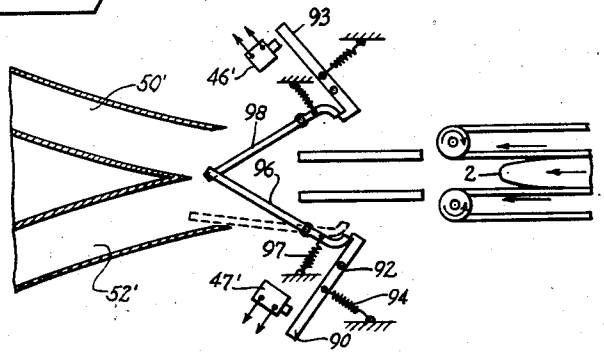


Fig. 4

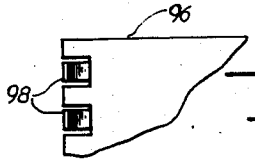


Fig. 5

Fig. 6

INVENTOR

Gregory J. Harmon

BY Max L. Libman

ATTORNEY

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2,936,886

STAMP SENSING LETTER SORTER

Gregory J. Harmon, Bethesda, Md., assignor to Reed Research, Inc., Washington, D.C., a corporation of Delaware

Application October 5, 1954, Serial No. 460,385

9 Claims. (Cl. 209—111)

This invention relates to a device for sorting mail in accordance with the presence or absence of a postage stamp thereon, and more specifically to a photoelectric sensing system for controlling the operation of selector gates to automatically separate properly stamped letters from unstamped letters.

Various attempts have been made to provide a practical stamp sensing optical system for sorting mail by sensing the intensity or condition of light reflected from the surface of supposedly stamped envelopes while conveying them past a sensing station. However, all prior art systems of which I am aware depend on the naive assumption that there is a sufficient difference in intensity of reflected light between the unstamped area of an envelope and the stamped area, if a stamp is actually present, to actuate a photocell system which can then be used to control a sorting gate. In other words, such systems assume a clean, highly reflective envelope surface which is optically homogeneous, and an optically sharply contrasting stamp surface. In practice, however, these favorable conditions are seldom found to exist. Practically, mail often contains discolored or otherwise marked surfaces which give signals undistinguishable in a naive system from those produced by stamps. Furthermore, present day postage stamps are of many different colors and shades, and envelopes are often of very similar colors and shades. Wrinkles and other surface irregularities of the envelope also tend to produce changes in the reflective condition of the envelope which closely resemble the changes produced by a stamp. A still greater difficulty exists in the case of picture postcards, one entire side of which is usually covered with optically contrasting marks, which produce signals usually indistinguishable from those produced by a stamp.

It is a primary object of my invention to provide a stamp sensing system which takes into consideration all of the above enumerated difficulties and operates with an extremely high percentage of accuracy. More specifically, it is an object of the invention to provide a stamp sensing system capable of distinguishing an unstamped picture postcard from one which is stamped. A further object of the invention is to provide a stamp sensing system which minimizes the effects of small irregularities of an envelope such as wrinkles, printing and other small marks, flap edge, etc., while providing a maximum signal for a stamp.

According to the invention, the above and other results are obtained by the use of a differential optical system which compares contiguous elemental reflected areas of the envelope or other item of mail, and which is gated for operative sensing only of that area of the envelope surface where a stamp is normally placed. Inhibiting means are provided responsive to optical irregularities of other areas on the mail whereby a postcard or similar optically mottled surface is prevented from triggering the selector gate. A special type of balanced differential amplifier is provided for minimizing discrepancies due to small surface irregularities such as wrinkles, etc.

The specific nature of my invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawings, in which:

Fig. 1 is a schematic circuit diagram of the back-edge sensing arrangement;

Fig. 2 is a detailed circuit diagram of this same arrangement;

Fig. 3 is a timing chart, showing the time relationship of the various pulses occurring in the circuit of Fig. 2;

Fig. 4 is a schematic plan view showing the principle of the letter selector gates;

Fig. 5 is a detailed view of the gates shown in Fig. 4;

Fig. 6 is a schematic circuit diagram of the front-edge senser;

Fig. 7 is a front elevation of the photocell housing unit; and

Fig. 8 is a sectional plan view of the same unit, showing the same relationship of the light beams and letter surface.

Referring to Fig. 1, a piece of mail such as an envelope or postcard 2, which is assumed to be bearing a stamp 4 is assumed to be resting on its lower edge 6 and moving in the direction of the arrow, that is, from left to right. Automatic machines for accomplishing this by means of rollers or belts are well known and form no part of the present invention. It is further assumed that letter 2 is spaced by a minimum definite amount from other letters preceding or following it. In practice, special means are provided for assuring such spacing, but these means form not part of the present invention, and will not be described further. The unit to be described is a photoelectric unit generally indicated at 8 for optically scanning a limited area of the letter 2 adjacent its bottom edge 6 as the letter passes in front of the scanning unit 8, which comprises two light sources 10 and 12 so arranged as to reflect equal amounts of light flux to respective phototubes 14 and 16 when no stamp is present in the area and when the reflecting surface of the letter is optically homogeneous, that is, reasonably clear and uniform. Light is admitted to photocells 14 and 16 through two narrow slits 18 and 20 running parallel to edge 2 of the letter and upward from bottom edge 6 thereof. In practice, the slits are formed in an opaque mask directly in front of the photocells, and located adjacent and parallel to the surface of the letter. Hence, the photocells will conduct in equal amount when any plane surface of uniform reflectance passes near to and parallel to the plane of the mask, to cause reflection from areas 18' and 20', corresponding to the areas of slits 18 and 20 respectively.

A third photocell 22 is so arranged with respect to a light beam from lamp 24 and with respect to differential arrangement 8, that the back edge 3 has just passed light beam 23 when slits 18 and 20 are apposite point 26 of the letter. Light beam 23, previously obstructed by the letter, can now reach photocell 22 to initiate a desired sequence of operations which will be fully described below. The time of this event will henceforth be termed "t_1." It will be noted that light beam 23 was previously interrupted by front edge 2 of the letter at a time which will be designated "t_T" and which is of no particular significance for our purpose. A short time after t_T, the front edge 2 also reaches scanner 8 and begins to affect the scanner; this time will be referred to as "t_0" and is also of no particular significance except as a reference point. The important sequence of events which affect the operation of the system begins at time t_1.

The principle of operation of the invention will now be described with reference to Fig. 1; it will be understood that Fig. 1 is a highly schematic diagram intended only to illustrate the underlying principles and general mode

of operation of the invention, rather than to represent a practical embodiment thereof. Approximate voltage waveforms will be shown adjacent various conductors of the system to indicate the time sequence of events. Initial interruption of light beam 23 by front edge 2 of the letter causes an increase of voltage at time t_T, while subsequent resumption of the light beam causes a decrease of the voltage at time t_1. This is inverted in amplifier inverter 32 and the resultant positive-going pulse at time t_1 produced on line 33 triggers square wave gate generator 34 to produce a square pulse on line 35 whose duration, as determined by the time constants of the gate generator extends until time t_2. This pulse is used on line 36 to energize the lower half of flip-flop 42; it is also used to initiate another pulse at delay gate generator 38 which appears on line 39 at time t_3 and lasts until time t_4; this pulse is used to gate amplifier 40 so that if between times t_3 and t_4 a signal output is received from differential amplifier 37 it will be transmitted and amplified by amplifier 40. Such a signal is produced by differential amplifier 37 if it senses a stamp or similar optical discontinuity in the small area of the letter reserved for stamps since during time t_3—t_4 the scanner 8 is sensing this area. It will be noted that anything previously sensed by scanner 8 will not be passed through gated amplifier 40. Therefore, the gated amplifier passes only what the scanner sees on the area of the letter reserved for stamps. Assuming that a stamp is positioned in the proper place and is sensed by scanner 8, the output of gated amplifier 40 on line 41 is a positive pulse extending between times t_3 and t_4. This pulse is fed into the upper unit of flip-flop 42 to energize line 43, and deenergize line 45 if that was previously energized, and thereby energize magnet 46 to operate mechanical gate 48 to direct letter 2, which has just been sensed, into channel 50 reserved for all stamped letters having this particular orientation. In the absence of a definite signal from the scanner 8, the lower half of flip-flop 42 remains energized and supplies line 45 to energize magnet 47 to direct the mail into channel 52. It will be noted that the lower half of flip-flop 42 has previously been energized by the pulse extending from time t_1—t_2 on line 36 as previously described.

The above system is in itself operative for ordinary letters to direct them into channel 52 if no stamp signal is received, and to direct them into channel 50 is a stamp signal is received. It will be noted that there are four possible orientations of the letter. That is to say, the letter may be flipped about either its horizontal or its vertical axis, and in each of these positions the stamp may be on the side facing the scanner or on the opposite side. Therefore, assuming a random distribution of the mail, and assuming practically all of the letters to be properly stamped, as is usually the case, substantially one quarter of the letters will be delivered to channel 50 and all of these will be faced the same way. A similar arrangement to that shown in Fig. 1 can also be used to scan the other side of the letters, but in this case the stamp must be looked for near the front edge. If all letters were of the same size, the top edge of the letters could be scanned by a similar arrangement suitably spaced from the bottom edge. However, due to the differences in sizes of letters, it is necessary to use the bottom edge as a reference. For this reason, postal stamp cancelling machines are also arranged to operate at a given distance from the bottom edges of letters. It is therefore necessary, after both sides of the bottom edge of the letters have been examined, and no stamp found, to turn the remaining letters over and run them through a similar arrangement on the edges which were previously the top edges. This can either be performed by hand, or by suitable known machinery, which is no part of the present invention. All of the letters not sorted by the machine will continue on a separate channel and will ultimately require inspection by a human operator. For the machine to be practical and effective, this residue must be reduced to a minimum and should constitute only a very small percentage of the original mail.

In practice, particularly during the summer time, a large percentage of the mail consists of picture postcards, the picture face of which will usually produce a signal indistinguishable from that due to the presence of a stamp. It will be noted that this occurs on the unstamped side of the postcard, since the stamp is always required to be placed on the blank or writing side. If the side which is being scanned is the picture side, it should not be passed as a stamped piece of mail, but should be rejected, and the present invention provides means for accomplishing this. Essentially, this consists in supplying an inhibiting gate for the upper side of flip-flop 42, whereby if the differential scanner 8 has been producing a substantial signal output in the area immediately preceding the stamped area, then selection due to a signal impulse at the stamp area is inhibited. Ultimately, of course, the stamped side will be scanned and will produce a proper signal to channel the postcard for segregation with other mail similarly faced.

The postcard inhibiter gate generator 54 is supplied over line 56 with the output of differential amplifier 37. It is gated "on" over line 36 by a pulse from time t_1—t_2. It is therefore affected by the output of the differential amplifier from point 26 (Fig. 1) on. If the picture side of a postcard is being scanned, there will be a definite output from the area which causes gate generator 54 to produce an output on line 58 which is made to have a duration from time t_1—t_4 so as to inhibit the operation of magnet 46. Thus the postcard is not passed through channel 50 but continues on channel 52, even though a signal has been produced by the stamped area due to the markings thereon.

While the above device has been described as a postcard inhibiter, it will be apparent that it will also inhibit the selection of any marked envelope surface due to printing, advertising, etc. In practice, it has been found that the area immediately preceding the stamp area on a piece of mail is nearly always free from objectionable markings which would interfere with the proper operation of the device.

Fig. 2 is a schematic circuit diagram of a practical circuit embodying the invention of Fig. 1. Corresponding elements have been given the same reference characters as in Fig. 1, but, of course, it will be necessary to employ a number of additional reference characters to identify the details not shown in Fig. 1. The placement of symbols t_T through t_5 with respect to the diagram of the letter shown in Fig. 2 represents the relative position of a point on scanner with respect to the letter as the letter passes by. Thus, at t_T, the leading edge of the letter has not yet reached the scanner; at time t_0, the leading edge reaches the scanner and begins to affect it; and so on, as described in connection with Fig. 1. The wave forms appearing on the various conductors of the circuit are again shown and are identified by capital letters so that their timing relationship may be more readily correlated with the corresponding waveform shown in Fig. 3.

In the following discussion, the amplifier unit 37 will be referred to as a "differential amplifier" because this expression best indicates the essential function of the amplifier; although it is not a conventional differential amplifier, its output is indicative of the differential reflectance of the areas 18 and 20. This results from the fact that the left side tube has a conventional plate resistor, which may conveniently be in the order of 100K, while the right side tube operates essentially as a cathode follower and has no plate resistor. Thus the current flowing in the left tube is greater than that flowing through the right tube for the same energization of the photocells, and the adjustment is such that the plate voltage at B is related to the differential reflectance. In practice, this arrangement, for which no novelty is

claimed per se, has been found to work very satisfactorily.

The input from one side of scanner 8 to the corresponding side of differential amplifier 37 is shown at A. It will be understood that a similar waveform appears at line 16' but is displaced in time from waveform A by a time period Δt corresponding to the time required for the passage of the mail between slots 18 and 20. Since the width of each slot is approximately of the same order as the distance between slots, it will be apparent that the output from each slot represents an average effect of a certain area, and the differential output from amplifier 37 represents the difference of these average effects. It is clear, however, that when one slit has just passed the edge of a stamp, while the other slit is still on the envelope surface, there will be a sharp rise in output. This occurs at time t_3, and due to the discontinuities of the optical surface of the stamp, an irregular output of moderate valve will continue until the trailing edge of the stamp passes the scanner 8 at which time the output will fall to its original level. I have found empirically that exact balancing of the differential amplifier is undesirable, and appears to emphasize noise, that is, the signal due to vary small variations of the optical surface of the letter. By unbalancing the anode resistors of the differential amplifier, a definite increase in the signal-to-noise ratio has been noted. In effect, it appears that the spikes due to all signals are reduced by a fairly constant amount, which tends to suppress the small signals, while scarcely affecting the large signals upon which the operation of the device depends. On the other hand, accurately balancing the circuit appears to emphasize the small discrepancies. The optimum effect appears to be obtained, in the circuit shown, by making the gain for one side of the differential amplifier approximately one-half of the gain for the other side.

Continuing with the description of the circuit, the output of the differential amplifier, having the waveform B (Figs. 2 and 3) is supplied to gated amplifier 40. This amplifier is gated by a delayed gate D on line 31, as in Fig. 1, put out by delayed gate generator 38, during the time interval t_3—t_4. If there is a stamp in the detected area, then during this interval amplifier 40 will put out a signal as shown at E. This signal is passed through pulse transformer 60, and is also inverted as shown at F by connecting the grid of thyratron 42*a* to the transformer secondary terminal of the proper polarity to accomplish this inversion. The secondary of transformer 60 is shunted with a 15,000 ohm resistor 62 for impedance matching and circuit clamping, to minimize ringing. Thyratron 42*a* constitutes the upper half of flip-flop 42 of Fig. 1, which is accomplished by coupling its anode through lead 64 and condenser 66 to the anode of thyratron 42*b*, which constitutes the lower half of the flip-flop. Therefore, if tube 42*a* is fired while 42*b* is on, the consequent lowering of potential at its anode will depress still further the plate voltage of thyratron 42*b*, and cause it to be extinguished, as is well known. Energization is thereby switched from magnet 47 to magnet 46 as explained in connection with Fig. 1. At the time this occurs, tube 42B will normally be on because it is fired by an earlier-timed pulse, as will now be explained.

The gating signal for the above procedure is timed by the end of the interruption of light beam 23 by the letter as previously explained. This produces pulse H in line 39 which is inverted in amplifier 32 as shown at I. This pulse is differentiated by the combination of condenser 70 and resistor 72 shown as a potentiometer for adjustability, to produce spikes at t_T and t_1 as shown at J. As thyratron 74 is normally deionized, the negative spike t_T has no effect, but the positive spike at t_1 fires thyratron 74 to produce a waveform, as shown at K, as condenser 76 discharges through the ionized tube 74 until the deionizing voltage is reached and the tube ceases to conduct. Waveform K is sharpened by the RC combination of condenser 78 and resistor 80, and fed to the grid of gate generator 34, extending from time t_1—t_2 as determined by the time constant of the preceding RC combination. This pulse is fed on line 36 to gate the picture postcard inhibitor as explained in connection with Fig. 1, and is also fed on line 35 to normally conducting delayed gate tube 38, where the negative-going side of the pulse at time t_2 again cuts off tube 38 due to the clamping action of the grid of tube 38, for a time extending from t_2—t_4 as determined by the time constant of the RC combination in the grid circuit of tube 38, similar to that for tube 34. The output of tube 38 on line 39 is pulse D extending from t_2—t_4 which is used as the gating pulse for amplifier 40 as previously explained. It will be noted that by virtue of this arrangement, time t_2 and t_3 occur at the same instant, that is, they become a single time. This is done primarily for convenience and to simplify the circuitry. So far as the principle of the invention is concerned, time interval t_1—t_2 could be selected to fall on any suitable area of the letter in advance of the postage stamp area.

Pulse M from tube 34 is also fed, through potentiometer 79, to the primary of transformer 80, the secondary of which is shunted by suitable 15K resistor, similar to resistor 62 of transformer 60, and used to fire thyratron 42*b* at time t_1. This insures that thyratron 42*b* is fired in advance of 42*a*.

Pulse M is also fed along line 36, as previously explained, to one control grid of tube 82 which functions as a gated amplifier for the picture postcard inhibitor. The other control grid of tube 82 is fed through line 56 with pulse B from the differential amplifier 37. If the waveform is as shown at B, nothing happens, since the positive signal at time t_3 has not yet begun. However, if the scanner 8 has been scanning the picture side of a picture postcard, or its optical equivalent, then the differential amplifier 37 will be producing a signal prior to time t_3, and this signal will be gated through amplifier 82 by gate pulse M. Ordinarily, this pulse will extend in duration from t_1—t_2 and passes from tube 82 along the line 83 to pulse transformer 84, where its polarity is reversed and it appears at the grid of thyratron 54 as pulse Q, to produce an output on line 58 as pulse R, which inhibits tube 42*a* as previously explained. Thus, it is seen how the circuit of Fig. 2 accomplishes all of the functions generally described in connection with the schematic diagram of Fig. 1.

It will be understood that an arrangement similar to scanner 8, at a different station on the conveyer line carrying the letters, is used to scan the opposite face of the letter from that scanned by scanner 8, except that the reference time must be taken from the front edge of the letter instead of from the back edge, as will be explained below. If no stamp is found, the letter is flipped over in any suitable manner, and continued along the conveyer now resting on edge 5 as its bottom edge, which was previously its top edge. It will be noted that in one of these positions, the stamp may appear adjacent the front edge of the letter rather than adjacent the back edge as shown in Figs. 1 and 2. For this position, the scanner shown in Fig. 1 and Fig. 2 will produce no result, since it is scanning the wrong corner of the letter. It is therefore necessary, for two of the sensing stations, to trigger the action of the scanner by the front edge of the letter rather than by the rear edge and in this case to place the scanner immediately behind the light beam 23 (or its equivalent) so that it will scan the proper area. Alternatively, the rejected letters could be turned top-edge down and returned to the conveyer system at a point ahead of the same two stations for front and back edge scanning. While this would save two stations, it would also reduce the speed of the system, so that the use of four stations is generally preferable. However, the light beam, instead of being resumed as before by the back edge, is now interrupted by the front edge, and the

timing pulse is reversed in polarity compared to the previous situation. It is therefore now necessary to reverse the grid connections to the differential amplifier and to reverse gates 34 and 38 in order to secure the same action as before with the reversed polarity. Furthermore, since the picture postcard gate now occurs after the stamp area has been scanned and not before it as in the previous case, it is no longer possible to inhibit thyratron 42*a* as before. An inhibiting pulse must be fed to thyratron 42*b* to trigger this thyratron at the correct time, as will be explained below, and consequently deionize thyratron 42*a* to operate the correct letter door relay 47. Except for these readily apparent changes, the circuit is the same as before.

Fig. 6 shows how the above results are accomplished. Except for the above noted differences, the circuit of Fig. 6 is the same as that of Fig. 1, and corresponding elements are identified by the same reference numerals with prime (') added. It will be noted that the letter is shown moving in the opposite direction to that of Fig. 1, since the possibility of a stamp being located adjacent the front edge is now being investigated. Light beam 23' is interrupted by front edge 2' of the letter to produce the same kind of wave shape as before, since the polarity of the photocell 22' is reversed from that shown in Fig. 1. As the leading edge of this pulse is the only point of interest, the pulse is differentiated by the condenser-resistor arrangement shown at 99' and fed to inverter amplifier 32', whose output is a sharp negative pulse at time t_0 which is fed to square wave generator 34'. The output of generator 34' is a square wave lasting from t_0 to $t_{2'3}$. The back end of this pulse at time t_3 is fed to delayed gate 38' and used to produce a delayed pulse output lasting from t_3 to t_4. However, this pulse is not supplied to gated amplifier 40 as before, but is now supplied to one grid of coincidence tube 82' while the first gating pulse from generator 34' is now supplied to the gated amplifier 40'. It will thus be seen that leads 36' and 39' have been interchanged, which is necessary because scanner 8' is looking at the stamp area during time t_{1-2}, instead of time t_{3-4} as before. If there is an output from gated amplifier 37 during time t_{1-2} corresponding to a stamp (or a picture postcard), this output will appear on line 41' to trigger unit 42*a*' of the flipflop and operate the "accept" gate. The flipflop was previously triggered to 42*b*' by the pulse at time t_0 passing along line 100' to winding 80'A of transformer 80', which is now provided with two primary windings 80'A and 80'B. After this triggering of 42*b*', if there is no output from the differential amplifier, representing no stamp, magnet 47' remains energized. Note that tube 54 and transformer 84 of Fig. 2 are now omitted, since the delayed inhibiting pulse is not needed with the leading-edge senser.

In the case of a picture postcard, unit 42*a*' will be triggered as though by a stamp, during the interval t_{1-2}; however, during the interval t_{3-4} the picture postcard will produce a signal output on line 56' from the differential amplifier which will be gated through tube 82' by the delayed gate on line 39' and will reset the flipflop to the reject position through winding B of transformer 80'. Thus, instead of causing the picture signal to inhibit as in the previous case, it is caused to reset the flipflop in the leading edge senser. This enables the above-described simplification of the circuit since the output of tube 82' can now merely be fed to a second primary winding of transformer 80' as no pulse-extending circuit is now required. The circuit of Fig. 6 is now exactly the same as that of Fig. 1 except for the changes noted.

One point to be noted in the operation of the front edge senser is that the timing must be so related that the undelayed gate, roughly designated in Fig. 6 as t_0–t_2, on line 36', should not begin until just after both slits of the mask are covered by the letter, so that the passage of the letter edge opposite the two slots will not produce an unwanted differential signal resembling a stamp signal due to the contrast of the black background and reflected light. The angle of beam 23' must therefore be such that this beam is not interrupted until after the letter has safely passed both slits of the mask before the gate is produced. Therefore, t_0 actually represents the time when both slits have been covered by the letter. In the back edge senser, similarly, the delayed gate must definitely be terminated before either of the two slits clears the back edge of the letter, which is controlled by proper selection of the time constants in the gate generators.

While a schematic showing of a mechanical gate suitable for channeling the letters is shown in Fig. 1 as a pivoted gate arrangement directly operated by the respective magnets 46 and 47, the speed at which such a gate can be operated is found to be rather slow in comparison with the desired speed. A more practical gate for high speed operation is shown in Figs. 4 and 5. In this case, as before, the problem is to direct the front edge of letter 2 into the selected one of channels 50' and 52'. This is done by means of two pivoted selector gates 96 and 98. Normally these gates are held latched in the position shown by respective latches 92 and 93. Assuming magnet 47' to be energized, it attracts armature 90 of latch 92 to unlatch selector gate 96. Gate 96 is still held in the position shown by the action of tension spring 97. While the latch 92 is so released, the letter 2 is advanced against the gate at a fairly high speed (for example, at ten feet per second) by a conveyor system shown schematically as a belt and pulley system. Selector gate 98 being latched cannot be moved by the letter, but gate 96 has been unlatched and is therefore moved aside by the letter into the position shown in dotted lines and the letter passes by its own inertia into channel 52'. Conversely, if magnet 46' is energized, the letter will pass into channel 50'. After the letter has passed through, spring 97 resets selector gate 96 to its original position as shown and when magnet 47' is deenergized, latch 92 is again reengaged to secure the gate against motion. Since the magnets are now required only to condition the gates by moving a small latch member for a very short distance, it will be apparent that much faster operation is possible than with the sort of arrangement shown in Fig. 1, where the magnets are required to move the entire gate. As shown in Fig. 5, the adjacent ends of gates 98 and 96 have an interlocked comb-toothed construction, to facilitate guiding the letter into the proper channel. In practice, it has been found that the gate construction as shown in Fig. 4 can handle approximately ten letters a second.

Figs. 7 and 8 show the physical construction of the photocell housing. In practice, instead of two separate cells 14 and 16, a single envelope double photocell 15 is used, which is placed in an opaque tubular housing 17 provided with slits 18 and 20, as in Fig. 1. Photocell 22 is also placed in the same housing at a higher level, as shown in Fig. 7, facing approximately at an angle of 45° to the plane of the letter, and a suitably placed light beam source 24 (Fig. 1) is directed at cell 22 at an angle so that the point of interception of the beam by the edge of the envelope occurs in the correct relationship with the position of the slits 18, 20, to produce the desired timing sequence.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction and arrangement within the scope of the invention as defined in the appended claims.

I claim:

1. Apparatus for electing similarly oriented and faced letters from a group of randomly oriented stamped letters by sensing the position of the stamp, comprising means for conveying the randomly oriented letters in single file past a series of four photoelectric scanning devices for producing an electrical output in response to the reflect-

ance of the letter surface scanned, each optical device being positioned to scan a different potential stamp-bearing corner area and a normally homogeneous adjacent area of each letter as it passes the device, a selector gate associated with each scanning device for selecting a letter from the moving file when said gate is energized by a predetermined level of electrical output from its scanning device corresponding to the presence of a stamp in the scanned corner area, and means for preventing operation of each gate upon reception of a predetermined level of electrical output from the scanned normally adjacent area.

2. Means for conveying a rectangular letter having two longitudinal and two vertical edges with one longitudinal edge lying in a datum line and moving along said line, means for producing a beam of light across the path of said letter, photoelectric means in the path of said beam responsive to the passage of the back vertical edge of said letter past a station to produce an electric timing pulse, a stationary scanner comprising means for illuminating two adjacent areas of one side of said letter and two photocells, each positioned and masked to receive light from a different one of said areas only, said areas each having a vertical extent from said datum line corresponding to the height of a stamp in the lower back corner of the letter, a differential amplifier connected to said photocells for producing an electrical output which is a function of the differential reflectance of said areas, first pulse gate means electrically connected to said photoelectric means for producing a first gating pulse timed by said timing pulse to commerce when the scanner is positioned to scan a reference area of said letter adjacent the back corner and to end by the time the scanner is positioned to scan said corner area, second pulse gate means for producing a second gating pulse timed to substantially coincide with the scanning of the corner area, an electrically controlled letter selector gate having one electrical state for electing said letter and a second electrical state for rejecting said letter, first coincidence gating means for producing said one electrical state, said first coincidence gating means being connected to the output of said differential amplifier and to said second pulse gate means, and means controlled by the output of said first pulse gate means for producing said second electrical state.

3. The invention according to claim 2, said first coincidence gating means being connected to produce said one electrical state upon coincidence of gating input signals from said differential amplifier and from said second pulse gate means.

4. The invention according to claim 3, including second coincidence gating means connected to the output of said differential amplifier and said first pulse gate means for inhibiting said one electrical state, said second coincidence means being biased to produce an inhibiting pulse upon coincidence of signals from said differential amplifier and said first pulse gate, said inhibiting pulse commencing from the beginning of said first gating pulse, and means for extending said inhibiting pulse through the entire duration of said second gating pulse, said inhibiting pulse being applied to said letter selector gate to inhibit said one electrical state.

5. The invention according to claim 2, said differential amplifier comprising two amplifiers having differentially related outputs and means for unbalancing said outputs by an amount sufficient to suppress the effect of small differences in reflectance of said areas but to pass large signals such as are produced by the presence of a stamp, whereby the effect of small optical differences is minimized.

6. Means for conveying a rectangular letter having two longitudinal and two vertical edges with one longitudinal edge lying in a datum line and moving along said line, means for producing a beam of light across the path of said letter, photoelectric means responsive to the passage of the front vertical edge of said letter past a station to produce an electric timing pulse, a stationary scanner comprising means for illuminating two adjacent areas of one side of said letter and two photocells, each positioned and masked to receive light from a different one of said areas only, said areas each having a vertical extent from said datum line corresponding to the height of a stamp in the lower front corner of the letter, a differential amplifier connected to said photocells for producing an electrical output which is a function of the differential reflectance of said areas, first pulse gate means in circuit relationship with said photoelectric means for producing a first gating pulse timed by said timing pulse to commence when the scanner is positioned to scan a predetermined potential stamp area of said letter in the front corner thereof and to end by the time the scanner is positioned to leave said corner area, second pulse gate means for producing a second gating pulse timed to substantially coincide with the scanning of a reference area adjacent the said potential stamp area, an electrically controlled letter selector gate having one electrical state for selecting said letter and a second electrical state for rejecting said letter, first coincidence gating means for producing said one electrical state, said first gating amplifier means being connected to the output of said differential amplifier and to said first pulse gate means and means controlled by the beginning of said timing pulse for producing said second electrical state.

7. The invention according to claim 6, said first coincidence gating means being connected to produce said one electrical state upon coincidence of gating the input signals from said differential amplifier and from said first pulse gate means.

8. The invention according to claim 7, and second coincidence gating means for producing said second electrical state, said second coincidence gating means being connected to produce said second electrical state upon coincidence of signals from said differential amplifier and from said seond pulse gate means, whereby reception of a signal from said reference area causes said letter selector gate to be in the reject position.

9. The invention according to claim 8, said differential amplifier comprising two amplifiers having differentially related outputs and means for unbalancing said outputs by an amount sufficient to suppress the effect of small differences of reflectance of said areas but to pass large signals such as are produced by the presence of a stamp, whereby the effect of small optical differences is minimized.

References Cited in the file of this patent

UNITED STATES PATENTS

1,217,092	Hopp	Feb. 20, 1917
1,729,521	Roddy	Sept. 24, 1927
2,224,646	Friedman et al.	Dec. 10, 1940
2,280,948	Gulliksen	Apr. 28, 1942
2,395,482	Hurley	Feb. 26, 1946
2,415,177	Hurley	Feb. 4, 1947
2,609,928	Doust	Sept. 9, 1952